International Association of Oil & Gas Producers

SPECIFICATION
S-737

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Specification for Deluge Skids

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
0.1	September 2020	Issued for Public Review

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).

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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).

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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of deluge skids for application in the petroleum and natural gas industries.

This JIP33 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 requirements specification (QRS) and information requirements specification (IRS) as follows.

IOGP S-737: Specification for Deluge Skids

The specification defines the technical requirements for the supply of the equipment.

IOGP S-737D: Data Sheet for Deluge Skids

The data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the JIP33 technical specification. The data sheet may also include fields for supplier provided information attributes subject to purchaser 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-737Q: Quality Requirements for Deluge Skids

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-737L: Information Requirements for Deluge Skids

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, QRS and IRS is in accordance with ISO/IEC Directives, Part 2.

The data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. This 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) purchaser defined requirements (data sheet, QRS, IRS);

d) this specification.

1 Scope

This specification covers the design, manufacture, inspection and testing requirements of deluge skids for onshore and offshore installations. This specification is limited to “deluge” type packages, with or without foam. This specification includes equipment and components from inlet flange(s) to outlet flange(s) of a deluge skid as shown on simplified schematic example in Figure 1.

Deluge skids may be part of a larger system comprising other firefighting equipment units e.g. sprinkler systems, spray systems, monitors and foam pourers. Deluge skids may be built as a single skid or as a multivalve skid where two or more deluge valves are located. Deluge skids may be built with or without an enclosure.

Systems and applications that are not covered by this specification are:

- firewater pumps;
- water supply piping or pilot piping outside boundaries of skid piping;
- nozzles, sprinklers and other discharge devices downstream of the deluge valve;
- fire and gas detection / ESD.

2 Normative references

API Recommended Practice 14F, Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Division 1, and Division 2 Locations

API Recommended Practice 686, Recommended Practice for Machinery Installation and Installation Design

ASME BPVC, Section VIII, Division 1, Rules for Construction of Pressure Vessels

ASME BPVC, Section IX, Welding and Brazing Qualifications

ASME B31.3, Process Piping

ASTM A269/A269M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

AWS D1.1, Structural welding - Steel

EN 50288-7, Multi-element metallic cables used in analogue and digital communication and control - Part 7: Sectional specification for instrumentation and control cables

IEC 60079, Explosive atmospheres

IEC 60092-350, Electrical installations in ships - Part 350: General construction and test methods of power, control and instrumentation cables for shipboard and offshore applications

IEC 60092-360, Electrical installations in ships - Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables

IEC 60092-376, Electrical installations in ships - Part 376: Cables for control and instrumentation circuits 150/250 V (300 V)

IEC 60331, Tests for Electrical Cables under Fire Conditions

IEC 60332, Tests on Electrical and Optical Fiber Cables Under Fire Conditions

IEC 60364-4-44, Low-voltage electrical installations - Part 4-44: Protection for safety - Protection against voltage disturbances and electromagnetic disturbances

IEC 60364-5-54, Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors

IEC 60502, Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV)

IEC 60529, Degrees of protection provided by enclosures (IP code).

IEC 60598-1, Luminaires - Part 1: General requirements and tests.

IEC 61537, Cable management - Cable tray systems and cable ladder systems

IEC 61892-4, Mobile and Fixed Offshore Units - Electrical Installations - Part 4: Cables

IEEE 48, IEEE Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.

IEEE 1580, Recommended Practice for Marine Cable for Use on Shipboard and Fixed or Floating Facilities

IOGP S-715, Supplementary Specification to NORSOK M-501 Coating and Painting for Offshore, Marine, Coastal and Subsea Environments

ISO 1070, Graphical symbols — Safety colours and safety signs — Registered safety signs

ISO 3834-2, Quality requirements for fusion welding of metallic materials - Part 2: Comprehensive quality requirements

ISO 3834-3, Quality requirements for fusion welding of metallic materials - Part 3: Standard quality requirements

ISO 9606, Qualification testing of welders - Fusion welding

ISO 9712, Non-destructive testing - Qualification and certification of NDT personnel

ISO 12944-2, Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 2: Classification of environments

ISO 12944-4, Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 4: Types of surface and surface preparation

ISO 12944-5, Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 5: Protective paint systems

ISO 12944-6, Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 6: Laboratory performance test methods

ISO 12944-7, Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 7: Execution and supervision of paint work

ISO 13702, Requirements and guidelines for the control and mitigation of fires and explosion on offshore oil and gas installations

ISO 14731, Welding coordination - Tasks and responsibilities

ISO 14732, Welding personnel – Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials

ISO 15614, Specification and qualification of welding procedures for metallic materials - Welding procedure test

ISO 15667, Acoustics - Guidelines for noise control by enclosures and cabins

ISO/IEC 17020 Conformity assessment - Requirements for the operation of various types of bodies performing inspection

ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories

NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA VE 1, Metal Cable Tray Systems

NFPA 13, Standard for Low-, Medium-, and High-Expansion FoamFirefighting foam system

NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection

NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray

NFPA 70, National Electrical Code

NORSOK S-001, Technical Safety

UL 1309, Standard for Marine Shipboard Cable

UL 1569, Standard for Metal-Clad Cables

UL 1598, Luminaires

UL 1685, Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

UL 2196, Standard for Tests for Fire Resistive Cables

UL 2225, Standard for Cables and Cable-Fittings For Use In Hazardous (Classified) Locations

UL 2250, Standard for Instrumentation Tray Cable

UL 2556, Wire and Cable Test Methods

3 Terms, definitions, acronyms and abbreviations

3.1 Terms and definitions

3.1.1 published information
technical product documentation
comprehensive and structured technical documents covering all the information required for the definition of a component: design, operating range, materials, construction, assembly, performance data, properties, configuration limitation, instructions, safety, health and environmental information

3.1.2
winterization
Achieved by addition of insulation, trace heating, electric motors designed for arctic duty and IP rating for electrical equipment.

3.1.3
ramp
fixed means of access, comprising a continuous inclined plane

3.1.4
stair
fixed means of access whose horizontal elements are steps

3.1.5
fixed ladder
fixed means of access whose horizontal elements are rungs

3.1.6
handrail
rigid top element designed to be grasped by the hand for body support which can be used individually or as the upper part of a guardrail

3.1.7
guard rail
device for protection against accidental fall sideways from stairs, stepladders, platforms and walkways

3.1.8
anti-slip surface
floor surface finish which is designed and manufactured to reduce the risk of slipping

3.1.9
outdoor area
area with no substantial obstacles to the open air and completely exposed to ambient conditions

3.1.10
authority having jurisdiction
organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure

3.1.11 fire department connection
connection through which the fire department(brigade) can pump supplemental water into the sprinkler system, standpipe, or other water-based fire protection systems, furnishing water for fire extinguishment to supplement existing water supplies

3.2 Acronyms and abbreviations

IWI-S International Welding Inspector Standard Level

IP ingress protection (rating code)

CSWIP Certification Scheme for Welding Inspection Personnel

LED light emitting diode

PPE personnel protective equipment

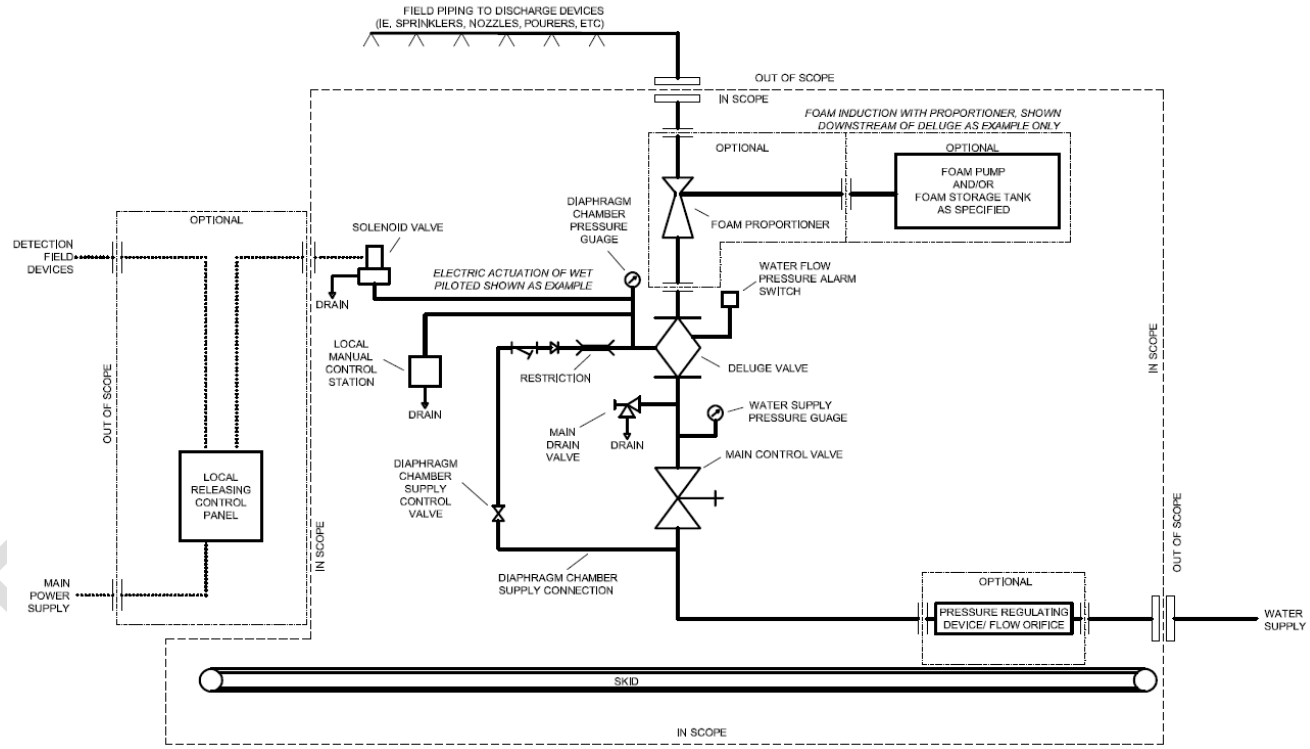

Figure 1 - Simplified schematic example of a deluge skid

4 General requirements

4.1 General

4.1.1

Units of measurements shall comply with NFPA 15:2017,1.6.

4.1.2

Deluge skids materials and components shall be installed in accordance with the manufacturer's published information.

4.2 Design objectives

The deluge skid shall automatically or manually supply water or foam water solution to the fire protection system.

4.3 Service life (design life)

Deluge skids shall be designed and constructed for a service life greater than 20 years.

4.4 Water / firefighting foam deluge skid scope (battery limits, interface)

4.4.1

Cables within the skid shall be terminated in a junction box at the skid edge.

4.4.2

Hydraulic and pneumatic tubing shall be terminated at the skid edge with bulkhead male connectors or unions.

4.4.3

Piping shall be terminated at the skid edge with a flange.

4.5 Hazardous (classified) area requirements

If specified, the package equipment shall be certified or listed by a notified body for the hazardous (classified) area classification in accordance with IEC 60079 or NRTL approved laboratories in conformance with NFPA 70, article 500 and article 505.

4.6 Ingress protection for equipment

Equipment shall have a minimum degree of ingress protection as specified in Table 1 and in accordance with IEC 60529 or NEMA 250.

Table 1 - Ingress protection rating and NEMA rating

Equipment	Location	IP rating	NEMA rating
Electric motors (onshore)	External	IP55	NEMA 4
Electric motors (offshore and onshore wet tropical locations)	External	IP56	NEMA 4
Power Socket Outlets	External	IP66	NEMA 4X

Equipment	Location	IP rating	NEMA rating
Free standing or wall mounted cabinets and consoles	Internal	IP41	NEMA 3
Instrument control panel	External	IP66	NEMA 4X
Instrument control panel	Internal	IP66	NEMA 4
Field instruments	External	IP66	NEMA 4X
Inside a control panel with door open	Internal	IP21	NEMA 2
Junction boxes	External	IP66	NEMA 4X
Cable glands	External	IP66	NEMA 4X
Luminaires	External	IP56	NEMA 4X
Luminaires	Internal	IP56	NEMA 4X
Distribution Board	Internal	IP21	NEMA 3
Distribution board	External	IP56	NEMA 4X
Transformer	Internal	IP21	NEMA 3
Transformer	External	IP56	NEMA 4

4.7 Winterization

4.7.1

Deluge skids shall be enclosed when winterization is required.

4.7.2

Heaters shall be equipped with the functionality to detect failure and provide an alarm.

4.8 Human factors engineering

4.8.1 Access

4.8.1.1 Means of access

4.8.1.1.1

Access from grade or a designated access platform shall be provided for locations intended for personnel to occupy during operations, inspections, servicing, readings and maintenance.

4.8.1.1.2

Fixed or permanent means of access to machinery and equipment shall be in the following order of preference:

1) access directly from floor or deck;

2) ramps or stairs;

3) fixed ladders.

Note Refer to Figure 2 for examples of means of access.

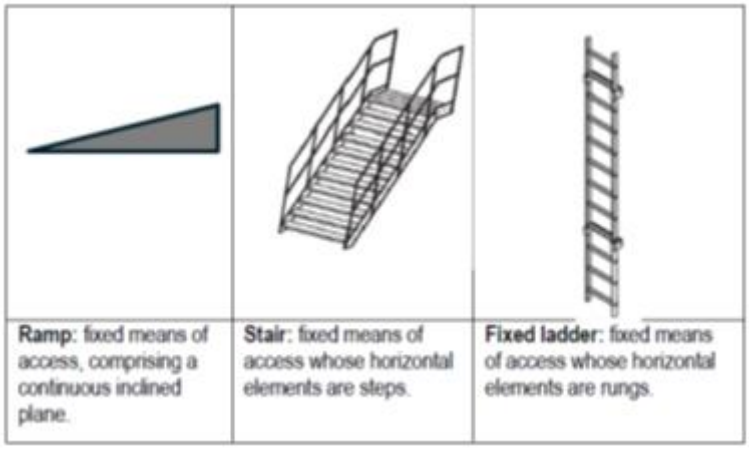

Figure 2 - Fixed or permanent means of access

4.8.1.1.3

Dimensions of the following items shall be according to regulatory and specified requirements:

- ramps;
- stairs;
- fixed ladders;
- railing (handrails, guardrails, stair rails);
- walkways;
- working platforms.

4.8.1.2 Walkways and access ways

Work areas shall have anti-slip properties in accordance with regulatory and specified requirements.

4.8.1.3 Workspace

4.8.1.3.1

Required space for the use of tools, equipment, safety equipment and removal of components shall be taken into consideration.

4.8.1.3.2

Cable trays, lighting fixtures, tubing, tubing supports and other elements shall be installed to provide head clearance as required by regulatory and specified requirements.

4.8.1.3.3

Field run items (e.g. cable trays, lighting fixtures, tubing and tubing supports) shall be installed so as not to obstruct or restrict access to equipment and machinery components.

4.8.1.4 Access to equipment and instruments

4.8.1.4.1

Installation height of valves, instruments, displays, switches, push buttons, junction boxes, detectors and other points of operator interactions shall be according to regulatory and specified requirements.

4.8.1.4.2

Visual displays, including gauges and level glasses, shall be located and orientated to allow accurate reading in all lighting conditions when standing on the floor or a working platform.

4.8.1.4.3

Workspace around flanges for maintenance, inspection and removal of flange bolts or studs shall be provided so the work can be done with a good ergonomic body posture as defined by regulatory and specified requirements.

4.8.1.4.4

Pipe flanges, tubing and fittings shall be accessible for maintenance with space for the necessary tools.

4.8.1.4.5

Pipe flanges, tubing and fittings shall be accessible for maintenance without the need for dismantling of the equipment.

4.8.1.5 Doors and hatches

4.8.1.5.1

It shall be possible to secure doors and hatches in open positions.

4.8.1.5.2

Doors shall be sized according to regulatory and specified requirements and the movement of personnel and materials.

4.8.1.5.3

The opening force of doors shall be in accordance with regulatory and specified requirements to eliminate excessive forces which may cause musculo-skeletal disorders or ergonomic strain.

4.8.1.5.4

Hinged doors leading to outdoor areas shall be provided with a damping mechanism.

4.8.2 Controls and displays

Instruments, control panels, push-buttons, displays, remote valve operation stations, emergency stops and other controls shall be installed in accordance with regulatory and specified requirements.

4.8.3 Adaption for cleaning

Floors, walls and equipment surfaces shall facilitate cleaning and maintenance.

4.8.4 Material handling

Mechanical handling solutions shall be designed so that the removal of equipment or components can be completed with minimal disturbance to the rest of the package.

4.8.5 Hot and cold surfaces

Personnel shall be protected from contact with hot and cold surfaces in accordance with regulatory and specified requirements.

4.8.6 Outdoor operation and weather protection

4.8.6.1

Sun shields and high luminance outdoor-type displays shall be used when displays and control panels are to be used in direct sunlight.

4.8.6.2

Handles, switches, handwheels, valve levers and other items requiring hand grasping shall accommodate the user's hand and required PPE.

4.8.7 Additional requirements for enclosed packages

4.8.7.1

Workspaces in alignment with regulatory and company requirements shall be provided inside enclosures that are not removable to allow for access and egress, the use of appropriate body postures for tasks and the use of materials handling equipment.

4.8.7.2

Doors or removable panels shall be provided on the container or enclosure to perform maintenance, inspection and operation.

4.8.7.3

Equipment to be dismantled for maintenance or inspection shall include provisions for lifting and transport of component in the equipment design, e.g. hoist, in accordance with regulatory and specified requirements.

4.8.7.4

When access to the roof of the enclosure is required for operation, maintenance and inspections, a fixed vertical means of access, guardrails and toe-plates shall be provided in alignment with regulator and specified requirements.

4.8.7.5

Head clearance shall be provided for walking and working surfaces in accordance with regulatory and specified requirements.

4.9 Authority having jurisdiction

Control system, field instruments and valves, shall be subjected to Authority Having Jurisdiction approval.

4.10 Noise control

Deluge skids shall be enclosed when the equipment sound pressure level exceeds the specified threshold.

4.11 Labelling, tagging and nameplate

4.11.1

The purchaser's tag number shall be included on the nameplate or on a separate tag plate for components with an assigned tag number.

4.11.2

Deluge skids and deluge valves shall be provided with nameplates.

4.11.3

Nameplates and tag plates shall be attached with stainless steel 316 screws or rivets.

4.11.4

Nameplates and tag plates shall be located and orientated for accurate reading from grade or platform.

4.11.5

Material of construction for tag plates shall be stainless steel 316 or Traffolyte.

4.11.6

Material of construction for nameplates shall be stainless steel 316.

4.11.7

The following information shall be stamped or engraved on the skid nameplate:

a) skid manufacturer;

b) weight (operating/dry);

c) year of manufacture;

d) purchaser’s tag number;

e) purchaser’s order number.

4.11.8

The following information shall be stamped or engraved on the deluge system nameplate:

a) service description;

b) design pressure;

c) design flow;

d) deluge system tag number.

4.11.9

Graphical symbols, safety colours and safety signs shall be in accordance with ISO 7010.

4.11.10

Text-only warning labels shall have white characters on a red background.

4.11.11

Non-warning labels shall have black characters on a white background.

4.11.12

Instrument junction boxes shall have tag plates installed on the outer surface of access cover.

4.12 Safety instrumented level (SIL)

Safety instrumented function transmitters with a SIL rating greater than 0 shall be provided with a certificate from an independent assessment body to establish conformance to IEC 61508.

5 System Components

5.1 Valves

5.1.1 General

5.1.1.1

Valve materials shall be compatible with the foam concentrate and foam solution.

5.1.1.2

The automatic valves for foam concentrate lines shall be compatibility tested with the specified foam by an independent testing agency.

5.1.2 Deluge valves

5.1.2.1

Deluge valves shall be pilot operated.

5.1.2.2

The design of the deluge valve or the trim shall prevent the automatic return of the valve to the closed position.

5.1.2.3

The design of the deluge valves shall not require disassembling the valve to return to service after maintenance activities.

5.1.3 Isolation valves

5.1.3.1

Isolation valves shall have an indicator showing the valve "open" or "shut" position.

5.1.3.2

A securing device shall be provided that allows less than 5 % movement from the intended position.

5.1.3.3

Isolation valves operating at maximum speed from the fully open position shall have a closing time of at least five seconds.

5.2 Piping and pipe fittings

Piping and fittings shall be compatible with the foam concentrate and foam solution.

5.3 Tubing and Fittings

5.3.1

For onshore applications, tubing and fittings shall be a minimum 316 stainless steel in accordance with ASTM A269/A269M.

5.3.2

For offshore applications tubing and fittings shall be TPU coated 316 stainless steel, 6Mo stainless steel, or 25Cr duplex stainless steel in accordance with ASTM A269/A269M.

5.4 Electrical and instrumentation design and installation

5.4.1 Heaters

5.4.1.1

Water heater elements of heaters 3 kW and above shall be three phase immersion type.

5.4.1.2

Water heater elements of heaters less than 3 kW shall be single phase immersion type.

5.4.2 Lighting

5.4.2.1

Lamps shall be LED type with integral electronic drivers.

5.4.2.2

Luminaires shall be in accordance with IEC 60598.

5.4.2.3

Luminaires shall be in accordance with UL 1598.

5.4.3 Cables

5.4.3.1 General

5.4.3.1.1

Minimum cable bending radius shall not exceed manufacturers recommendations.

5.4.3.1.2

Multi-pair cables shall have 10 % spares.

5.4.3.1.3

Cables within the package boundary shall be labelled.

5.4.3.1.4

Instrument, power and control cables not routed in a conduit or other external means of protection shall be armoured.

5.4.3.1.5

For IEC standard projects, cables shall be flame retardant, low smoke, zero halogen and certified in accordance with IEC 60332.

5.4.3.1.6

For IEC standard projects cables shall be UV resistant in accordance with EN 50289-4-17.

5.4.3.1.7

For IEC standard projects, cables for emergency systems or systems that operate during fire emergencies shall be fire resistant in accordance with IEC 60331.

5.4.3.1.8

For North American standard projects cables for emergency systems or systems that operate during fire emergencies shall be fire resistant in accordance with UL 2196.

5.4.3.1.9

For North American standard projects, cables shall be flame retardant, low smoke and certified in accordance with UL 1685 and UL 2250.

5.4.3.1.10

For North American standard projects cables shall be UV resistant in accordance with UL 2556.

5.4.3.2 Power and control cables

5.4.3.2.1

For onshore IEC standard projects, power cables shall be in accordance with IEC 60502.

5.4.3.2.2

For offshore IEC standard projects, cables shall be in accordance with IEC 61892-4.

5.4.3.2.3

For offshore North American standard projects, cables shall be in accordance with UL 1309 and IEEE 1580.

5.4.3.2.4

For North American standard projects power and control wiring in cable trays shall be Type MC or TC rated cable in accordance with the NFPA 70.

5.4.3.2.5

For three phase, four-wire systems of electrical power, the neutral conductor shall equal phase conductor specification and size.

5.4.3.2.6

Power conductors of electrical cables and wiring shall be continuous without splice.

5.4.3.2.7

For North American standard projects, electrical cables in hazardous (classified) areas shall be in accordance with UL 2225.

5.4.3.3 Instrumentation cables

5.4.3.3.1

For offshore IEC standard projects, instrument cables shall be in accordance with, IEC 61892-4, IEC 60092-350, IEC 60092-360 and IEC 60092-376.

5.4.3.3.2

For offshore North American standard projects, instrument cables shall be in accordance with UL1569, UL 2225 and UL 2250.

5.4.3.3.3

For onshore IEC standard projects, instrument cables shall be in accordance with EN 50288-7.

5.4.3.3.4

For onshore North American standard projects, instrument cables shall be in accordance with UL 2225 and UL 2250.

5.4.3.3.5

The outer sheath colour of intrinsically safe cables shall be blue.

5.4.3.3.6

The outer sheath colour of non-intrinsically safe cables shall be as specified.

5.4.4 Cable glands

5.4.4.1

Where earth continuity of the cable armour and gland cannot be achieved, the necessary bonding shall be provided between armour and gland to an external earth connection.

5.4.4.2

Adaptors and reducers shall be made of the same material as the gland.

5.4.5 Cable support systems

5.4.5.1

For IEC standard projects, cable trays and cable ladders shall be in accordance with IEC 61537.

5.4.5.2

For North American standard projects, cable trays and cable ladders shall be in accordance with NEMA VE 1.

5.4.6 Cable segregation and spacing

Separate rack and tray systems shall be used for the following cables:

- cables with system voltages greater than 1 000 V AC;
- cables with system voltages less than 1 000 V AC;
- instrument intrinsically safe cable;
- instrument non intrinsically safe cable.

Note In congested areas, cable trays and ladders may have a physical barrier (separation plate) between intrinsically safe, non-intrinsically safe and fire and gas cables.

5.4.7 Junction boxes

5.4.7.1

Electrical junction boxes shall be segregated as defined below:

- HV power junction box;
- LV power junction box;
- control junction box.

5.4.7.2

Separate junction boxes shall be provided for the following types of system:

- intrinsically safe analogue/digital;
- non-intrinsically safe analogue/digital;

- fire and gas system;
- communication;
- instrument power.

5.4.7.3

Junction boxes shall be 316 stainless steel or glass reinforced plastic.

5.4.7.4

Junction boxes shall be fitted with internal or external earth or ground studs.

5.4.7.5

Terminals and end brackets shall be blue for intrinsically safe signals.

5.4.7.6

The colour of terminals for non-intrinsically safe circuits shall be as specified.

5.4.7.7

Except for four-way junction boxes, cable entry shall be from the bottom.

5.4.7.8

Terminals shall be mounted on the DIN rail using end fixing plates and rail clamps.

5.4.7.9

Terminal blocks and individual terminals shall be permanently numbered.

5.4.7.10

Terminal blocks shall have a clearance of at least 100 mm on all sides.

5.4.7.11

Power terminals shall be raising screw clamp type.

5.4.7.12

One conductor shall be terminated per terminal.

5.4.7.13

Where conductor inter-connections are needed, metal links shall be used.

5.4.7.14

Power terminals shall be marked L1, L2, L3, N or PE/E using pre-marked plastic letters.

5.4.8 Cable transits

5.4.8.1

Cable transits shall be used to facilitate cable penetrations through walls, roofs and floors in pressurized enclosures.

5.4.8.2

Spare ways in transit frames shall be filled with blank filling blocks and 10 % spare ways shall be provided.

5.4.8.3

Transits shall be identified by labels located on either side of the penetrations.

5.4.8.4

Cable insert blocks shall be halogen free, non-flammable intumescent elastomeric polymer.

5.4.8.5

10 % filler block shall be provided.

5.4.8.6

Separate multi cable transit frames shall be provided for instrument and electrical cables.

5.4.9 Earthing and bonding

5.4.9.1

For offshore IEC standard projects, earthing or grounding installations shall be in accordance with IEC 61892.

5.4.9.2

For offshore North American standard projects, earthing or grounding installations shall be in accordance API 14F.

5.4.9.3

For IEC standard projects, the earth or ground design shall be in accordance with IEC 60364-4-44 and IEC 60364-5-54.

5.4.9.4

For North American projects the earth or ground design shall be in accordance with NFPA 70.

5.4.9.5

Package base frame shall have two M10, 316 stainless steel, earthing bosses, as a minimum, at diagonally opposed locations, with lugs, stud, flat washers, spring washer and nut.

5.4.9.6

Non-current carrying metallic equipment and enclosures shall be bonded to package steelwork.

5.4.9.7

Cable screens and drain wires shall be isolated within the instrument head, earthed/grounded at the control panel end only.

5.4.10 Terminations

5.4.10.1

For IEC standard projects, high voltage terminations shall be in accordance with IEC 60502.

5.4.10.2

For North American standard projects, high voltage terminations shall be in accordance with IEEE 48.

5.4.10.3

Spare cores, conductors, pairs and triads shall be terminated to spare terminals.

5.4.10.4

Spare power terminals shall be terminated at both ends to the PE-bar.

5.4.10.5

Instrument and telecom cable spare cores or conductors shall be left unconnected at the field end and connected to instrument earth (IE) in supply end/panel end only.

5.4.10.6

Low voltage power and control terminals shall be rated to a minimum of 600 V.

5.5 Structural steel base frame / enclosure / piping and valve support

5.5.1 Structural skid base frame

5.5.1.1 General

5.5.1.1.1

For offshore applications, base-frames shall be designed with a maximum of four support points and analyzed with pinned boundary conditions.

5.5.1.1.2

Baseframe welding shall be continuous welds.

5.5.1.1.3

Baseframes shall be supplied with engineered tie down points for use in any of the temporary phases the package might encounter from engineering works to the installation site.

5.5.1.1.4

Areas on baseframes that are inaccessible for coating or inspection shall be boxed in and seal welded.

5.5.1.2 Equipment > 1 000 kg (2 200 lb)

5.5.1.2.1

For packages and equipment > 1 000 kg (2 200 lb), baseframe support points shall be bolted to a support plate as detailed in Figure 3, Figure 4, Figure 5 and Figure 6.

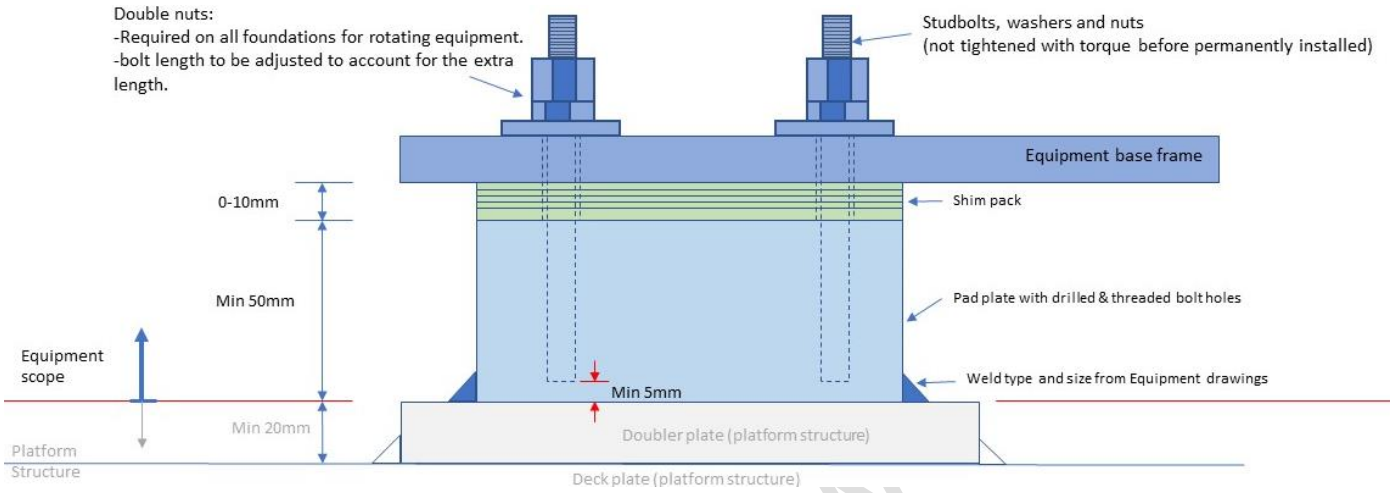

Figure 3 - Foundation for equipment ≥ 1 000 kg (2 200 lb) operational weight, interface design and responsibilities, double securing nut

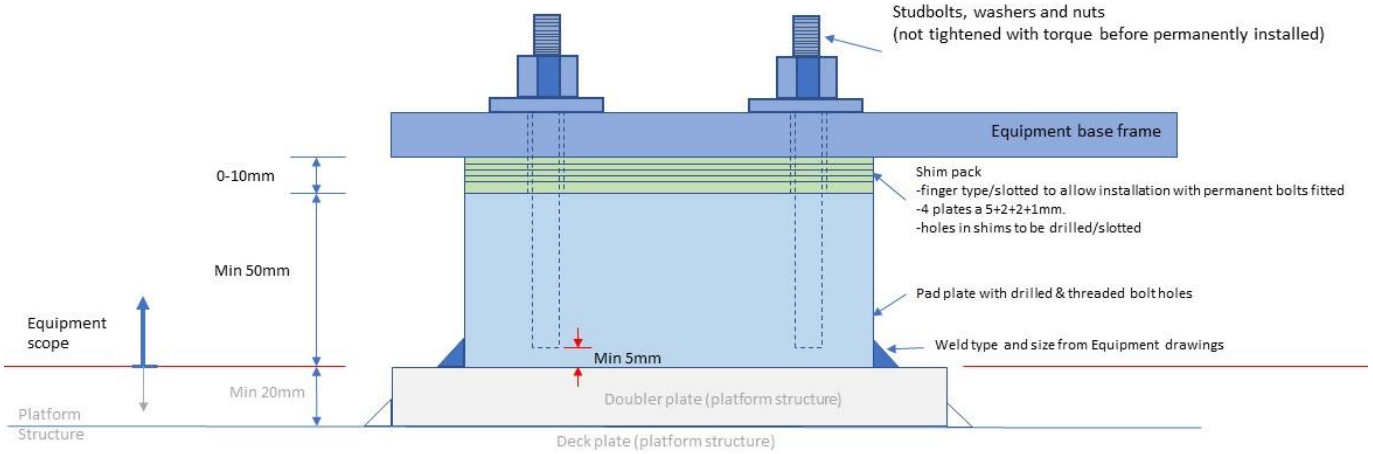

Figure 4 - Foundation for equipment ≥ 1 000 kg (2 200 lb) operational weight, interface design and responsibilities, single securing nut

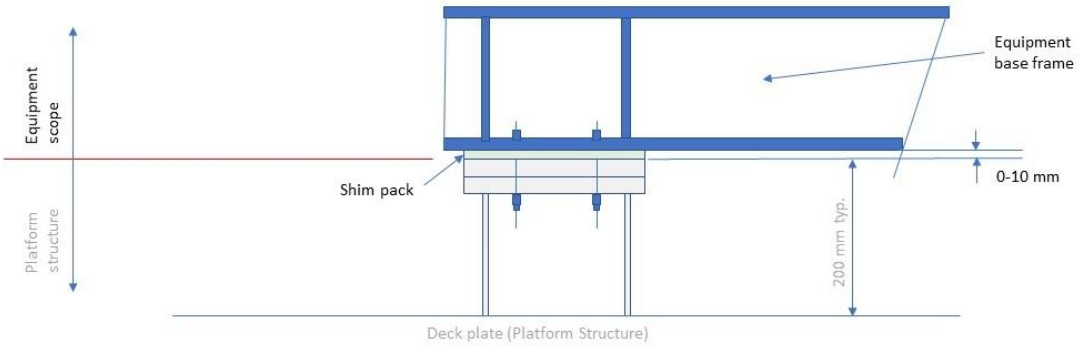

Figure 5 - Foundation for equipment ≥ 1 000 kg (2 200 lb) operational weight, elevated support, interface design and responsibilities

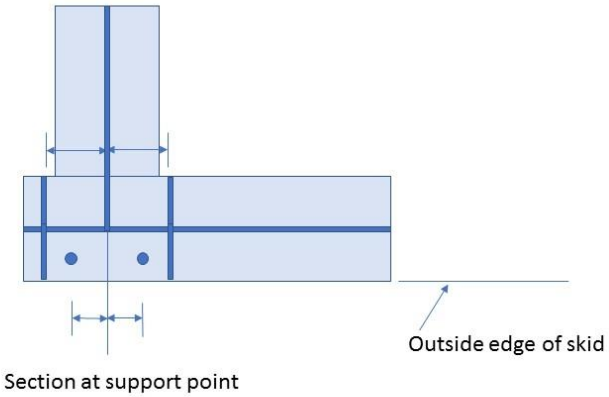

Figure 6 - Foundation for equipment ≥ 1 000 kg (2 200 lb) operational weight, section at support point showing bolt positions at support

5.5.1.2.2

The package or equipment support pad plate, as detailed in Figure 3 and Figure 4, shall be 316L stainless steel.

5.5.1.2.3

Shim packs for each package or equipment support, as detailed in Figure 3, Figure 4, Figure 5 and Figure 6, shall be 316 stainless steel.

5.5.1.2.4

Shim packs shall not be included on the general arrangement drawing or in the 3D model of the equipment.

5.5.1.2.5

Bolts for each equipment or package shall be as specified in the data sheet.

5.5.1.2.6

Nuts and washers for each equipment or package shall be a certified nut and washer type compatible with the specified foundation bolt type.

5.5.1.2.7

Hot dip galvanized nuts and washers for each package or equipment support shall be provided as detailed in Figure 3, Figure 4, Figure 5 and Figure 6.

5.5.1.2.8

Anchoring bolts at support points shall be located on the outside face of the package skid.

5.5.1.2.9

Baseplate design, fabrication and mounting details for attachment to concrete foundation shall be in accordance with API RP 686.

5.5.2 Enclosure

5.5.2.1

Ventilation shall prevent the enclosure temperature from exceeding the maximum ambient temperature.

5.5.2.2

Heating shall prevent the temperature inside the enclosure from falling below 5 °C (41 °F).

5.6 Mainline strainer

5.6.1 General

5.6.1.1

The mainline strainer shall permit removal of the filter for replacement or repairs without removing the strainer from the line.

5.6.1.2

The mainline strainer shall be manufactured from corrosion resistant materials.

5.6.1.3

The mainline strainer shall be designed to entrap foreign material between 3.0 mm ($^1/_8$ inch) and 6.4 mm (¼ inch).

5.6.1.4

The mainline strainer shall be provided with a flushing outlet.

5.6.2 Flushing Outlet

5.6.2.1

The outlet shall be sized to maintain a water flow velocity of 1.8 m (6.0 feet) per second in the supply pipe when 345 kPa (50 psi) pressure is maintained at the inlet connection to the strainer and there is no flow through the strainer.

5.6.2.2

The flushing outlet shall be provided with a shut-off valve.

5.7 Firefighting foam water proportioner equipment

5.7.1

The foam proportioner equipment shall be evaluated and certified for use with the foam concentrate by the foam concentrate supplier.

5.7.2

The foam proportioner equipment and the foam concentrate shall be proven as compatible using actual fire testing.

5.8 Foam Concentrate Tank

5.8.1

Foam concentrate tanks shall comply with NFPA 16:2019, 6.6.

5.8.2

Foam concentrate tanks shall have a drain valve for foam concentrate sampling.

5.8.3

Foam concentrate tanks shall have a DN 600 (NPS 24) manway in the top of the tank.

5.8.4

Where the foam concentrate tank is too small to permit a DN 600 (NPS 24) manway the tank shall have an inspection hatch.

5.8.5

Tanks shall have a filling opening at top of the tank with optional transfer hose connection equipped with a dip pipe.

5.8.6

Foam concentrate tanks shall have a pressure and vacuum relief valve located at the top.

5.8.7

Foam concentrate tanks shall have a foam outlet connection.

5.8.8

Foam concentrate tanks shall have a foam concentrate return line connection.

5.9 Foam concentrate pump

Foam concentrate pumps shall comply with NFPA 16:2019, 6.5.

5.10 Pressure gauge

Pressure gauges shall have an upper range not less than twice working pressure.

6 System configuration

6.1 Bypass line

Bypass lines shall have a flow capacity equal to the flow capacity of the deluge system.

6.2 Piping installation

6.2.1 Valves

6.2.1.1

Isolation valves shall be located at every water supply connection on the deluge skid.

6.2.1.2

An isolation valve shall be located upstream of every deluge valve.

6.2.1.3

Isolation valves shall be provided at the connection of the bypass line upstream of the deluge valve.

6.2.1.4

Isolation valves shall be provided between the deluge valve and connection of the bypass line downstream of the deluge valve.

6.2.2 Draining

6.2.2.1

Pipe and fittings downstream of the deluge valve shall be sloped at no less than 25 mm per 3 m (1 in per 10 ft) to permit draining through the deluge valve drain.

6.2.2.2

Auxiliary drains shall be provided where a change in piping direction or a valve prevents drainage through the deluge valve drain.

6.2.2.3

Auxiliary drains shall be sized in accordance with NFPA 15:2017, 6.3.3.8.2.

6.2.2.4

Auxiliary drains larger than ¾ inch shall be routed to the skid edge for connection to field piping.

6.2.2.5

Drains shall be provided with a method to verify water flow.

6.2.3 Piping and valve supports

6.2.3.1

All pipe supports shall be designed to withstand the loads that the piping may experience during its design life, including:

- transportation;
- start-up;
- operation;
- maintenance;
- environmental.

6.2.3.2

Pipe stands shall be anchored to the skid.

6.2.3.3

Support components welded to piping shall be the same or equivalent material grade as the pipe itself.

6.2.3.4

Dissimilar metals shall have an insulating barrier between the process piping and supports.

6.2.3.5

Small bore piping branches at risk of vibration shall be braced back to the header pipe in two perpendicular directions.

6.2.3.6

Hollow pipe support sections shall have ends sealed with closure plates and vent holes sealed after welding.

6.2.4 Test line

6.2.4.1

The test line shall be located downstream of the deluge valve.

6.2.4.2

Lines provided for capacity testing of the deluge valve shall be routed to the skid edge for connection to field piping.

6.2.4.3

Isolation valves shall be provided at test line connections.

6.2.5 Pneumatic and hydraulic pilot line

6.2.5.1

The pilot line for the deluge valve shall be hydraulic or a combination of pneumatic and hydraulic.

6.2.5.2

A double check valve shall be provided in the pneumatic supply line.

6.2.5.3

An isolation valve shall be included in the pneumatic supply line on the supply side of the double check valve.

6.2.5.4

The pilot line shall have a solenoid to relieve pressure.

6.2.5.5

The pilot line shall have a valve to manually relieve pressure.

6.3 System attachment

6.3.1 Instrumentation

6.3.1.1

A transmitter for indication of low pressure shall be provided downstream of the double check valves on the pneumatic supply.

6.3.1.2

Heated enclosures shall have a function to detect temperature and activate an alarm if the temperature is below 5 °C (41 °F).

6.3.1.3

Instrumentation shall be provided to detect water flow when the system is activated.

6.3.2 Fire department connection

6.3.2.1

The fire department connection piping shall be without isolation valves.

6.3.2.2

A check valve shall be installed in each fire department connection.

6.3.2.3

Piping between the check valve and the fire department connection termination point on the skid shall be equipped with an automatic drain valve.

6.3.2.4

For foam water type deluge skids, the fire department connection shall be configured to provide water to the supply side of the foam proportioner.

6.3.3 Gauges

6.3.3.1

Pressure gauges shall be installed upstream and downstream the deluge valve.

6.3.3.2

Pressure gauges shall be installed on the pneumatic or hydraulic supply to pilot lines.

6.3.3.3

Pressure gauges shall be removable for maintenance purposes.

6.3.4 Mainline strainer

6.3.4.1

If specified, the mainline strainer shall be installed upstream of the deluge valve.

6.3.4.2

The flushing outlet shall be routed to the skid edge for connection.

6.3.4.3

Mainline strainers shall be installed to be accessible for flushing or cleaning.

6.4 Foam

6.4.1

The method of foam proportioning shall comply with NFPA 16:2017, 6.4.

6.4.2

The foam proportioning unit shall maintain a constant ratio of foam concentrate to the deluge and foam distribution piping.

6.4.3

Balanced proportioning or a flexible pressure-sensitive elastomeric control ring shall be provided to control the flow rate of foam concentrate equivalent to 1%, 3% or 6% of firewater flow rate during fluctuations in firewater supply pressure.

6.4.4

Where the foam proportioner method requires foam inlet pressure to be higher than the fire water pressure, the pressure difference shall be at least 100 kPa (14.5 psi) greater.

6.4.5

Proportioning equipment and discharge devices shall be certified for use with the foam concentrate.

6.4.6

Local manual activation via foam release valve and remote activation with local reset shall be provided.

6.4.7

Back flow of firewater into foam concentrate tank or foam concentrate distribution line shall be prevented.

6.4.8

The foam proportioning unit shall be installed between flanges in the firewater line.

6.4.9

Foam concentrate storage tanks shall be mounted on the skid base frame.

6.4.10

Foam concentrate tanks shall be provided with capability for local external indication of the foam level.

6.4.11

Foam concentrate hydraulic activation tubes shall be configured to be constantly pressurized or drained, if provided.

7 Welding

7.1 Welding management requirements

Welding shall be performed under a weld quality management system complying to the applicable part of ISO 3834 specified in Table 2 or equivalent requirements in the specified fabrication code (e.g. ASME B31.3 Appendix Q or ASME VIII Appendix 10).

Table 2 - Quality assurance level requirements for welding

Fabrication of:	Applicable part of ISO 3834:	Welding coordinator qualification requirements:
Piping and Pressure containing equipment	ISO 3834-2	As specified in ISO 14731:2019, 6.2.2
Primary structure (major load-bearing structures with severe consequences of failure)	ISO 3834-2	As specified in ISO 14731:2019, 6.2.2
Any other welding associated with the package	ISO 3834-3	As specified in ISO 14731:2019, 6.2.3
Note Welding coordinators holding IWE certification is considered to satisfy the requirements of ISO 14731:2019,6.2.2. Welding coordinators holding IWT certification is considered to satisfy the requirements of ISO 14731:2019,6.2.3. Engineers or technologists holding equivalent technical qualifications/certifications and/or relevant experience may also be acceptable.		

7.2 Welding procedure specifications

7.2.1

Welding procedures for piping, pressure containing equipment and attachments welded thereto shall be qualified in accordance with S-705.

7.2.2

Welding procedures for structures shall be qualified by a PQR in accordance with the applicable code and AWS D1.1 or the applicable parts of ISO 15614.

7.2.3

Welding procedures for any other welding associated with the package shall be qualified by a PQR in accordance with the applicable code, ASME BPVC Section IX or the applicable parts of ISO 15614.

7.2.4

Additional welding procedure qualification requirements shall be in accordance with the data sheet.

7.2.5

WPSs shall be issued directly to the welder or posted on a notice board adjacent to the welding activity.

7.2.6

WPSs shall be translated from the contract language to a language understood by the welder or welding operator.

7.3 Welder and welding operator qualification

7.3.1

Welders and tack welders shall be qualified in accordance with applicable parts of ISO 9606, ASME BPVC Section IX or the applicable design and fabrication code.

7.3.2

Welding operators shall be qualified in accordance with ISO 14732, ASME Section IX or the applicable design and fabrication code.

7.3.3

Additional welder or welding operator qualification requirements shall be in accordance with the data sheet.

7.3.4 Welding inspector qualification

Welding inspectors shall hold a current level 2 or equivalent certification from a recognized scheme, such as AWS-CWI, CSWIP 3.1, CWB-Level 2 or IWI-S.

7.4 Welding coordinator qualification

7.4.1

Welding coordinators shall be qualified in accordance with Table 2.

7.4.2

The tasks and responsibilities of the welding coordinator shall be in accordance with ISO 14731.

7.5 Test laboratories

Test laboratories for mechanical, chemical and corrosion testing shall have a certified laboratory system in compliance with ISO/IEC 17025 for the test methods employed.

7.6 Non-destructive testing quality system

The final NDE of welds shall be performed by an organization or part-organization operating a documented quality management system in compliance with ISO/IEC 17020 or ASME equivalent.

7.7 Inspection and non-destructive testing personnel

7.7.1

NDE personnel shall be certified in accordance with ISO 9712 or ASNT as specified.

7.7.2

NDE personnel shall not perform tasks that exceed their certification level as defined by ISO 9712/ASNT qualification.

7.8 Production parameter monitoring

7.8.1

The recording frequency of production parameter monitoring shall be in accordance with the data sheet, but not less than the first weld per WPS and the first weld by a welder or welding operator.

7.8.2

Production parameter monitoring records shall be traceable to a specific welder, WPS and production weld.

7.8.3

Production parameter monitoring records shall verify correct fit-up and root pass penetration for single sided welds where full penetration is required, including weldolets and attachment welds.

7.8.4

Production parameter monitoring records shall detail the actual preheat and interpass temperature, consumables, welding parameters and resulting heat input.

7.8.5

Production parameter monitoring records shall be endorsed by the welding coordinator or welding inspector.

7.9 Weld repair rates

Repair rates of individual welders and welding operators shall be recorded.

7.10 Weld history records

Records shall be produced that show the WPS, joint type and size, welder or welding operator, date and time of welding, PWHT and NDE as a minimum for each weld.

7.11 Calibration of welding and measuring equipment

Welding and parameter-measuring/recording equipment shall be calibrated at least every 12 months or more often if required by the equipment manufacturer's recommendations.

8 Protective coating, painting and insulation

8.1 Protective coatings

8.1.1

Painting and coating of equipment and piping for onshore (excluding marine coastal) applications in an environment with atmospheric corrosivity category C1 to C3 (low to medium corrosivity to ISO 12944-2) shall be selected and qualified in accordance with ISO 12944-5 and ISO 12944-6.

8.1.2

Painting and coating of equipment and piping for offshore and marine coastal applications and submerged coating shall be in accordance with IOGP S-715.

8.1.3

Surface preparation for onshore applications shall be in accordance with ISO 12944-4.

8.1.4

Execution and supervision of coating application for onshore applications shall be in accordance with ISO 12944-7 and the qualified coating system procedure specification.

8.2 Insulation

8.2.1 Enclosure insulation

The selection of insulation materials for enclosures and cabins shall be in accordance with ISO 15667.

8.2.2 Piping and instrument insulation

8.2.2.1

Insulation shall be removable.

8.2.2.2

Insulated surfaces shall be coated in accordance with IOGP S-715.

8.2.2.3

Perforated guards or screens shall be used for personnel protection for surface temperatures up to 150 °C (300 °F).

9 Special tools

9.1

Special tools shall be identified and supplied for assembly and maintenance of the equipment in the deluge skid.

9.2

Special tools shall be marked or tagged to indicate the intended use.

10 Preparation for shipment

Open gland entries shall be fitted with temporary blanking plugs to maintain the ingress protection rating during transportation and storage.

11 Lifting requirements

11.1 Lifting arrangements

11.1.1

Lifting equipment shall be certified by a competent enterprise approved by local authorities.

11.1.2

Lifting equipment and rigging arrangement shall be designed such that a single point lift can be performed safely, keeping the package horizontal.

11.2 Padeyes and lifting lugs

11.2.1

Lifting lug and padeye sizes internally on the package shall be selected from the following size list, per the governing lifting arrangement: 1, 3, 6, and 10 metric tonnes.

11.2.2

Lifting lugs and padeyes shall be welded to the supporting structure.

11.2.3

Where tension loading is perpendicular to the plate or section thickness, lifting lug and padeye welded connections to the supporting structure shall be inspected for lamellar tearing over the weld length and 50 mm on each side, as detailed in Figure 7.

NOTE Not required if the supporting material is of Z (through thickness) quality.

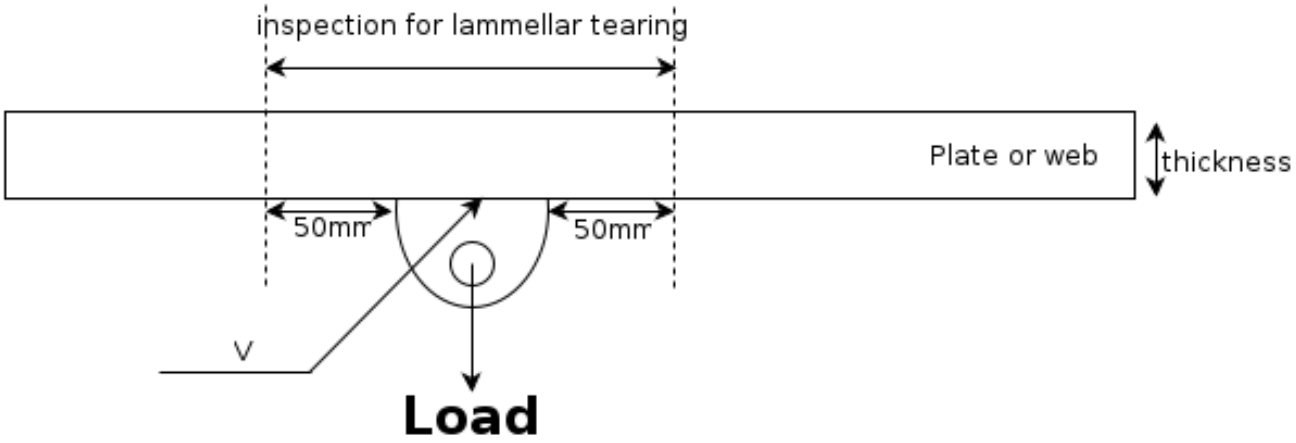

Figure 7 - Padeye and lifting lug NDT

Registered Office
City Tower
40 Basinghall Street
14th Floor
London EC2V 5DE
United Kingdom

T +44 (0)20 3763 9700
F +44 (0)20 3763 9701
reception@iogp.org

Brussels Office
Bd du Souverain,165
4th Floor
B-1160 Brussels
Belgium

T +32 (0)2 566 9150
F +32 (0)2 566 9159
reception@iogp.org

Houston Office
10777 Westheimer Road
Suite 1100
Houston, Texas 77042
United States

T +1 (713) 470 0315
reception@iogp.org

www.iogp.org