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Supplementary Specification to API Standard 537 Flare Details for Petroleum, Petrochemical, and Natural Gas Industries

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

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Acknowledgements

This IOGP Specification was prepared by a Joint Industry Project 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 for projects 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 approved specification, building on recognized industry and/or 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, facilitating improved standardization of major projects across the globe. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focussed 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 supplementary requirements for the procurement of Flare Packages in accordance with API Standard 537, Third Edition, March 2017 for application in the petroleum and natural gas industries.

This JIP33 standardized procurement 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

It is required to use all of these documents in conjunction with each other when applying this specification, as follows.

S-722: Specification for Flare Package

This specification is written as an overlay to API Standard 537 3rd Edition, following the clause structure of the parent standard, to assist in cross-referencing the requirements. Where clauses from the parent standard API STD 537 are not covered in this specification, there are no supplementary requirements or modifications to the respective clause. The terminology used within this specification follows that of the parent standard and otherwise is in accordance with ISO/IEC Directives, Part 2.

Modifications to the parent standard defined in this specification are identified as *Add* (add to clause or add new clause), *Replace* (part of or entire clause) or *Delete*.

S-722D: Datasheet for Flare Package

This document provides project specific requirements where this specification requires the purchaser to define an application specific requirement. It also includes information required by the purchaser for technical evaluation. Additional purchaser supplied documents are also listed in the datasheet, to define scope and technical requirements for enquiry and purchase of the equipment.

S-722L: Information requirements for Flare Package

This document defines the information requirements, including format, timing and purpose, for information to be provided by the vendor. It also defines the specific conditions which must be met for conditional information requirements to become mandatory. The information requirements listed in the IRS have references to the source of the requirement.

S-722Q: Quality requirements for Flare Package

This document includes a conformity assessment system (CAS) which specifies standardized user interventions against quality management activities at four different levels. The applicable CAS level is specified by the purchaser in the datasheet.

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

Unless defined otherwise in the purchase order, 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 (datasheet, IRS, QRS);

d) this specification;

e) the parent standard.

1 Scope

Replace section with

This specification provides requirements and guidance for the selection, design, specification, operation, and maintenance of flares and related combustion and mechanical components used in pressure-relieving and vapour-depressurizing systems for petroleum, petrochemical, and natural gas industries. This specification is intended for onshore and offshore facilities.

Annex A, Annex B, Annex C and Annex D provide further guidance and best practices for the selection, specification, and mechanical details for flares and on the design, operation, and maintenance of flare combustion and related equipment.

It is intended that IOGP S-722D datasheet is used to communicate and record design information. Datasheets in Annex F and instructions in Annex E are retained for information.

2 Normative References

Delete from section

ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ISO 2408:2004	Steel Wire Ropes for General Purposes—Minimum Requirements

Add to section

ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
ISO 10684	Fasteners hot dip galvanized coatings
ISO 2408	Steel wire ropes - Requirements

3 Terms and Definitions

Add to section

3.65
heat-resistant materials
Heat-resistant materials are alloys or austenitic stainless steels that have high creep resistance and strength at high temperatures.

3.66
proven
Proven means the equipment or system met its intended performance and had reliable operation for at least five years at a minimum of two different installations.

3.67
high-energy ignition (HEI)
High-energy igniters utilize a solid-state sparkplug that produces a spark, generally of 1 J or greater energy. The voltage required to produce a spark is generally less than 8 kV. Refer to A.4.3 for more information.

3.68
high-tension / high voltage spark igniter
High-tension or high-voltage type ignition system utilizes sparking device (or spark plug) with dielectric insulator between the electrodes and an air gap between the electrodes' ends. High-tension type system typically requires voltage above 8 kV to produce a spark. Refer to A.4.3 for more information.

3.69
flame-ionization
Flame-ionization detectors function based on a change of resistance between two electrodes. The electrodes are located within the flame envelope in contact with the ionized gases generated by flame. Refer to A.5.3 for more information.

4 Design

4.2 System Design

Add to item a)

In addition, a minimum continuous case shall be defined on the datasheets.

4.4 Types of Flares

Replace NOTE 1 with

NOTE 1 Refer to Figure A.1 for a general flare type selection guide. Within each general type of flare, various alternatives and proprietary design aspects can exist. An understanding of alternatives and/or proprietary design aspects can be obtained and evaluated using the IOGP S-722D.

4.5 Flare Burners

Add to item a)

— Flare burners shall be constructed of a heat-resistant material, type 310 stainless steel as a minimum.

NOTE For elevated flare burner flange material, refer to 5.4.2.

— Alloys with nickel content more than 25 % shall not be used for flare burner construction if flare gas is expected to contain more than 1 mol % H_2S.

— The minimum thickness of flare burner parts fabricated from plate or pipe material shall be 9 mm (0.35 in.)

— Elevated flare burners shall be designed to withstand operating conditions without the need for internal or external refractory lining.

— The number of welds exposed to high temperatures shall be minimized.

— The material of steam injection nozzles and steam piping exposed to flame shall be type 310 stainless steel.

— The material of assist air distribution and injection parts exposed to flame shall be type 310 stainless steel.

— The bolting used for all flanged connections and attachments at the flare burner shall be of a high nickel alloy material for offshore/coastal; and minimum ASTM A193 Grade B8M for onshore.

— The windshield design and attachment to the flare burner shall take into account differential thermal expansion.

— The material of construction for the windshield and windshield supports shall be the same as the flare burner material.

Add to item b)

— When potential freezing conditions are indicated on the datasheet, drain lines from steam injection points and muffler shall be provided to grade, heat-traced and insulated.

— Separate steam risers and controls shall be provided for each of the following:

1) internal steam tubes,

2) centre steam injection (if equipped),

3) upper steam injection (if equipped).

Add new item d)

d) For flare burners with variable orifice, additional protection from system overpressure due to orifice blockage or variable orifice mechanism failure shall be provided.

4.6 Mechanical Design

4.6.2

Add new item p)

p) thermal cycling, flame-lick and low flows shall be taken into account in the mechanical design, fabrication, inspection, and testing of the mechanical components of a flare.

4.7 Pilots

Replace first paragraph with

Pilots shall be self-inspirating pre-mix type burners with fixed heat release. The following are the functional requirements that shall be met.

Add to item e)

This performance verification test shall be in accordance with A.6.

Add to item f)

For multi-burner staged flares, the minimum of two pilots shall be provided for each stage.

Table 1 — Number of Pilots for Single-point Flares

Add NOTE 3 to table

NOTE 3 For multi-point flares, the inlet diameter of flare burner shall be used in Table 1.

Replace item g) with

g) Pilot burner heads shall be constructed from cast material of the same grade as the flare burner. The minimum requirement is Grade CK20 (UNS J94202) or Grade HK (UNS J94224) cast stainless steel.

Replace item i) with

i) A strainer or settling chamber shall be installed upstream of the gas orifice at the pilot regardless of the fuel gas piping material. The strainer shall contain a screen or wire mesh with openings that are 25 % or less than the diameter of the fuel orifice.

Replace item j) with

j) Pilot components between the pilot tip and the air mixer shall be constructed of type 310 stainless steel as a minimum.

Replace item p) with

p) Individual fuel gas supply lines shall be installed to each pilot from a location that is accessible while the flare is in service.

Add new item q)

q) Weld attachments to the cast pilot tip shall be minimized.

Add new item r)

r) Threaded connections at the pilot tip shall not be used.

Add new item s)

s) One or more strainers shall be installed upstream of the pilot fuel gas regulator.

Add new item t)

t) The strainers mounted upstream of the regulator shall be installed in a way to allow online cleaning of the strainers without interruption of the fuel gas supply to pilots.

Add new item u)

u) The strainers mounted upstream of the regulator shall have a screen or wire mesh that has smaller openings than the screen installed in the strainer at the pilot.

Add new item v)

v) One or more pressure regulators shall be installed in a way to allow online maintenance without interruption of fuel gas supply to pilots.

Add new item w)

w) The material of construction for pilot fuel gas piping, valves, fittings downstream and including the strainers up to the pilot inlet flange shall be minimum 304L stainless steel for onshore applications, and minimum 316L stainless steel for offshore/coastal applications.

Add new item x)

x) Requirements for performance test of pilots at the supplier's shop shall be specified by the purchaser on the datasheet.

4.8 Pilot Ignition Systems

Replace last sentence of item a)

This performance verification test shall be in accordance with A.6.

Add to item a)

The supplier shall provide the performance test results for the proposed pilot ignition systems with the bid.

Add new item f)

f) For flares in continuous service, at least one of the pilot ignition systems shall be maintainable while the flare is in service.

Add new item g)

g) If two independent pilot ignition systems are required as a result of safety risk assessment, the primary pilot ignition system shall have automatic pilot re-ignition upon detection of pilot flame failure.

Add new item h)

h) High-tension type ignition systems shall not be used.

NOTE High-tension type ignition system utilizes sparking device (or spark plug) with dielectric insulator between the electrodes and an air gap between the electrodes' ends. High-tension type system requires voltage above 8 kV to produce a spark.

Add new item i)

i) All components of ignition systems shall be proven in successful operation for at least 5 years in two or more installations. The supplier shall provide references with the bid.

Add new item j)

j) Local control panel shall be provided with the following functions as a minimum:

- power on/off selection and indication;
- status indication for each pilot;
- pilot selection for manual ignition;
- manual spark pushbutton;
- automatic or manual ignition mode selection;
- automatic re-ignition failure indication.

Add new item k)

k) The local control panel shall be installed at location accessible while the flare is in service.

Add new item l)

l) Functional test of ignition and flame detection system shall be performed at the supplier's shop in accordance with the approved procedure.

Add new section

4.8.1 High Energy Ignition

a) The sparking device shall ignite the fuel/air mixture prior to the pilot tip.

b) Ignition system electrical components shall be rated to withstand the highest temperature for which they are exposed during all flaring cases. The design temperature shall be specified on the datasheet.

c) The ignition cable connecting the ignition probe with the first junction box shall be protected from the flare flame radiation.

d) The first junction box shall be installed in a sheltered location under the flare burner access platform.

e) Junction boxes installed local to the pilots shall be of stainless steel material with ceramic connectors.

f) The ignition system exciter shall be installed at location accessible while the flare is in service.

Add new section

4.8.2 Flame Front Generator

a) Each pilot shall have a dedicated flame front ignition line from the ignition control panel.

b) The material of construction for flame front generator lines shall be minimum 304L stainless steel for onshore applications and minimum 316L stainless steel for offshore and coastal applications.

c) The flame front generator line size shall be DN 25 (NPS 1).

d) The minimum wall thickness for FFG lines shall be Schedule 40S.

e) The number of bends in flame front generator lines shall be minimized. If standard elbows are used, they shall be long radius type.

f) If freezing conditions are possible the flame front generator lines shall be heat-traced and insulated.

g) Pressure regulators and pressure gauges downstream of the regulators shall be provided on the ignition fuel gas line and the air supply line.

h) The pressure gauges installed in fuel and air supply lines shall be able to withstand or be protected from the pressure pulses occurring during ignition of the fuel-air mixture.

i) Pressure regulators installed in ignition fuel line and air supply line shall have shut-off valves and a bypass with a manual throttling valve.

j) The ignition system design pressure specified on the datasheet shall be applicable to the whole system including components located downstream of the pressure regulators.

4.9 Pilot Flame Detection

Add to item b) before last sentence

The supplier shall provide the performance test results for the proposed pilot flame detection systems with the bid.

Replace last sentence of item b)

This performance verification test shall be in accordance with A.6.

Add new item d)

d) Thermocouples shall be provided for pilot flame detection.

Add new item e)

e) If two independent flame detection systems for pilots are required as a result of safety risk assessment, the second flame detection system shall be one of the following:

- flame ionization type;
- acoustic type;
- optical type.

Add new item f)

f) The second flame detection system shall be proposed by the supplier. The proposed flame detection system shall be proven in successful operation with offered pilot model for at least 5 years in two or more installations. Supplier shall provide references with the bid.

Add new item g)

g) An alarm shall be provided in the local control panel and plant central control system when the loss of flame is detected. The alarm shall identify the pilot that has a flame failure.

4.9.1 Thermocouples

a) Two single-circuit Type K thermocouples shall be provided for each pilot.

b) The thermocouple tip weld shall be ungrounded type. Sheath material shall be Hastelloy X (UNS N06002) or equal. Magnesium oxide insulation shall be used.

c) Each thermocouple shall be installed in a thermowell incorporated into the pilot tip casting.

d) Thermocouple sheath shall be protected from flame impingement for a distance of 1.8 m (6 ft) or 125 % of the actual burner diameter (whichever is greater) from top of the flare burner.

e) Thermocouple sheathing shall extend to the junction boxes installed in sheltered location under the flare burner access platform.

f) Thermocouple junction boxes shall be of stainless steel material with ceramic terminals.

g) The thermocouple extension cable shall be rated to withstand the highest temperature which it is exposed during all flaring cases.

4.9.2 Flame Ionization

a) The ionization probe shall extend at least 1.8 m (6 ft) or 125 % of the actual burner diameter (whichever is greater) from top of the flare burner.

b) The ionization cable shall be rated to withstand the highest temperature which it is exposed during all flaring cases.

c) Part of the ionization system cable between the ionization probe and the first junction box local to the pilot shall be installed in the flexible stainless steel conduit.

d) The first junction box shall be installed in the sheltered location below the flare burner access platform.

e) Ionization system junction boxes shall be of stainless steel material with ceramic terminals.

f) The ionization system transformer and electronics shall be installed at a location that is accessible while the flare is in service.

4.9.3 Optical Systems

a) If an optical system is provided, it shall be infrared (IR) type.

b) The optical sensors shall be installed on a vibration-free platform accessible while the flare is in service.

4.9.4 Acoustic Systems

a) Acoustic sensors shall be installed at a location that is accessible while the flare is in service.

4.10 Piping

Add new section

4.10.9

Supplier's piping termination points shall be anchored. The supplier shall provide maximum allowable loads on termination flanges to the purchaser.

Add new section

4.10.10

The supplier's piping termination points shall be flanged.

Add new section

4.10.11

Manual valves shall comply with the purchaser's specifications.

Add new section

4.10.12

All auxiliary piping shall be sloped to low point drains that can be accessed while the flare is in service.

4.11 Auxiliary Components

Add new section

4.11.4

Whenever velocity or venturi-type purge seals are used, they shall incorporate drain holes at their base.

Add new section

4.11.5

Knockout drum shall be designed in accordance with API STD 521. Mechanical design shall comply with IOGP S-619.

Add new section

4.11.6

Whenever liquid seal is used, it shall be designed in accordance with API STD 521. Mechanical design shall be in comply with IOGP S-619.

Add new section

4.11.7

For air-assisted flares, the package supplier shall be responsible for the blower and driver selection and design. Blower and driver shall be proven in operation for 5 years or more in at least two installations. The supplier shall provide references with the bid.

Add new section

4.11.8

The type of driver for the blowers shall be electric motor.

Add new section

4.11.9

Electric motors shall comply with IEC 60034 and the purchaser's specification.

Add new section

4.11.10

Belt drives shall not be used for air-assist blower.

Add new section

4.11.11

Electric motors shall be shielded from flare radiation.

Add new section

4.11.12

General requirements for instrumentation and controls within the package shall be in accordance with the purchaser's specifications.

Add new section

4.11.13

A mechanical run test of the air-assist blowers shall be performed at the supplier's shop in accordance with the approved procedure.

Add new section

4.12 Noise

4.12.1

For elevated flares under emergency conditions, the noise level at the base of the stack shall not exceed the absolute limit specified on the datasheet.

4.12.2

For ground flares, the noise level outside wind fence shall not exceed the work area limit specified on the datasheet.

4.12.3

For air-assisted flares, the noise level at the blowers location under normal operating conditions shall not exceed the work area limit specified on the datasheet.

4.12.4

For steam-assisted flares, the steam noise at steam flow rate corresponding to the relevant flaring case shall be considered when assessing the overall flare noise level under normal operating conditions and emergency conditions.

5 Mechanical Details—Elevated Flares

5.1 Mechanical Design—Design Loads

Add to item i)

6) Lifting lugs or brackets provided on the flare burner for initial installation shall be removed prior to placing the flare burner in service.

7) Loads imposed by temporary lifting equipment or scaffolding, during maintenance or replacement of the flare burner, shall be considered in the structural design.

5.2 Design Details

Delete "Unless otherwise specified" from item a)

Unless otherwise specified

Add to item d)

5) When double pipe stack is used for air-assisted flare, the design shall take into consideration the risk of corrosion on riser surfaces in contact with assist air.

5.3 Flanges

Replace the first sentence with

Elevated flare burner and all auxiliary connections (pilot fuel gas, FFG lines, steam, air) to the respective risers shall be flanged. Flanges for the flare burner and auxiliary connections shall be as follows:

Replace item a) with

for DN 600 (NPS 24) and smaller burners: ASME B16.5, Class 150 RFSO / RFWN or EN 1092-1, PN 25 Type 01 / Type 11.

Replace item b) with

for sizes greater than DN 600 (NPS 24): forged flanges or fabricated plate flanges drilled to ASME B16.47 or dimensions as specified in Table 3; for flange sizes greater than those shown in Table 3, follow the flare manufacturer's standard;

Replace item c) with

for DN 600 (NPS 24) and smaller size auxiliary connections: flange ratings shall be as per ASME B16.5 RFWN type.

5.3.3

Replace section with

Bolted connection of flare burner to stack and all bolted attachments mounted on the flare burner (e.g. pilots, windshield, muffler) shall have double nuts.

Add new section

5.3.4

The supplier shall provide recommended bolt tightening torque values for flare burner flange and all auxiliary piping flanges.

5.4 Materials of Construction

5.4.2

Replace section including NOTE

The flare burner inlet flange material shall be 316L stainless steel or higher grade heat-resistant material. If flare stack material is of a higher grade than 316L the flare burner inlet flange shall meet the metallurgical requirements of the flare stack.

5.5 Welding

5.5.1

Replace section with

Relief-gas-containing portions of the support structure shall be fabricated in accordance with the welding requirements of IOGP S-705.

5.5.2

Replace section with

If the bottom portion of the stack is designed in accordance with the pressure design code, the fabrication of that portion shall be governed by the welding qualification requirements of the pressure design code and IOGP S-705.

5.6 Inspection

Add to item c)

2) Butt welds in flare burner shall be 100 % radiographed.

Add new section

5.6.3

Fillet welds in the flare burner shall be 100 % examined by dye penetrant testing.

Add new section

5.6.4

Positive material identification (PMI) shall be performed on all flare burner parts materials and welds after fabrication is completed.

Add new section

5.6.5

Where flare support structure is shipped to site in two or more sections, the supplier shall perform a trial assembly of the structure before shipping.

5.7 Surface Preparation and Protection

5.7.1

Replace section with

Carbon steel external surfaces of stack and piping that can be directly exposed to weather shall be painted in accordance with the purchaser's coating specifications.

5.7.2

Replace section with

Components of derricks, ladders, platforms, etc. shall be prepared and hot-dip galvanized in accordance with the applicable sections of ASTM A123/123M or ISO 1461, ASTM A143/143M, ASTM A153/153M, ASTM A384/384M and ASTM A385/385M. Bolts joining galvanized sections shall be galvanized in accordance with or ASTM A153/153M or ISO 10684.

5.7.3

Replace section with

Requirements for coating of corrosion resistant alloys shall be in accordance with the purchaser's coating specification.

5.7.4

Delete section 5.7.4

5.10 Platforms and Ladders

5.10.6

Replace section with

Ladder safety gates in areas exposed to high flame radiation shall be hot-dip galvanized steel.

Add new section

5.10.7

For non-demountable elevated flares, a 360° platform shall be provided below the flare burner mounting flange and be positioned so that it can be used during inspections, maintenance, and flare burner replacement.

Add new section

5.10.8

The flare burner maintenance platform shall have not less than 0.9 m (3 ft) clearance width from the flare burner and its appurtenances.

Add new section

5.10.9

If the flare is equipped with a buoyancy-type air seal, a platform shall be provided for access to the inspection and clean-out nozzles.

Add new section

5.10.10

Access platforms shall be provided for inspection and maintenance of fixed, non-retractable aircraft warning lights.

Add new section

5.10.11

If the flare system is equipped with a knockout drum and/or a liquid seal, platforms shall be provided for access to manways, instruments and valves.

Add new section

5.10.12

Ladder and platform attachments to the flare stack shall be by bolting to the welded support clips.

Add new section

5.10.13

If spare or maintenance flare stack is provided, the ladders shall be located on the flare stack side facing away from the other flare.

Add new section

5.10.14

For demountable derrick-supported flares, stairway access shall be provided from grade to working platforms used for riser mounting/demounting.

Add new section

5.10.15

Ladders shall have a side exit to the arrival area.

Add new section

5.10.16

For guy-wired flares, access platform shall be provided at guy wire fixing elevation.

6 Mechanical Details—Enclosed-flame Flares

6.1 Combustion Chamber

6.1.4

Replace section with

Personnel protection shall be provided adjacent to the combustion chamber when surface temperatures exceed the value specified on the datasheet for areas for personnel access during operation.

6.4 Pilots

6.4.1

Replace section with

Each stage shall be equipped with at least two pilots.

6.4.2

Delete NOTE 1 from Section 6.4.2

6.5 Wind Fence

Add new section

6.5.7

View port(s) shall allow observance of all pilots and burners while the flare is in service.

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