Flare Details for Petroleum, Petrochemical, and Natural Gas Industries

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Notice

Instructions for Submitting a Proposed Revision to this Standard Under Continuous Maintenance

The American Petroleum Institute maintains this standard under continuous maintenance procedures. These procedures establish a document program for regular publication of addenda or revisions, including timely and documented consensus action on requests for revisions to any part of the standard. Proposed revisions shall be submitted to the Director, Standards Department, American Petroleum Institute, 1220 L Street, NW Washington, D.C. 20005-4070, standards@api.org.

Introduction

A flare is a critical mechanical component of a complete system design intended for the safe, reliable, and efficient discharge and combustion of hydrocarbons from pressure-relieving and vapor-depressurizing systems.

The high-level safety and operating goals of a flare are summarized as follows:

— to provide safe, reliable, and efficient discharge and combustion of hydrocarbons with a high combustion efficiency;

— to ensure that the discharged hydrocarbons burn with stable combustion over the entire defined operating range;

— to ensure a continuity of the flare flame under severe weather conditions;

— to ensure that ground level concentrations of specified compounds do not exceed environmental limits;

— to ensure that the back pressure does not exceed the maximum allowable;

— to ensure that velocity throughout the flare piping and the flare burner does not exceed the maximum specified;

— to ensure that the opacity limit at the smokeless flow rate range does not exceed that defined;

— to ensure that the flare radiation intensity does not exceed the maximum allowable; and

— to ensure that noise levels do not to exceed the maximum permissible.

For new designs, the development of a design can be advanced using the guidance and examples of good engineering practice that are identified in this standard.

A flare design basis is developed in consideration of the performance expectations, the functional requirements and mechanical details required to fulfill the safety and operating goals established for each application. Section 4 provides the basis for design and functional requirements related to the primary components critical to fulfilling these safety and operating goals. Section 5 and Section 6 provide requirements more specific to the arrangement and mechanical details of design.

The functional requirements in this standard are supported by the technical guidance provided in Annex A, Annex B, Annex C, and Annex D. The technical guidance provided in the informative annexes addresses alternative designs or techniques and provides good practices on the basis of which, through sound engineering judgment, the practitioner can make appropriate design decisions and selections.

Datasheets are provided in Annex F in order to properly communicate and preserve the finalized basis of design and requirements. Annex E provides instructions for completing the flare datasheets in Annex F.

Users of this standard should be aware that further or differing requirements may be needed for individual applications. This standard is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this standard and provide details.

The International System of Units (SI) is used in this standard. Where practical, U.S. customary (USC) units are included in brackets for information.

A bullet (•) at the beginning of a section or subsection indicates that either a decision is required or further information is to be provided by the purchaser. This information should be indicated on datasheets (see examples in Annex F) or stated in the inquiry or purchase order.

Addendum 1 contains a new annex (Annex G) added to the Third Edition of API Standard 537. Annex G contains a combination of normative and informative content migrated from the Sixth Edition of API Standard 521 through joint API Standard 521/API Standard 537 committee review. Both the Seventh Edition of API Standard 521 and Addendum 1 of the Third Edition of API Standard 537 are being issued concurrently to align both standards and ensure preservation of technical requirements and information. The normative content contained, and that which may be derived through further development of this Annex, will be removed and incorporated into the normative sections of the next edition of API Standard 537.

Flare Details for Petroleum, Petrochemical, and Natural Gas Industries

1 Scope

This standard specifies requirements and provides guidance for the selection, design, specification, operation, and maintenance of flares and related combustion and mechanical components used in pressure-relieving and vapor-depressurizing systems for petroleum, petrochemical, and natural gas industries. While this standard is primarily intended for onshore facilities, guidance related to offshore applications is included.

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.

Annex E explains how to use the datasheets provided in Annex F; it is intended that these datasheets be used to communicate and record design information.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Recommended Practice 2A-WSD:2000, *Planning, Designing and Constructing Fixed Offshore Platforms—Working Stress Design*

API Standard 521, *Pressure-Relieving and Depressuring Systems*

API Standard 560, *Fired Heaters for General Refinery Service*

ASME B16.5 [1], *Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard*

ASME STS-1, *Steel Stacks*

ASTM A123/A123M [2], *Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*

ASTM A143/A143M, *Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement*

ASTM A153/A153M, *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*

ASTM A384/A384M, *Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies*

ASTM A385/385M, *Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)*

ASTM A475-03, *Standard Specification for Zinc-Coated Steel Wire Strand*

ASTM A586-04a, *Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand*

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[1] ASME International, 2 Park Avenue, New York, New York 10016-5990, www.asme.org.
[2] ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.

ASTM B633, *Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel*

EN 1092-1:2007 [3], *Flanges and their Joints—Circular Flanges for Pipes, Valves, Fittings and Accessories, PN Designated—Part 1: Steel Flanges*

EN 10264-2:2002, *Steel Wire and Wire Products—Steel Wire for Ropes—Part 2: Cold Drawn Non Alloy Steel Wire for Ropes for General Applications*

EN 12385-10, *Steel Wire Ropes—Safety—Part 10: Spiral Ropes for General Structural Applications*

ISO 2408:2004, *Steel Wire Ropes for General Purposes—Minimum Requirements*

NACE MR0103 [4]/ISO 17945 [5], *Petroleum, Petrochemical and Natural Gas Industries—Metallic Materials Resistant to Sulfide Cracking in Corrosive Petroleum Refining Environments*

NACE MR0175/ISO 15156, *Petroleum, Petrochemical, and natural gas industries–Materials for use in H_2S-Containing Environments in Oil and Gas Production, Parts 1, 2, and 3*

SSPC SP 6 [6]/NACE No. 3, *Commercial Blast Cleaning*

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1
air seal
purge reduction device
Device used to reduce the amount of purge gas needed to protect against air infiltration into the flare stack.

NOTE Examples include buoyancy seal, orifice seal, and velocity seal.

3.2
assist gas
Fuel gas that is added to relief gas prior to the flare burner or at the point of combustion in order to raise the heating value.

NOTE 1 Also refer to **enrichment** (3.23) and **supplemental gas** (3.60).

NOTE 2 In some designs, the assist gas can increase turbulence for improved combustion.

3.3
back blowing
Procedure by which the dry air seal drain line is blown back from the base of the drain into the buoyancy seal to ensure the line is clear.

3.4
blowoff
Loss of a stable flame where the flame is lifted above the burner that occurs when the fuel velocity exceeds the flame velocity.

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[3] CEN European Committee for Standardization, 36 rue de Stassart, B-1050 Brussels, www.cenorm.be.
[4] NACE International (formerly the National Association of Corrosion Engineers), 1440 South Creek Drive, Houston, Texas 77084-4906, www.nace.org.
[5] International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland, www.iso.org.
[6] The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh, Pennsylvania 15222, www.sspc.org.

3.5
buoyancy seal
diffusion seal
density seal
Dry vapor seal that minimizes the required purge gas needed to protect from air infiltration.

NOTE The buoyancy seal functions by trapping a volume of light gas in an internal inverted compartment that prevents air from displacing buoyant light gas in the flare.

3.6
burnback
Internal burning within the burner.

NOTE Burnback can result from air backing down the flare burner at purge or low flaring rates.

3.7
burning velocity
flame velocity
Speed at which a flame front travels into an unburned combustible mixture.

3.8
burn pit flare
Open excavation, normally equipped with a horizontal flare burner that can handle liquid as well as gaseous hydrocarbons.

3.9
Coanda flare
Flare burner that is designed to employ the aerodynamic effect where moving fluids follow a curved or inclined surface over which they flow.

NOTE Flares of this type generally use steam or pressure to achieve smokeless performance.

3.10
combustion air
Air required to combust the flare gases.

3.11
combustion efficiency
Percentage of the combustible fluid totally oxidized by the burner.

NOTE In the case of hydrocarbons, combustion efficiency is the mass percent of carbon in the original fluid that oxidizes completely to CO_2.

3.12
condensable gas
Vapor that can condense at the temperature and pressure expected in a flare header during or after a flaring event.

3.13
cryogenic service
Systems that may be called upon to handle waste gas below –29 °C (–20 °F).

3.14
derrick support
Lattice based support system for the elevated flare stack, normally used for very tall flares or when plot space is limited.

NOTE Various derrick-supported arrangements are available: a fixed system has its stack permanently supported to the derrick; a demountable derrick has multiple riser sections that are designed such that they can be lowered and