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INSPECTION OF REFINERY EQUIPMENT

API 510 ◆◆

Pressure Vessel Inspection Code: In-Service Inspection, Rating, Repair, and Alteration

Covers the in-service inspection, repair, alteration, and rerating activities for pressure vessels and the pressure-relieving devices (PRDs) protecting these vessels. This inspection code applies to all hydrocarbon and chemical process vessels that have been placed in service; however, it could also be applied to process vessels in other industries at owner-operator discretion. This includes: vessels constructed in accordance with an applicable construction code [e.g., ASME *Boiler and Pressure Vessel Code (BPVC)*]; where a pressure vessel has been constructed to the American Society of Mechanical Engineers (ASME) Section VIII Code, API 510 is intended to apply to Divisions 1 and 2 and not Division 3; vessels constructed without a construction code (noncode vessels); vessels constructed and approved as jurisdictional special based upon jurisdiction acceptance of particular design, fabrication, inspection, testing, and installation; nonstandard vessels. Pages: 83

11th Edition | October 2022 | Product Number: C51011 | Price: \$268.00

API 570 ◆

Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems

(includes Addendum 1 dated May 2017, Addendum 2 dated March 2018, and Errata 1 dated April 2018)

Covers inspection, rating, repair, and alteration procedures for metallic and fiberglass reinforced plastic (FRP) piping systems and their associated pressure-relieving devices that have been placed in service. This inspection code applies to all hydrocarbon and chemical process piping covered in 1.2.1 that have been placed in service unless specifically designated as optional per 1.2.2. This publication does not cover inspection of specialty equipment including instrumentation, exchanger tubes, and control valves. However, this piping code could be used by owner/users in other industries and other services at their discretion. Process piping systems that have been retired from service and abandoned in place are no longer covered by this “in-service inspection” Code. However abandoned in place piping may still need some amount of inspection and/or risk mitigation to assure that it does not become a process safety hazard because of continuing deterioration. Process piping systems that are temporarily out of service but have been mothballed (preserved for potential future use) are still covered by this Code. Pages: 88

4th Edition | February 2016 | Product Number: C57004 | Price: \$195.00

RP 571 ◆

Damage Mechanisms Affecting Fixed Equipment in the Refining Industry

Provides background information on damage that can occur to equipment in the refining process. It is intended to supplement Risk-Based Inspection (RP 580 and Publ 581) and Fitness-for-Service (API 579-1/ASME FFS-1) technologies developed in recent years by API to manage existing refining equipment integrity. It is also an excellent reference for inspection, operations, and maintenance personnel. This RP covers over 60 damage mechanisms. Each write-up consists of a general description of the damage, susceptible materials, construction, critical factors, inspection method selection guidelines, and control measures. Wherever possible, pictures are included and references are provided for each mechanism. In addition, generic process flow diagrams have been included that contain a summary of the major damage flow mechanism expected for typical refinery process units. Pages: 376

3rd Edition | March 2020 | Product Number: C57103 | Price: \$374.00

RP 572 ◆

Inspection Practices for Pressure Vessels

Supplements API 510 by providing pressure vessel inspectors with information that can improve skills and increase basic knowledge of inspection practices. This recommended practice (RP) describes inspection practices for the various types of pressure vessels (e.g. drums, heat exchangers, columns, reactors, air coolers, spheres) used in petroleum refineries and chemical plants. This RP addresses vessel components, inspection planning processes, inspection intervals, methods of inspection and assessment, methods of repair, records, and reports. API 510 has requirements and expectations for inspection of pressure vessels. Pages: 154

4th Edition | December 2016 | Product Number: C57204 | Price: \$249.00

RP 573 ◆

Inspection of Fired Boilers and Heaters

Covers inspection practices for fired boilers and process heaters (furnaces) used in petroleum refineries and petrochemical plants. The practices described in this document are focused to improve equipment reliability and plant safety by describing the operating variables which impact reliability, and to ensure that inspection practices obtain the appropriate data, both on-stream and off-stream, to assess current and future performance of the equipment. Pages: 129

4th Edition | January 2021 | Product Number: C57304 | Price: \$175.00

RP 574 ◆

Inspection Practices for Piping System Components

Supplements API 570 by providing piping inspectors with information that can improve skill and increase basic knowledge of inspection practices. This recommended practice describes inspection practices for piping, tubing, valves (other than control valves), and fittings used in petroleum refineries and chemical plants. Common piping components, valve types, pipe joining methods, inspection planning processes, inspection intervals and techniques, and types of records are described to aid the inspectors in fulfilling their role implementing API 570. This publication does not cover inspection of specialty items, including instrumentation, furnace tubulars, and control valves. Pages: 113

4th Edition | November 2016 | Product Number: C57404 | Price: \$227.00

RP 575 ◆

Inspection Practices for Atmospheric and Low-Pressure Storage Tanks

Covers the inspection of atmospheric and low-pressure storage tanks that have been designed to operate at pressures from atmospheric to 15 psig. Includes reasons for inspection, frequency and methods of inspection, methods of repair, and preparation of records and reports. This recommended practice is intended to supplement Std 653, which covers the minimum requirements for maintaining the integrity of storage tanks after they have been placed in service. Pages: 116

4th Edition | July 2020 | Product Number: C57504 | Price: \$226.00

RP 576 ◆

Inspection of Pressure-Relieving Devices

Describes the inspection and repair practices for self-actuated pressure-relieving devices commonly used in the oil/gas and petrochemical industries. As a guide to the inspection and repair of these devices in the user's plant, it is intended to ensure their proper performance. This publication covers self-actuated devices such as direct acting spring loaded valves, pilot operated pressure-relief valves, rupture disks, pin actuated devices, and weight-loaded pressure vacuum vents.

The recommendations in this publication are not intended to supersede requirements established by regulatory bodies. This publication excludes tank weak seams and/or sections or tank thief hatches, explosion doors, fusible plugs, control valves, pressure regulating devices, integral rotating equipment components, other devices that either depend on an external source of power for operation or are manually operated or devices not designed to be

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inspected or recertified. Inspections and tests made at manufacturers' plants, which are usually covered by codes or purchase specifications, are not covered by this publication.

This publication does not cover training requirements for personnel involved in the inspection and repair of pressure-relieving devices. Those seeking these requirements should see API 510/570, which gives the requirements for a quality control system and specifies that the repair organization maintain and document a training program ensuring that personnel are qualified. Pages: 80
4th Edition | April 2017 | Product Number: C57604 | Price: \$227.00

RP 576 *

Inspection of Pressure-Relieving Devices—Spanish

Spanish translation of RP 576.

4th Edition | April 2017 | Product Number: C57604S | Price: \$227.00

RP 577 ◆

Welding Processes, Inspection, and Metallurgy

Provides guidance to the API authorized inspector on welding inspection as encountered with fabrication and repair of refinery and chemical plant equipment and piping. Common welding processes, welding procedures, welder qualifications, metallurgical effects from welding, and inspection techniques are described to aid the inspector in fulfilling their role implementing API 510, API 570, Std 653, and RP 582. The level of learning and training obtained from this document is not a replacement for the training and experience required to be an American Welding Society (AWS) Certified Welding Inspector (CWI). Pages: 194

3rd Edition | October 2020 | Product Number: C57703 | Price: \$269.00

RP 578 ◆

Guidelines for a Material Verification Program (MVP) for New and Existing Assets

Provides the guidelines for the owner/user to develop and implement a material verification program (MVP) as part of an asset integrity program. The MVP uses positive material identification and other methods to verify that the nominal composition of an asset, an asset component, or weldment within the pressure envelope is consistent with the selected or specified construction materials.

A well-designed and implemented MVP is an important management system used to minimize the potential for the release of hazardous substances due to nonconforming materials of construction. Pages: 28

3rd Edition | February 2018 | Product Number: C57803 | Price: \$227.00

API 579-1/ASME FFS-1 ■

Fitness-For-Service

Provides guidance for conducting fitness-for-service assessments using methodologies specifically prepared for pressurized equipment. Fitness-for-service assessments are quantitative engineering evaluations that are performed to demonstrate the structural integrity of in-service components that may contain a flaw or damage, or that may be operating under a specific condition that might cause a failure. The guidelines provided in this standard can be used to make run-repair-replace decisions to help determine if components in pressurized equipment containing flaws that have been identified by inspection can continue to operate safely for some period of time. These fitness-for-service assessments are currently recognized and referenced by API codes and standards (510, 570, and 653), and by NB-23 (National Board Inspection Code) as suitable means for evaluating the structural integrity of pressure vessels, piping systems, and storage tanks where inspection has revealed some level of degradation and/or flaws in the equipment. Pages: 1478

4th Edition | December 2021

Product Number: C57904 | Price: \$1,274.00

API 579-2/ASME FFS-2

Fitness-For-Service Example Problem Manual

Fitness-For-Service (FFS) assessments in API 579-1/ASME FFS-1 are engineering evaluations that are performed to demonstrate the structural integrity of an in-service component that may contain a flaw or damage or that may be operating under specific conditions that could produce a failure. API 579-1/ASME FFS-1 provides guidance for conducting FFS assessments using methodologies specifically prepared for pressurized equipment. The guidelines provided in this standard may be used to make run-repair-replace decisions to help determine if pressurized equipment containing flaws that have been identified by inspection can continue to operate safely for some period of time. These FFS assessments of API 579-1/ASME FFS-1 are currently recognized and referenced by the API Codes and Standards (510, 570, and 653), and by NB-23 as a suitable means for evaluating the structural integrity of pressure vessels, piping systems, and storage tanks where inspection has revealed degradation and flaws in the equipment or where operating conditions suggest that a risk of failure may be present.

Example problems illustrating the use and calculations required for Fitness-For-Service assessments described in API 579-1/ASME FFS-1 are provided in this document. Example problems are provided for all calculation procedures in both SI and U.S. customary units.

An introduction to the example problems in this document is described in Part 2 of this standard. The remaining parts of this document contain the example problems. The parts in this document coincide with the parts in API 579-1/ASME FFS-1. For example, example problems illustrating calculations for local thin areas are provided in Part 5 of this document. This coincides with the assessment procedures for local thin areas contained in Part 5 of API 579-1/ASME FFS-1. Pages: 366

1st Edition | August 2009 | Product Number: C57921 | Price: \$168.00

RP 580 ◆

Risk-Based Inspection

Provides users with the basic minimum and recommended elements for developing, implementing, and maintaining a risk-based inspection (RBI) program. It also provides guidance to owner-users, operators, and designers of pressure-containing equipment for developing and implementing an inspection program. These guidelines include means for assessing an inspection program and its plan. The approach emphasizes safe and reliable operation through risk-prioritized inspection. A spectrum of complementary risk analysis approaches (qualitative through fully quantitative) can be considered as part of the inspection planning process. RBI guideline issues covered include an introduction to the concepts and principles of RBI for risk management and individual sections that describe the steps in applying these principles within the framework of the RBI process. Pages: 94

3rd Edition | February 2016 | Product Number: C58003 | Price: \$287.00

RP 581

Risk-Based Inspection Methodology

(includes Addendum 1 dated April 2019 and Addendum 2 dated October 2020)

Provides quantitative procedures to establish an inspection program using risk-based methods for pressurized fixed equipment including pressure vessel, piping, tankage, pressure relief devices (PRDs), and heat exchanger tube bundles. RP 580 provides guidance for developing Risk-Based Inspection (RBI) programs on fixed equipment in refining, petrochemical, chemical process plants, and oil and gas production facilities. The intent is for RP 580 to introduce the principles and present minimum general guidelines for RBI, while this recommended practice provides quantitative calculation methods to determine an inspection plan.

The calculation of risk outlined in API RP 581 involves the determination of a probability of failure (POF) combined with the consequence of failure (COF). Failure is defined as a loss of containment from the pressure boundary resulting in leakage to the atmosphere or rupture of a pressurized component. Risk increases as damage accumulates during in-service operation as the risk tolerance or risk target is approached and an inspection

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is recommended of sufficient effectiveness to better quantify the damage state of the component. The inspection action itself does not reduce the risk; however, it does reduce uncertainty and therefore allows more accurate quantification of the damage present in the component. Pages: 632

3rd Edition | April 2016 | Product Number: C58103 | Price: \$936.00

API Risk-Based Inspection Software

API RBI software, created by petroleum refinery and chemical plant owner/users for owner/users, finds its basis in API Publication 581, *Base Resource Document—Risk-Based Inspection*. Practical, valuable features are built into the technology, which is based on recognized and generally accepted good engineering practices.

The purposes of the Risk-Based Inspection Program are:

- screen operating units within a plant to identify areas of high risk;
- estimate a risk value associated with the operation of each equipment item in a refinery or chemical process plant based on a consistent methodology;
- prioritize the equipment based on the measured risk;
- design a highly effective inspection program; and
- systematically manage the risks associated with equipment failures.

The RBI method defines the risk of operating equipment as the combination of two separate terms: the consequence of failure and the likelihood of failure.

For more information: e-mail rbi@api.org or call 281-537-8848

RP 582

Welding Guidelines for the Chemical, Oil, and Gas Industries

Provides supplementary guidelines and practices for welding and welding related topics for shop and field fabrication, repair, and modification of the following:

- pressure-containing equipment, such as pressure vessels, heat exchangers, piping, heater tubes, and pressure boundaries of rotating equipment and attachments welded thereto;
- tanks and attachments welded thereto;
- non-removable internals for process equipment;
- structural items attached and related to process equipment;
- other equipment or component items, when referenced by an applicable purchase document.

This document is general in nature and augments the welding requirements of ASME *BPVC* Section IX and similar codes, standards, specifications, and practices, such as those listed in Section 2. The intent of this document is to be inclusive of chemical, oil, and gas industry standards, although there are many areas not covered herein, e.g. pipeline welding and offshore structural welding are intentionally not covered. This document is based on industry experience, and any restrictions or limitations may be waived or augmented by the purchaser. Pages: 38

3rd Edition | May 2016 | Product Number: C58203 | Price: \$149.00

RP 583 ◆

Corrosion Under Insulation and Fireproofing

Covers design, maintenance, inspection, and mitigation practices to address external corrosion under insulation (CUI) and corrosion under fireproofing (CUF). The document discusses the external corrosion of carbon and low-alloy steels under insulation and fireproofing, and external chloride stress corrosion cracking (ECSCC) of austenitic and duplex stainless steels under insulation. Pages: 106

2nd Edition | March 2021 | Product Number: C58302 | Price: \$202.00

RP 584 ◆

Integrity Operating Windows

Explains the importance of integrity operating windows (IOWs) for process safety management and to guide users in how to establish and implement an IOW program for process facilities. It is the intent of the document to provide the user with information and guidance on the work process for the

development and implementation of IOWs to help strengthen the mechanical integrity (MI) program for each process unit. This edition includes a new Annex D, Barriers to Successful IOW Implementation, as a way to assist in improving industry safety and sustainability. Pages: 69

2nd Edition | December 2021 | Product Number: C58402 | Price: \$140.00

RP 585 ◆

Pressure Equipment Integrity Incident Investigation

Provides owner-operators with practices for developing, implementing, sustaining, and enhancing an investigation program for pressure equipment integrity (PEI) incidents. This document describes characteristics of how an effective investigation could be structured so organizations can learn from PEI failures, near-misses, or discoveries. Pages: 52

2nd Edition | April 2021 | Product Number: C58502 | Price: \$149.00

Bull 587

Guidance for the Development of Ultrasonic Examiner Qualification Programs

Provides owner/users with guidelines for developing basic in-house qualification programs to identify industry-qualified UT angle beam examiners that are equivalent to those possessing an ultrasonic angle beam qualification from API (e.g. API QUTE/QUSE Detection and Sizing Tests) for inspection of pressure equipment and piping as required by API 510 and API 570. The availability of high-quality and accurate ultrasonic testing (UT) data is often the cornerstone for weld and base metal discontinuities detection and sizing for equipment integrity assessments. As a result, API has implemented several certification programs to assist in defining the minimum criteria for assessing the performance of UT technicians. Pages: 31

1st Edition | May 2021 | Product Number: C58701 | Price: \$94.00

RP 588

Recommended Practice for Source Inspection and Quality Surveillance of Fixed Equipment

Summarizes the basic body of knowledge that the source inspector typically needs to know to perform as a source inspector for fixed equipment. A secondary purpose is to assist candidates intending to take the API Source Inspection Examination to become certified source inspectors. This recommended practice (RP) outlines the fundamentals of source inspection and may be useful to all personnel conducting such activities to perform their jobs in a competent and ethical manner.

This RP covers the process of specifying the necessary quality surveillance of materials, equipment, and fabrications being supplied for use in the oil, petrochemical, and gas Industry, including upstream, midstream, and downstream segments. This RP may be used as the basis for providing a systematic approach to risk-based source inspection in order to provide confidence that materials and equipment being purchased meet the minimum requirements as specified in the project documents and contractual agreements. Pages: 72

1st Edition | July 2019 | Product Number: C58801 | Price: \$175.00

Bull 590 ■

SCIMI Term, Definition, and Acronym Standardization Work Process

Establishes a work process to manage terms, definitions, and acronyms in documents published by the API Committee on Refining Equipment (CRE) Subcommittee on Inspection and Mechanical Integrity (SCIMI). The work processes described in this publication shall be used when SCIMI develops new standards or new terms, definitions, and acronyms in existing standards. The work processes shall also be used to verify accuracy and consistent use of terms, definitions, and acronyms when an existing SCIMI document is revised. Pages: 12

1st Edition | November 2022 | Product Number: C59001 | Price: \$69.00

Std 653 ♦

Tank Inspection, Repair, Alteration, and Reconstruction

(includes Addendum 1 dated April 2018, Addendum 2 dated May 2020, and Errata 1 dated March 2020)

Covers steel storage tanks built to Std 650 and its predecessor Spec 12C. It provides minimum requirements for maintaining the integrity of such tanks after they have been placed in service and addresses inspection, repair, alteration, relocation, and reconstruction.

The scope is limited to the tank foundation, bottom, shell, structure, roof, attached appurtenances, and nozzles to the face of the first flange, first threaded joint, or first welding-end connection. Many of the design, welding, examination, and material requirements of Std 650 can be applied in the maintenance inspection, rating, repair, and alteration of in-service tanks. In the case of apparent conflicts between the requirements of this standard and Std 650 or its predecessor Spec 12C, this standard shall govern for tanks that have been placed in service.

This standard employs the principles of Std 650; however, storage tank owner/operators, based on consideration of specific construction and operating details, may apply this standard to any steel tank constructed in accordance with a tank specification.

This standard is intended for use by organizations that maintain or have access to engineering and inspection personnel technically trained and experienced in tank design, fabrication, repair, construction, and inspection.

This standard does not contain rules or guidelines to cover all the varied conditions which may occur in an existing tank. When design and construction details are not given, and are not available in the as-built standard, details that will provide a level of integrity equal to the level provided by the current edition of Std 650 must be used.

This standard recognizes fitness-for-service assessment concepts for evaluating in-service degradation of pressure containing components. API 579-1/ASME FFS-1, *Fitness-For-Service*, provides detailed assessment procedures or acceptance criteria for specific types of degradation referenced in this standard. When this standard does not provide specific evaluation procedures or acceptance criteria for a specific type of degradation or when this standard explicitly allows the use of fitness-for-service criteria, API 579-1/ASME FFS-1 may be used to evaluate the various types of degradation or test requirements addressed in this standard. Pages: 162

5th Edition | November 2014 | Product Number: C65305 | Price: \$255.00

Std 653 *

Tank Inspection, Repair, Alteration, and Reconstruction—Chinese

(includes Addendum 1 dated April 2018, Addendum 2 dated May 2020, and Errata 1 dated March 2020)

Chinese translation of Std 653.

5th Edition | November 2014 | Product Number: C65305C | Price: \$255.00

Std 653 *

Tank Inspection, Repair, Alteration, and Reconstruction—Portuguese

(includes Addendum 1 dated April 2018, Addendum 2 dated May 2020, and Errata 1 dated March 2020)

Portuguese translation of Std 653.

5th Edition | November 2014 | Product Number: C65305P | Price: \$255.00

MECHANICAL EQUIPMENT STANDARDS FOR REFINERY SERVICE

Std 610

Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries

Specifies requirements for centrifugal pumps, including pumps running in reverse as hydraulic power recovery turbines, for use in petroleum, petrochemical, and gas industry process services. This document is applicable to overhung pumps, between bearings pumps, and vertically suspended

pumps. This document also provides requirements applicable to specific types of pumps. Illustrations are provided of the various specific pump types and the designations assigned to each specific pump type. Pages: 233

12th Edition | January 2021 | Product Number: C61012 | Price: \$175.00

Std 611 ■

General-Purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services

Covers the minimum requirements for general-purpose steam turbines. These requirements include basic design, materials, related lubrication systems, controls, auxiliary equipment, and accessories for use in the petroleum, chemical, and gas industry services. This standard includes only general-purpose turbines. General-purpose turbines are horizontal or vertical turbines used to drive equipment that is usually spared or is in noncritical service. They are generally used where steam conditions will not exceed a pressure of 48 bar (700 psig) and a temperature of 400 °C (750 °F). Pages: 150

6th Edition | June 2022 | Product Number: C61106 | Price: \$175.00

Std 612

Petroleum Petrochemical, and Natural Gas Industries—Steam Turbines—Special-Purpose Applications

Specifies the minimum requirements for steam turbines for special-purpose applications for use in the petroleum, petrochemical, and natural gas industries. These requirements include basic design, materials, fabrication, inspection testing, and preparation for shipment. It also covers the related lube oil systems, instrumentation, control systems, and auxiliary equipment. It is not applicable to general-purpose steam turbines, which are covered in Std 611. Pages: 199

8th Edition | November 2020 | Product Number: C61208 | Price: \$263.00

Std 613

Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services

(ANSI/API Std 613)

Covers the minimum requirements for special-purpose, enclosed, precision single- and double-helical one- and two-stage speed increasers and reducers of parallel-shaft design for refinery services. This standard is primarily intended for gear units that are in continuous service without installed spare equipment. Pages: 124

6th Edition | July 2021 | Product Number: C61306 | Price: \$250.00

Std 614 ■

Lubrication, Shaft-Sealing, and Control-Oil Systems and Auxiliaries

Covers the minimum requirements for lubrication systems, oil-type shaft-sealing systems, oil-control systems, and auxiliaries, excluding dry gas seal systems and fuel systems. These systems can serve individual equipment such as compressors, gears, pumps, and drivers or complete trains. Pages: 246

6th Edition | February 2022 | Product Number: CX61405 | Price: \$350.00

Std 616 ■

Gas Turbines for the Petroleum, Chemical and Gas Industry Services

Covers the minimum requirements for open-, simple-, and regenerative-cycle combustion gas turbine units for services of mechanical drive, generator drive, or process gas generation. All auxiliary equipment required for operating, starting, controlling, and protecting gas turbine units is either discussed directly in this standard or referred to in this standard through references to other publications. Specifically, gas turbine units that are capable of firing gas or liquid or both are covered by this standard. This standard covers both industrial and aeroderivative gas turbines. Pages: 286

6th Edition | September 2022 | Product Number: C61606 | Price: \$245.00

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Std 617 ■

Axial and Centrifugal Compressors and Expander-Compressors

Specifies minimum requirements and gives recommendations for axial compressors, single-shaft and integrally geared process centrifugal compressors, and expander-compressors for special-purpose applications that handle gas or process air in the petroleum, chemical, and gas industries. Pages: 348

9th Edition | April 2022 | Product Number: C61709 | Price: \$286.00

Std 618

Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services

(ANSI/API Std 618)

(includes Errata 1 dated November 2009 and Errata 2 dated July 2010)

Covers the minimum requirements for reciprocating compressors and their drivers used in petroleum, chemical, and gas industry services for handling process air or gas with either lubricated or nonlubricated cylinders. Compressors covered by this standard are of low to moderate speed and in critical services. Also covered are related lubricating systems, controls, instrumentation, intercoolers, aftercoolers, pulsation suppression devices, and other auxiliary equipment. Pages: 190

5th Edition | December 2007 | Reaffirmed: July 2017

Product Number: C61805 | Price: \$196.00

Std 618 *

Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services—Russian

(ANSI/API Std 618)

(includes Errata 1 dated November 2009 and Errata 2 dated July 2010)

Russian translation of Std 618.

5th Edition | December 2007 | Reaffirmed: July 2017

Product Number: C61805R | Price: \$196.00

Std 619/ISO 10440-1:2007

Rotary-Type Positive Displacement Compressors for Petroleum, Petrochemical and Natural Gas Industries

(includes Errata 1 to datasheets dated August 2018)

Specifies requirements for dry and oil-flooded, helical-lobe rotary compressors used for vacuum or pressure or both in petroleum, petrochemical, and gas industry services. It is intended for compressors that are in special-purpose applications. It is not applicable to general-purpose air compressors, liquid-ring compressors, or vane-type compressors.

This edition of API Std 619 is the identical national adoption of ISO 10440-1:2007. Pages: 135

5th Edition | December 2010 | Product Number: CX61905 | Price: \$234.00

Std 619/ISO 10440-1:2007 *

Rotary-Type Positive Displacement Compressors for Petroleum, Petrochemical and Natural Gas Industries—Russian

(includes Errata 1 to datasheets dated August 2018)

Russian translation of Std 619/ISO 10440-1:2007.

5th Edition | December 2010

Product Number: CX61905R | Price: \$234.00

Std 670

Machinery Protection Systems

Provides a purchase specification to facilitate the manufacture, procurement, installation, and testing of vibration, axial-position, and bearing temperature monitoring systems for petroleum, chemical, and gas industry services. Covers the minimum requirements for monitoring radial shaft vibration, casing vibration, shaft axial position, and bearing temperatures. It outlines a standardized monitoring system and covers requirements for hardware (sensors and instruments), installation, testing, and arrangement. Pages: 244

5th Edition | November 2014 | Reaffirmed: May 2022

Product Number: C67005 | Price: \$212.00

Std 670 *

Machinery Protection Systems—Russian

Russian translation of Std 670.

5th Edition | November 2014 | Product Number: C67005R | Price: \$212.00

Std 671

Special Purpose Couplings for Petroleum, Chemical, and Gas Industry Services

Specifies the requirements for couplings for the transmission of power between the rotating shafts of two machines in special-purpose applications in the petroleum, petrochemical and natural gas industries. Such applications are typically in large and/or high speed machines, in services that can be required to operate continuously for extended periods, are often unspared and are critical to the continued operation of the installation. By agreement, it can be used for other applications or services.

Couplings covered are designed to accommodate parallel (or lateral) offset, angular misalignment and axial displacement of the shafts without imposing unacceptable mechanical loading on the coupled machines. It is applicable to gear, metallic flexible element, quill shaft and torsionally resilient type couplings. Torsional damping and resilient type couplings are detailed in Annex A; gear-type couplings are detailed in Annex B and quill shaft style coupling are detailed in Annex C. Also covers the design, materials of construction, manufacturing quality, inspection and testing special purpose couplings. Pages: 103

5th Edition | August 2020 | Product Number: C67105 | Price: \$253.00

Std 672

Packaged, Integrally Geared Centrifugal Air Compressors for Petroleum, Chemical, and Gas Industry Services

Covers the minimum requirements for constant-speed, packaged, general purpose integrally geared centrifugal air compressors, including their accessories. This standard is not applicable to machines that develop a pressure rise of less than 0.35 bar (5.0 psi) above atmospheric pressure, which are classed as fans or blowers. Pages: 125

5th Edition | August 2019 | Product Number: C67205 | Price: \$315.00

Std 673

Centrifugal Fans for Petroleum, Chemical, and Gas Industry Services

Covers the minimum requirements for centrifugal fans for use in petroleum, chemical, and gas industry services. Fan static pressure rise is limited to differential usually not exceeding 130 in. (330 cm) of water equivalent air pressure from a single impeller or each impeller in a two stage fan. This standard does not apply to axial flow, aerial cooler, cooling tower, and ventilation fans and positive displacement blowers.

This standard covers equipment for both general purpose and special purpose applications. The purchaser shall determine which classification applies. Refer to Section 3 for definition of the terms general purpose and special purpose.

Additional or overriding requirements applicable to special purpose applications are included at the end of each section (e.g. 6.7.5, etc.). Pages: 113

3rd Edition | December 2014 | Product Number: C67303 | Price: \$184.00

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Std 673 *

Centrifugal Fans for Petroleum, Chemical, and Gas Industry Services—Russian

Russian translation of Std 673.

3rd Edition | December 2014

Product Number: C67303R | Price: \$184.00

Std 674

Positive Displacement Pumps—Reciprocating

(includes Errata 1 dated May 2014 and Errata 2 dated April 2015)

Covers the minimum requirements for reciprocating positive displacement pumps and pump units for use in the petroleum, petrochemical, and gas industry services. Both direct-acting and power-frame types are included. Controlled-volume pumps, hydraulically driven pumps, and rotary pumps are not included. Pages: 95

3rd Edition | December 2010 | Reaffirmed: November 2016

2-Year Extension: November 2015

Product Number: C67403 | Price: \$202.00

Std 674 *

Positive Displacement Pumps—Reciprocating—Russian

(includes Errata 1 dated May 2014 and Errata 2 dated April 2015)

Russian translation of Std 674.

3rd Edition | December 2010 | Reaffirmed: November 2016

Product Number: C67403R | Price: \$202.00

Std 675

Positive Displacement Pumps—Controlled Volume for Petroleum, Chemical, and Gas Industry Services

(includes Errata 1 dated June 2014 and Errata 2 dated April 2015)

Covers the minimum requirements for reciprocating, controlled volume pumps, and pump units for use in the petroleum, petrochemical, and gas industry services. These pumps are either hydraulic diaphragm or packed plunger design. Rotary positive displacement pumps are not included. Diaphragm pumps that use direct mechanical actuation are also excluded.

NOTE See Std 674 for positive displacement reciprocating pumps and Std 670 for positive displacement rotary pumps.

This standard requires the purchaser to specify certain details and features. A bullet (•) at the beginning of a paragraph indicates that either a decision by, or further information from, the purchaser is required. Further information should be shown on the datasheets (see example in Annex A) or stated in the quotation request and purchase order. Pages: 64

3rd Edition | November 2012 | Reaffirmed: July 2021

Product Number: C67503 | Price: \$138.00

Std 675 *

Positive Displacement Pumps—Controlled Volume for Petroleum, Chemical, and Gas Industry Services—Russian

(includes Errata 1 dated June 2014 and Errata 2 dated April 2015)

Russian translation of Std 675.

3rd Edition | November 2012 | Reaffirmed: July 2021

Product Number: C67503R | Price: \$138.00

Std 676 ■

Positive Displacement Pumps—Rotary

Covers the minimum requirements for rotary positive displacement process pumps and pump units for use in the petroleum, petrochemical, and gas industry services. Controlled-volume pumps, hydraulically driven pumps and positive displacement reciprocating pumps are not included. Pages: 101

4th Edition | February 2022 | Product Number: C67604 | Price: \$179.00

Std 677

General-Purpose, Extruder, and Epicyclic Gear Units for Petroleum, Chemical, and Gas Industry Services

Covers the minimum requirements for general-purpose, enclosed single and multistage gear units incorporating parallel shaft spur, and helical gears for use in the petroleum, chemical, and gas industry services. General-purpose and extruder gears manufactured according to this standard are limited to pitch line velocities that do not exceed 60 m/s (12,000 ft/min). Pages: 188

4th Edition | September 2021 | Product Number: C67704 | Price: \$194.00

Std 681

Liquid Ring Compressors and Vacuum Pumps in Petroleum, Chemical, and Gas Industry Services

Defines the minimum requirements for the basic design, inspection, testing, and preparation for shipment of liquid ring vacuum pump and compressor systems for service in the petroleum, chemical, and gas industries. It includes both vacuum pump and compressor design and system design. Pages: 151

2nd Edition | July 2021 | Product Number: C68102 | Price: \$175.00

Std 682

Pumps—Shaft Sealing Systems for Centrifugal and Rotary Pumps

Specifies requirements and gives recommendations for sealing systems for centrifugal and rotary pumps used in the petroleum, natural gas, and chemical industries. See A.1.1 and A.1.2. It is the responsibility of the purchaser or seal vendor to ensure that the selected seal and auxiliaries are suitable for the intended service condition. It is applicable mainly for hazardous, flammable, and/or toxic services where a greater degree of reliability is required for the improvement of equipment availability and the reduction of both emissions to the atmosphere and life-cycle sealing costs. It covers seals for pump shaft diameters from 20 mm (0.75 in.) to 110 mm (4.3 in.). This standard is also applicable to seal spare parts and can be referred to for the upgrading of existing equipment. A classification system for the seal configurations covered by this standard into categories, types, arrangements, and orientations is provided.

This standard is referenced normatively in Std 610. It is applicable to both new and retrofitted pumps and to pumps other than Std 610 pumps (e.g. ASME B73.1, ASME B73.2, and Std 676 pumps). This standard might also be referenced by other machinery standards such as other pumps, compressors, and agitators. Users are cautioned that this standard is not specifically written to address all of the potential applications that a purchaser may specify. This is especially true for the size envelope specified for Std 682 seals. The purchaser and seal vendor shall mutually agree on the features taken from this standard and used in the application. Pages: 256

4th Edition | May 2014 | Reaffirmed: May 2022

Product Number: C68204 | Price: \$277.00

Std 682 *

Pumps—Shaft Sealing Systems for Centrifugal and Rotary Pumps—Chinese

Chinese translation of Std 682.

4th Edition | May 2014 | Reaffirmed: May 2022

Product Number: C68204C | Price: \$277.00

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Std 682 *

Pumps—Shaft Sealing Systems for Centrifugal and Rotary Pumps—Russian

Russian translation of Std 682.

4th Edition | May 2014 | Reaffirmed: May 2022

Product Number: C68204R | Price: \$277.00

RP 684

API Standard Paragraphs Rotordynamic Tutorial: Lateral Critical Speeds, Unbalance Response, Stability, Train Torsionals, and Rotor Balancing

Describes, discusses, and clarifies the section of the API Standard Paragraphs that outline the complete lateral and torsional rotordynamics and rotor balancing acceptance program designed by API to ensure equipment mechanical reliability. Background material on the fundamentals of these subjects (including terminology) along with rotor modeling utilized in this analysis is presented for those unfamiliar with the subject. This document is an introduction to the major aspects of rotating equipment vibrations that are addressed during a typical lateral dynamics analysis. Pages: 303

2nd Edition | August 2005 | Reaffirmed: November 2010

Product Number: C68402 | Price: \$191.00

TR 684-1

API Standard Paragraphs Rotordynamic Tutorial: Lateral Critical Speeds, Unbalance Response, Stability, Train Torsionals, and Rotor Balancing

Describes, discusses, and clarifies the section of the API Standard Paragraphs that outlines the complete rotordynamics acceptance program. The acceptance program was designed by API to ensure mechanical reliability of equipment. This document is an introduction to the major aspects of rotating equipment vibrations that are addressed during a typical lateral dynamics analysis. Pages: 538

1st Edition | November 2019 | Product Number: C684101 | Price: \$245.00

Std 685 ■

Sealless Centrifugal Pumps for Petroleum, Petrochemical, and Gas Industry Process Service

Covers the minimum requirements for sealless centrifugal pumps for use in petroleum, heavy-duty petrochemical, and gas industry services. It is applicable to single-stage overhung pumps of two classifications, magnetic drive pumps (MDPs) and canned motor pumps (CMPs). Sections 2 through 8 and Section 10 cover requirements applicable to both classifications. Section 9 is divided into two subsections and covers requirements unique to each classification. Pages: 197

3rd Edition | July 2022 | Product Number: C68503 | Price: \$245.00

RP 686

Recommended Practice for Machinery Installation and Installation Design

Provides recommended procedures, practices, and checklists for the installation and precommissioning of new, existing, and reapplied machinery and to assist with the installation design of such machinery for petroleum, chemical, and gas industry services facilities. In general, this RP is intended to supplement vendor instructions and the instructions provided by the original equipment manufacturer (OEM) should be carefully followed with regard to equipment installation and checkout. Most major topics of this RP are subdivided into sections of "Installation Design" and "Installation" with the intent being that each section can be removed and used as needed by the appropriate design or installation personnel. Pages: 254

2nd Edition | December 2009 | Reaffirmed: November 2014

Product Number: C68602 | Price: \$203.00

RP 687

Rotor Repair

Covers the minimum requirements for the inspection and repair of special purpose rotating equipment rotors, bearings and couplings used in petroleum, chemical, and gas industry service. Pages: 540

1st Edition | September 2001 | Reaffirmed: March 2015

Product Number: C68701 | Price: \$289.00

RP 688

Pulsation and Vibration Control in Positive Displacement Machinery Systems for Petroleum, Petrochemical, and Natural Gas Industry Services

Provides guidance on the application of pulsation and vibration control requirements found in the API purchasing specifications for positive displacement machinery. The fundamentals of pulsation and piping system analysis are presented in Part 1. Part 2 deals specifically with reciprocating compressors and provides commentary regarding each paragraph of Section 7.9 of Std 618, 5th Edition. Pages 128

1st Edition | April 2012 | Reaffirmed: July 2021

Product Number: C68801 | Price: \$170.00

RP 691

Risk-Based Machinery Management

Defines the minimum requirements for the management of health, safety, and environmental (HSE) risks across the machinery life cycle. It shall be applied to the subset of operating-company- and/or vendor-defined high-risk machinery. Pages: 198

1st Edition | June 2017 | Product Number: C69101 | Price: \$177.00

Std 692

Dry Gas Sealing Systems for Axial, Centrifugal, and Rotary Screw Compressors and Expanders

Covers the minimum dry gas sealing system requirements in association with axial, centrifugal, and rotary screw compressors and expanders for use in the petroleum, chemical, and gas industry services as described in API 617 and API 619. Pages: 258

1st Edition | June 2018 | Product Number: C69201 | Price: \$179.00

EQUIPMENT DATASHEETS

Electronically formatted mechanical equipment standards datasheets are now available in electronic format (Excel 5.0 spreadsheets):

All of the following datasheets are available for single user at \$65.00 each or for intranet licensing at \$317.00 each.

Std 610, 12th Edition	Std 660, 9th Edition	Std 675, 3rd Edition
Std 611, 6th Edition	Std 661, 7th Edition	Std 676, 4th Edition
Std 612, 8th Edition	Std 663, 2nd Edition	Std 677, 4th Edition
Std 613, 6th Edition	Std 664, 1st Edition	Std 681, 2nd Edition
Std 614, 6th Edition	Std 670, 5th Edition	Std 682, 4th Edition
Std 616, 6th Edition	Std 671, 5th Edition	Std 685, 3rd Edition
Std 617, 9th Edition	Std 672, 5th Edition	Std 687, 1st Edition
Std 618, 5th Edition	Std 673, 3rd Edition	
Std 619, 5th Edition	Std 674, 3rd Edition	

Mechanical Equipment Residual Unbalance Worksheets

Electronic versions of the residual unbalance worksheets that appear in mechanical equipment standards (Excel) along with instructions (Word).

Price: \$124.00

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The American Petroleum Institute Specification Database Software™ provides a knowledge-management toolset for the project engineering team. Facilitates the entire equipment specification process including the entry of process data and release to design to the final entry of mechanical datasheets and development of the technical bid specification package. Electronic outputs can be combined to form a master technical specification bid package for quotation and purchasing purposes with a modern tree-view format for ease of navigation. Completed projects provide on-going documentation for plant equipment assets—improving safety and reliability. Available in a full-featured corporate wide Oracle® format or a portable ODBC database format with primary focus on equipment datasheets.

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STORAGE TANKS

Impact of Gasoline Blended with Ethanol on the Long-Term Structural Integrity of Liquid Petroleum Storage Systems and Components

Summarizes the results of a literature review conducted for the American Petroleum Institute on the impact of gasoline blended with ethanol on the long-term structural integrity of liquid petroleum storage systems and components. It is anticipated that the use of ethanol in motor fuels will continue to increase. This has generated interest about the potential long-term structural effects of ethanol on liquid petroleum storage systems, including underground storage tanks (USTs), underground piping, and associated components. The objective of the literature review is to determine the state of industry knowledge and research on the effects of ethanol/gasoline blends on the long-term structural integrity of UST systems and components. This review is intended to assist decision-makers on further research requirements and needed changes or supplements to existing standards for underground storage system components used for storing and dispensing gasoline blended with ethanol. Appendix A may be purchased separately as an electronic database file. The database synopsis' and bibliographic information for all articles reviewed for the project. The report is organized by article index number. Reference numbers cited in this report refer to the article index number. Pages: 25

January 2003 | Executive Summary | Price: \$71.00
Appendix A—Literature Review | Price \$138.00

Spec 12B ♦

Specification for Bolted Tanks for Storage of Production Liquids

Covers material, design, fabrication, and testing requirements for vertical, cylindrical, aboveground, closed and open-top, bolted steel storage tanks in various standard sizes and capacities with internal pressures approximating atmospheric pressure. This specification is designed to provide the oil production industry with safe and economical bolted tanks of adequate safety and reasonable economy for use in the storage of crude petroleum and other liquids commonly handled and stored by the production segment of the industry. Pages: 30

17th Edition | December 2020
Product Number: G12B17 | Price: \$143.00

Spec 12D ♦

Specification for Field-Welded Tanks for Storage of Production Liquids

Covers material, design, fabrication, and testing requirements for vertical, cylindrical, aboveground, closed top, welded steel storage tanks with internal pressures approximately atmospheric at various sizes and capacities ranging from 500 to 10,000 barrels. This specification is designed to provide the oil production industry with tanks of adequate safety and reasonable economy for use in the storage of crude petroleum and other liquids commonly handled and stored by the production segment of the industry. This specification is for the convenience of purchasers and manufacturers in ordering and fabricating tanks. Pages: 29

12th Edition | June 2017 | Effective Date: December 1, 2017
Product Number: G12D12 | Price: \$116.00

Spec 12F ♦

Specification for Shop-Welded Tanks for Storage of Production Liquids

Covers material, design, fabrication, and testing requirements for new shop-fabricated vertical, cylindrical, aboveground, welded steel storage tanks in the standard sizes and capacities, and for internal pressures approximately atmospheric, given in Table 1.

This specification is designed to provide the oil production industry with tanks of adequate safety and reasonable economy for use in the storage of crude petroleum and other liquids commonly handled and stored by the production segment of the industry. This specification is for the convenience of purchasers and manufacturers in ordering and fabricating tanks. Pages: 35

13th Edition | January 2019 | Effective Date: July 1, 2019
Product Number: G12F13 | Price: \$146.00

Spec 12P ♦

Specification for Fiberglass Reinforced Plastic Tanks

Covers material, design, fabrication, and testing requirements for fiberglass reinforced plastic (FRP) tanks. Only shop-fabricated, vertical, cylindrical tanks are covered. Tanks covered by this specification are intended for above ground and atmospheric pressure service. This specification applies to new tanks. The requirements may be applied to existing tanks at the discretion of the owner/operator.

This specification is designed to provide the petroleum industry with various standard sizes of FRP tanks. Because of the versatility of FRP tanks, the user shall be responsible for determining the suitability of FRP tanks for the intended service. Unsupported cone bottom tanks are outside the scope of this specification. Pages: 27

4th Edition | February 2016 | Effective Date: August 1, 2016
Product Number: G12P04 | Price: \$117.00

Std 12R1

Installation, Operation, Maintenance, Inspection, and Repair of Tanks in Production Service (includes Addendum 1 dated June 2021)

For use as a guide for new tank installations and maintenance of existing tanks, Spec 12R1 contains recommendations for good practices in the collection of well or lease production; gauging; delivery to pipeline carriers for transportation; and other production storage and treatment operations. This recommended practice is intended primarily for application to tanks fabricated to Specs 12F, 12D, 12E, and 12P when employed in on-land production service, but its basic principles are applicable to atmospheric tanks of other dimensions and specifications when they are employed in similar oil and gas production, treating, and processing services. It is not applicable to refineries, petrochemical plants, marketing bulk stations, or pipeline storage facilities operated by carriers. Pages: 53

6th Edition | March 2020 | Product Number: G12R16 | Price: \$157.00

Std 620

Design and Construction of Large, Welded, Low-Pressure Storage Tanks (includes Addendum 1 dated November 2014, Addendum 2 dated April 2018, and Addendum 3 dated September 2021)

Covers the design and construction of large field-assembled, welded, low-pressure carbon steel above ground storage tanks (including flat-bottom tanks) that have a single vertical axis of revolution, that contain petroleum intermediates (gases or vapors) and finished products, as well as other liquid products commonly handled and stored by the various branches of the industry.

Covered are tanks designed for metal temperatures not greater than 250 °F and with pressures in their gas or vapor spaces not more than 15 pounds per square inch gauge. The basic rules in this standard provide for installation in areas where the lowest recorded 1-day mean atmospheric temperature is -50 °F. Annex S covers stainless steel low-pressure storage tanks in ambient temperature service in all areas, without limit on low temperatures. Annex R

Refining

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Covers low-pressure storage tanks for refrigerated products at temperatures from +40 °F to -60 °F. Annex Q covers low-pressure storage tanks for liquefied gases at temperatures not lower than -325 °F.

This standard is applicable to tanks that (a) hold or store liquids with gases or vapors above their surface or (b) hold or store gases or vapors alone. These rules do not apply to lift-type gas holders.

Although the rules in this standard do not cover horizontal tanks, they are not intended to preclude the application of appropriate portions to the design and construction of horizontal tanks designed in accordance with good engineering practice. Pages: 288

12th Edition | October 2013 | Product Number: C62012 | Price: \$471.00

Std 620 * Design and Construction of Large, Welded, Low-Pressure Storage Tanks—Chinese

(includes Addendum 1 dated November 2014, Addendum 2 dated April 2018, and Addendum 3 dated September 2021)

Chinese translation of Std 620.

12th Edition | October 2013 | Product Number: C62012C | Price: \$471.00

Std 625 Tank Systems for Refrigerated Liquefied Gas Storage

(includes Addendum 1 dated July 2013, Addendum 2 dated November 2014, Addendum 3 dated June 2018, and Addendum 4 dated September 2021)

Covers low pressure, aboveground, vertical, and cylindrical tank systems storing liquefied gases requiring refrigeration. This standard provides general requirements on responsibilities, selection of storage concept, performance criteria, accessories/appurtenances, quality assurance, insulation, and commissioning of tank systems. Included are tank systems having a storage capacity of 800 cubic meters (5000 bbls) and larger. Stored product shall be liquids which are in a gaseous state at ambient temperature and pressure and require refrigeration to less than 5 °C (40 °F) to maintain a liquid phase. Also covered are tank systems with a minimum design temperature of -198 °C (-325 °F), a maximum design internal pressure of 50 kPa (7 psig), and a maximum design uniform external pressure of 1.75 kPa (0.25 psig).

Tank system configurations covered consist of a primary liquid and vapor containment constructed of metal, concrete, or a metal/concrete combination and, when required, a secondary liquid containment. Pages: 63

1st Edition | August 2010 | Product Number: C62501 | Price: \$251.00

Std 650 ♦ Welded Tanks for Oil Storage (includes Errata 1 dated January 2021)

Establishes minimum requirements for material, design, fabrication, erection, and testing for vertical, cylindrical, aboveground, closed- and open-top, welded carbon, or stainless steel storage tanks in various sizes and capacities for internal pressures approximating atmospheric pressure (internal pressures not exceeding the weight of the roof plates), but a higher internal pressure is permitted when addition requirements are met. This standard applies only to tanks whose entire bottom is uniformly supported and to tanks in non-refrigerated service that have a maximum design temperature of 93 °C (200 °F) or less. Pages: 514

13th Edition | March 2020 | Product Number: C65013 | Price: \$565.00

RP 651 ♦ Cathodic Protection of Aboveground Petroleum Storage Tanks

Presents procedures and practices for achieving effective corrosion control on aboveground storage tank bottoms through the use of cathodic protection. This RP contains provisions for the application of cathodic

protection to existing and new aboveground storage tanks. Corrosion control methods based on chemical control of the environment or the use of protective coatings are not covered in detail.

When cathodic protection is used for aboveground storage tank applications, it is the intent of this RP to provide information and guidance specific to aboveground metallic storage tanks in hydrocarbon service. Certain practices recommended herein may also be applicable to tanks in other services. It is intended to serve only as a guide to persons interested in cathodic protection. Specific cathodic protection designs are not provided. Such designs should be developed by a person thoroughly familiar with cathodic protection practices for aboveground petroleum storage tanks.

This RP does not designate specific practices for every situation because the varied conditions in which tank bottoms are installed preclude standardization of cathodic protection practices. Pages: 46

4th Edition | September 2014 | Product Number: C65104 | Price: \$136.00

RP 651 * Cathodic Protection of Aboveground Petroleum Storage Tanks—Chinese

Chinese translation of RP 651.

4th Edition | September 2014
Product Number: C65104C | Price: \$136.00

RP 652 ♦ Linings of Aboveground Petroleum Storage Tank Bottoms

Provides guidance on achieving effective corrosion control by the application of tank bottom linings in aboveground storage tanks in hydrocarbon service. It contains information pertinent to the selection of lining materials, surface preparation, lining application, cure, and inspection of tank bottom linings for existing and new storage tanks. In many cases, tank bottom linings have proven to be an effective method of preventing internal corrosion of steel tank bottoms.

Provides information and guidance specific to aboveground steel storage tanks in hydrocarbon service. Certain practices recommended herein may also be applicable to tanks in other services. This recommended practice is intended to serve only as a guide and detailed tank bottom lining specifications are not included.

This recommended practice does not designate specific tank bottom linings for every situation because of the wide variety of service environments. Pages: 40

5th Edition | May 2020 | Product Number: C65205 | Price: \$155.00

Std 653 ♦ Tank Inspection, Repair, Alteration, and Reconstruction (includes Addendum 1 dated April 2018, Addendum 2 dated May 2020, and Errata 1 dated March 2020)

Covers steel storage tanks built to Std 650 and its predecessor Spec 12C. It provides minimum requirements for maintaining the integrity of such tanks after they have been placed in service and addresses inspection, repair, alteration, relocation, and reconstruction.

The scope is limited to the tank foundation, bottom, shell, structure, roof, attached appurtenances, and nozzles to the face of the first flange, first threaded joint, or first welding-end connection. Many of the design, welding, examination, and material requirements of Std 650 can be applied in the maintenance inspection, rating, repair, and alteration of in-service tanks. In the case of apparent conflicts between the requirements of this standard and Std 650 or its predecessor Spec 12C, this standard shall govern for tanks that have been placed in service.

This standard employs the principles of Std 650; however, storage tank owner/operators, based on consideration of specific construction and operating details, may apply this standard to any steel tank constructed in accordance with a tank specification.

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This standard is intended for use by organizations that maintain or have access to engineering and inspection personnel technically trained and experienced in tank design, fabrication, repair, construction, and inspection.

This standard does not contain rules or guidelines to cover all the varied conditions which may occur in an existing tank. When design and construction details are not given, and are not available in the as-built standard, details that will provide a level of integrity equal to the level provided by the current edition of Std 650 must be used.

This standard recognizes fitness-for-service assessment concepts for evaluating in-service degradation of pressure containing components. API 579-1/ASME FFS-1, *Fitness-For-Service*, provides detailed assessment procedures or acceptance criteria for specific types of degradation referenced in this standard. When this standard does not provide specific evaluation procedures or acceptance criteria for a specific type of degradation or when this standard explicitly allows the use of fitness-for-service criteria, API 579-1/ASME FFS-1 may be used to evaluate the various types of degradation or test requirements addressed in this standard. Pages: 162

5th Edition | November 2014 | Product Number: C65305 | Price: \$255.00

Std 653 *

Tank Inspection, Repair, Alteration, and Reconstruction—Chinese
(includes Addendum 1 dated April 2018, Addendum 2 dated May 2020, and Errata 1 dated March 2020)

Chinese translation of Std 653.

5th Edition | November 2014 | Product Number: C65305C | Price: \$255.00

Std 653 *

Tank Inspection, Repair, Alteration, and Reconstruction—Portuguese
(includes Addendum 1 dated April 2018, Addendum 2 dated May 2020, and Errata 1 dated March 2020)

Portuguese translation of Std 653.

5th Edition | November 2014 | Product Number: C65305P | Price: \$255.00

TR 654

Aboveground Storage Tank Caulking or Sealing the Bottom Edge Projection to the Foundation

Provides guidance to owner/operators that have tanks that are set on a foundation system with the goal to protect the asset from deterioration by minimizing corrosion and foundation deterioration and allowing for proper support of the tank shell. The asset includes the tank itself, as well as the foundation system.

This document does not require that caulking or sealants be installed at the bottom edge projection and the foundation of aboveground storage tanks. It provides guidance in situations in which caulking or sealants may be advantageous and should be considered.

This technical report applies to situations where an owner/operator is considering caulk or sealant in this area, or if any regulatory agency requires or recommends that an owner/operator installs some type of caulk or sealant. This document will also consider how to inspect existing caulk and sealant, including maintenance procedures, and includes a suggested inspection schedule. Pages: 23

1st Edition | May 2019 | Product Number: C65401 | Price: \$115.00

TR 655

Vapor Corrosion Inhibitors for Storage Tanks

Provides details on utilizing vapor corrosion inhibitors (VCIs) for protection of the soil side of tank bottoms. Pages: 28

1st Edition | April 2021 | Product Number: C65501 | Price: \$72.00

Publ 937

Evaluation of Design Criteria for Storage Tanks with Frangible Roof Joints

Describes research that evaluated the ability of the present Std 650 tank design criteria to ensure the desired frangible joint behavior. Particular questions include:

- evaluation of the area inequality as a method to predict the buckling response of the compression ring,
- effect of roof slope, tank diameter, and weld size on the frangible joint, and
- effect of the relative strength of the roof-to-shell joint compared to the shell-to-bottom joint. Pages: 73

1st Edition | April 1996 | Product Number: C93701 | Price: \$146.00

Publ 937-A

Study to Establish Relations for the Relative Strength of API 650 Cone Roof, Roof-to-Shell and Shell-to-Bottom Joints

Investigates the relative strengths of the roof-to-shell and shell-to-bottom joints, with the goal of providing suggestions for frangible roof design criteria applicable to smaller tanks. Pages: 68

1st Edition | August 2005 | Product Number: C937A0 | Price: \$133.00

TR 939-D

Stress Corrosion Cracking of Carbon Steel in Fuel Grade Ethanol—Review, Experience Survey, Field Monitoring, and Laboratory Testing
(includes Addendum 1 dated October 2013)

Addresses stress corrosion cracking (SCC) in carbon steel equipment used in distribution, transportation, storage, and blending of denatured fuel ethanol. API, with assistance from the Renewable Fuels Association (RFA), conducted research on the potential for metal cracking and product leakage in certain portions of the fuel ethanol distribution system. TR 939-D contains a review of existing literature, results of an industry survey on cracking events and corrosion field monitoring, and information on mitigation and prevention. Pages: 172

2nd Edition | May 2007 | Product Number: C939D0 | Price: \$174.00

Std 2015 ◆

Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks

Applicable to stationary atmospheric and low-pressure (up to and including 15 psig) aboveground petroleum storage tanks used in all sectors of the petroleum and petrochemical industry, including crude oil and gas production; refining; petrochemicals; pipelines and terminals; bulk storage; and ethanol facilities. This standard provides requirements for safely planning, coordinating, and conducting tank entry and cleaning operations, from removal from service through return to service. Pages: 146

8th Edition | January 2018 | Product Number: K20158 | Price: \$215.00

RP 2026 ◆■

Safe Access/Egress Involving Floating Roofs of Storage Tanks in Petroleum Service

Addresses the hazards associated with access/egress onto external and internal floating roofs of in-service petroleum storage tanks and identifies some of the most common practices and procedures for safely accomplishing this activity. This RP is intended primarily for those persons who are required to perform inspection, service, maintenance, or repair activities that involve descent onto floating roofs of in-service petroleum tanks. Pages: 28

4th Edition | July 2022 | Product Number: K202604 | Price: \$110.00

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RP 2027

Ignition Hazards and Safe Work Practices for Abrasive Blasting of Atmospheric Storage Tanks in Hydrocarbon Service

Provides safe work practices for the prevention and control of vapor, ignition, and other potential hazards during abrasive blasting of aboveground storage tanks in liquid hydrocarbon service at atmospheric pressure. It also provides assistance to employers in developing operating procedures that provide for hazard recognition to significantly reduce ignition risks during abrasive blasting of hydrocarbon storage tanks in service that may contain or have the potential to develop a flammable atmosphere in the vapor space. This RP applies to safe work practices required for abrasive blasting of exterior shells and exterior roofs of all aboveground atmospheric storage tanks in liquid hydrocarbon service. It also applies to safe work practices for abrasive blasting conducted on the roofs and inner portions of the exposed surfaces of shells (that portion of the shell above the roof level) on open-top (external) floating roof tanks. This RP also covers recognition and control of ignition hazards that are specific to and may be present during abrasive blasting of aboveground storage tanks in liquid hydrocarbon service at atmospheric pressure. The ignition sources covered in this RP include static electricity, internal combustion engines, electric motors, friction sparks, hot metal surfaces, and external-to-the-work ignition sources. Pages: 27

4th Edition | November 2018 | Product Number: C20274 | Price: \$132.00

RP 2207 ◆■

Preparing Tank Bottoms for Hot Work

Addresses only the safety aspects of hot work performed on petroleum storage tank bottoms. It discusses safety precautions for preventing fires, explosions, and associated injuries. The term “hot work,” as used in this publication, is defined as an operation that can produce a spark or flame hot enough to ignite flammable vapors. RP 2009 provides more in-depth information on safe hot work practices, and its requirements are not duplicated here. Pages: 28

8th Edition | April 2022 | Product Number: K22078 | Price: \$121.00

Std 2510

Design and Construction of LPG Installations

Provides minimum requirements for the design and construction of installations for the storage and handling of liquefied petroleum gas (LPG) at marine and pipeline terminals, natural gas processing plants, refineries, petrochemical plants, and tank farms. This standard covers storage vessels, loading and unloading systems, piping, and related equipment. Pages: 52

9th Edition | August 2020 | Product Number: C25109 | Price: \$132.00

Std 2610

Design, Construction, Operation, Maintenance, and Inspection of Terminal and Tank Facilities

Guides the management of terminals and tanks in a manner that protects the environment and the safety of workers and the public. This standard is intended for petroleum terminal and tank facilities associated with marketing, refining, pipeline, and other similar facilities. This standard may be used as a resource and management guide by those responsible for such facilities and by those working on their behalf. This standard is a compilation of industry knowledge, information, and management practices for all relevant aspects of terminal and tank operations aggregated into an overview document comprising best practices. Pages: 100

3rd Edition | September 2018 | Product Number: C26103 | Price: \$192.00

PRESSURE-RELIEVING SYSTEMS FOR REFINERY SERVICE

Std 520, Part I

Sizing, Selection, and Installation of Pressure-Relieving Devices—Part I—Sizing and Selection

Applies to the sizing and selection of pressure relief devices used in refineries and related industries for equipment that has a maximum allowable working pressure of 15 psig (103 kPag) or greater. The pressure relief devices covered in this standard are intended to protect unfired pressure vessels and related equipment against overpressure from operating and fire contingencies.

This standard includes basic definitions and information about the operational characteristics and applications of various pressure relief devices. It also includes sizing procedures and methods based on steady state flow of Newtonian fluids. Atmospheric and low-pressure storage tanks covered in Std 2000 and pressure vessels used for the transportation of products in bulk or shipping containers are not within the scope of this standard. See Std 521 for information about appropriate ways of reducing pressure and restricting heat input. The rules for overpressure protection of fired vessels are provided in ASME Section I and ASME B31.1 and are not within the scope of this standard. Pages: 172

10th Edition | October 2020 | Product Number: C520110 | Price: \$404.00

Std 520, Part II

Sizing, Selection, and Installation of Pressure-Relieving Devices—Part II—Installation

Covers the methods of installation for pressure relief devices for equipment that has a maximum allowable working pressure (MAWP) of 15 psig (1.03 bar g) or greater. Pressure relief valves or rupture disks may be used independently or in combination with each other to provide the required protection against excessive pressure accumulation. The term “pressure relief valve” includes safety relief valves used in either compressible or incompressible fluid service, and relief valves used in incompressible fluid service. Covers gas, vapor, steam, and incompressible fluid service. Pages: 69

7th Edition | October 2020 | Product Number: C5200207 | Price: \$310.00

Std 521

Pressure-Relieving and Depressuring Systems

Applies to pressure-relieving and vapor depressuring systems. Although intended for use primarily in oil refineries, it is also applicable to petrochemical facilities, gas plants, liquefied natural gas (LNG) facilities, and oil and gas production facilities. The information provided is designed to aid in the selection of the system that is most appropriate for the risks and circumstances involved in various installations. This standard specifies requirements and gives guidelines for the following:

- examining the principal causes of overpressure;
- determining individual relieving rates;
- selecting and designing disposal systems, including such component parts as piping, vessels, flares, and vent stacks.

This standard does not apply to direct-fired steam boilers. Pages: 247

7th Edition | June 2020 | Product Number: C52107 | Price: \$328.00

TR 522 ■

Technical Report on Pressure-Relief System Calculations

Provides equations and examples for performing relief system calculations. Users are responsible for performing their own calculations and using appropriate references for equations. This report contains a variety of calculation examples for equations and methods found in API publications on pressure-relief systems. Pages: 22

1st Edition | April 2022 | Product Number: C52201 | Price: \$65.00

To purchase individual API standards, visit apiwebstore.org

Std 526

Flanged Steel Pressure-Relief Valves

(includes Errata 1 dated September 2018)

Purchase specification for flanged steel pressure-relief valves. Basic requirements are given for direct spring-loaded pressure-relief valves and pilot-operated pressure-relief valves as follows:

- orifice designation and area;
- valve size and pressure rating, inlet and outlet;
- materials;
- pressure-temperature limits;
- center-to-face dimensions, inlet and outlet.

Nameplate nomenclature and requirements for stamping are detailed in Annex A. Pages: 53

7th Edition | September 2017 | Product Number: C52607 | Price: \$227.00

Std 526 *

Flanged Steel Pressure-Relief Valves—Russian

(includes Errata 1 dated September 2018)

Russian translation of Std 526.

7th Edition | September 2017

Product Number: C52607R | Price: \$227.00

Std 527

Seat Tightness of Pressure Relief Valves

Describes methods of determining the seat tightness of metal- and soft-seated pressure relief valves, including those of conventional, bellows, and pilot-operated designs.

The maximum acceptable leakage rates are defined for pressure relief valves with set pressures from 103 kPa gauge (15 psig) to 41,379 kPa gauge (6,000 psig). If greater seat tightness is required, the purchaser shall specify it in the purchase order.

The test medium for determining the seat tightness—air, steam, or water—shall be the same as that used for determining the set pressure of the valve.

For dual-service valves, the test medium—air, steam, or water—shall be the same as the primary relieving medium.

To ensure safety, the procedures outlined in this standard shall be performed by persons experienced in the use and functions of pressure relief valves. Pages: 13

5th Edition | July 2020 | Product Number: C52705 | Price: \$108.00

RP 576 ♦

Inspection of Pressure-Relieving Devices

Describes the inspection and repair practices for self-actuated pressure-relieving devices commonly used in the oil/gas and petrochemical industries. As a guide to the inspection and repair of these devices in the user's plant, it is intended to ensure their proper performance. This publication covers self-actuated devices such as direct acting spring loaded valves, pilot operated pressure-relief valves, rupture disks, pin actuated devices, and weight-loaded pressure vacuum vents.

The recommendations in this publication are not intended to supersede requirements established by regulatory bodies. This publication excludes tank weak seams and/or sections or tank thief hatches, explosion doors, fusible plugs, control valves, pressure regulating devices, integral rotating equipment components, other devices that either depend on an external source of power for operation or are manually operated or devices not designed to be inspected or recertified. Inspections and tests made at manufacturers' plants, which are usually covered by codes or purchase specifications, are not covered by this publication.

This publication does not cover training requirements for personnel involved in the inspection and repair of pressure-relieving devices. Those seeking these requirements should see API 510/570, which gives the requirements for a quality control system and specifies that the repair organization maintain and document a training program ensuring that personnel are qualified. Pages: 80

4th Edition | April 2017 | Product Number: C57604 | Price: \$227.00

RP 576 *

Inspection of Pressure-Relieving Devices—Spanish

Spanish translation of RP 576.

4th Edition | April 2017 | Product Number: C57604S | Price: \$227.00

Std 2000

Venting Atmospheric and Low-Pressure Storage Tanks

Covers the normal and emergency vapour venting requirements for aboveground liquid petroleum or petroleum products storage tanks and aboveground and underground refrigerated storage tanks, designed for operation at pressures from full vacuum through 103,4 kPa (ga) [15 psig]. Discussed in this International Standard are the causes of overpressure and vacuum; determination of venting requirements; means of venting; selection, and installation of venting devices; and testing and marking of relief devices.

This International Standard is intended for tanks containing petroleum and petroleum products but it can also be applied to tanks containing other liquids; however, it is necessary to use sound engineering analysis and judgment whenever this International Standard is applied to other liquids.

This International Standard does not apply to external floating-roof tanks. Pages: 87

7th Edition | March 2014 | Reaffirmed: April 2000

Product Number: C20007 | Price: \$244.00

PIPING COMPONENT AND VALVE STANDARDS

API 570 ♦

Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems

(includes Addendum 1 dated May 2017, Addendum 2 dated March 2018, and Errata 1 dated April 2018)

Covers inspection, rating, repair, and alteration procedures for metallic and fiberglass reinforced plastic (FRP) piping systems and their associated pressure-relieving devices that have been placed in service. This inspection code applies to all hydrocarbon and chemical process piping covered in 1.2.1 that have been placed in service unless specifically designated as optional per 1.2.2. This publication does not cover inspection of specialty equipment including instrumentation, exchanger tubes, and control valves. However, this piping code could be used by owner/users in other industries and other services at their discretion. Process piping systems that have been retired from service and abandoned in place are no longer covered by this "in-service inspection" Code. However abandoned in place piping may still need some amount of inspection and/or risk mitigation to assure that it does not become a process safety hazard because of continuing deterioration. Process piping systems that are temporarily out of service but have been mothballed (preserved for potential future use) are still covered by this Code. Pages: 88

4th Edition | February 2016 | Product Number: C57004 | Price: \$195.00

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RP 574 ◆

Inspection Practices for Piping System Components

Supplements API 570 by providing piping inspectors with information that can improve skill and increase basic knowledge of inspection practices. This recommended practice describes inspection practices for piping, tubing, valves (other than control valves), and fittings used in petroleum refineries and chemical plants. Common piping components, valve types, pipe joining methods, inspection planning processes, inspection intervals and techniques, and types of records are described to aid the inspectors in fulfilling their role implementing API 570. This publication does not cover inspection of specialty items, including instrumentation, furnace tubulars, and control valves. Pages: 113

4th Edition | November 2016 | Product Number: C57404 | Price: \$227.00

RP 578 ◆

Guidelines for a Material Verification Program (MVP) for New and Existing Assets

Provides the guidelines for the owner/user to develop and implement a material verification program (MVP) as part of an asset integrity program. The MVP uses positive material identification and other methods to verify that the nominal composition of an asset, an asset component, or weldment within the pressure envelope is consistent with the selected or specified construction materials.

A well-designed and implemented MVP is an important management system used to minimize the potential for the release of hazardous substances due to nonconforming materials of construction. Pages: 28

3rd Edition | February 2018 | Product Number: C57803 | Price: \$227.00

RP 591

Process Valve Qualification Procedure

Provides recommendations for evaluation of a manufacturer's valve construction and quality management system for the purpose of determining a manufacturer's capability to provide new valves manufactured in accordance with applicable standards listed. Testing per this recommended practice that does not have an established requirement in the applicable standard is for information only. Pages: 32

6th Edition | April 2019 | Product Number: C59106 | Price: \$113.00

Std 594 ◆■

Check Valves: Flanged, Lug, Wafer, and Butt-Welding

Covers the design, materials, face-to-face dimensions, pressure-temperature ratings, inspection, examination, and testing requirements for two types of check valves. Pages: 33

9th Edition | February 2022 | Effective Date: August 2022
Product Number: C59409 | Price: \$141.00

Std 598

Valve Inspection and Testing

Covers inspection, examination, supplementary examinations, and pressure test requirements for resilient-seated, nonmetallic-seated (e.g. ceramic), and metal-to-metal-seated valves of the gate, globe, plug, ball, check, and butterfly types. Pages: 14

10th Edition | October 2016 | Product Number: C59810 | Price: \$104.00

Std 598 *

Valve Inspection and Testing—Russian

Russian translation of Std 598.

10th Edition | October 2016 | Product Number: C59810R | Price: \$104.00

Std 599 ◆

Metal Plug Valves—Flanged, Threaded, and Welding Ends

Covers steel, nickel base, and other alloy plug valves with flanged or butt-welding ends and ductile iron plug valves with flanged ends in sizes NPS 1/2 through NPS 24 and threaded or socket-welding ends for sizes NPS 1/2 through NPS 2. Valve bodies conforming to ASME B16.34 may have one flange and one butt-welding end, or one threaded and one socket welding end. Pages: 26

8th Edition | March 2020 | Product Number: C59908 | Price: \$110.00

Std 600 ◆

Steel Gate Valves—Flanged and Butt-Welding Ends, Bolted Bonnets

Specifies the requirements for a heavy-duty series of bolted bonnet steel gate valves for petroleum refinery and related applications where corrosion, erosion, and other service conditions would indicate a need for full port openings, heavy wall sections, and large stem diameters. Pages: 42

14th Edition | May 2021 | Product Number: C60014 | Price: \$146.00

Std 602 ◆■

Gate, Globe, and Check Valves for Sizes DN 100 (NPS 4) and Smaller for the Petroleum and Natural Gas Industries

Specifies the requirements for a series of compact gate, globe, and check valves for petroleum and natural gas industry applications. It covers valves of the nominal pipe sizes DN: 8, 10, 15, 20, 25, 32, 40, 50, 65, 80, and 100; corresponding to nominal pipe sizes NPS: 1/4, 3/8, 1/2, 3/4, 1, 1 1/4, 1 1/2, 2, 2 1/2, 3, and 4; and applies to pressure class designations: 150, 300, 600, 800, and 1500. Pages: 72

11th Edition | May 2022 | Effective Date: November 1, 2022

Product Number: C60211 | Price: \$147.00

Std 603 ◆

Corrosion-Resistant, Bolted Bonnet Gate Valves—Flanged and Butt-Welding Ends

Specifies the requirements for corrosion-resistant bolted bonnet gate valves meeting the requirements of ASME B16.34, Standard Class, for valves having flanged or butt-weld ends in sizes NPS 1/2 through 24, corresponding to nominal pipe sizes in ASME B36.10M, and Classes 150, 300, and 600.

This standard covers the requirements for corrosion-resistant gate valves for use in process piping applications. Covered are requirements for outside-screw-and-yoke (OS&Y) valves with rising stems, non-rising hand-wheels, bolted bonnets, and various types of gate configurations. Pages: 9

9th Edition | September 2018 | Product Number: C60309 | Price: \$103.00

Std 607 ■

Fire Test for Quarter-Turn Valves and Valves Equipped with Nonmetallic Seats

Specifies fire testing requirements and method for confirming the pressure-containing capability of quarter-turn valves with nonmetallic or metallic seat(s) and other operated valves with nonmetallic seating under pressure during and after the fire test. It does not cover the testing requirements for valve actuators other than manually operated gear boxes or similar mechanisms when these form part of the normal valve assembly. Other types of valve actuators (e.g. electrical, pneumatic, or hydraulic) may need special protection to operate in the environment considered in this valve test, and the fire testing of such actuators is outside the scope of this standard. Pages: 26

8th Edition | October 2022 | Product Number: C60708 | Price: \$105.00

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Std 608 ♦

Metal Ball Valves—Flanged, Threaded, and Welding Ends

Specifies the requirements for metal ball valves suitable for petroleum, petrochemical and industrial applications that have butt-welding or flanged ends for NPS 1/2 through NPS 20 and threaded or socket-welding ends for NPS 1/4 through NPS 2, corresponding to the nominal pipe sizes in ASME B36.10M. Also applies to metal ball valves in pressure classes 150, 300, and 600 for flanged and butt-welding ends and in pressure classes 150, 300, 600, and 800 for socket-welding and threaded ends. Establishes requirements for bore sizes described as full bore, single reduced bore, and double reduced bore. Covers additional requirements for ball valves that are otherwise in full conformance to the requirements of ASME B16.34, Standard Class. Pages: 32

6th Edition | January 2020 | Product Number: C60806 | Price: \$129.00

Std 609 ♦

Butterfly Valves: Double-Flanged, Lug- and Wafer-Type, and Butt-Welding Ends

Covers design, materials, face-to-face dimensions, pressure-temperature ratings, and examination, inspection, and test requirements for gray iron, ductile iron, bronze, steel, nickel-based alloy, or special alloy butterfly valves. Pages: 34

9th Edition | April 2021 | Product Number: C60909 | Price: \$114.00

RP 615 ■

Valve Selection Guide

Aids in selection of valves for the hydrocarbon processing industry (HPI) and may also assist in the selection of valves for other industrial processes, such as power or general industry process applications. Selection guidance is provided for valve types covered by ASME B16.34 and API valve standards for the downstream segment, which include gate, ball, plug, butterfly, check, and globe valves. Modulating control valves and pressure-relief valves are outside the scope of this RP. Pages: 55

3rd Edition | August 2022 | Product Number: C61503 | Price: \$104.00

RP 621 ■

Reconditioning of Metallic Gate, Globe, and Check Valves

Provides guidelines for reconditioning heavy wall (API 600 and API 594 type) carbon steel, ferritic alloy (up to 9 % Cr), stainless steel, and nickel alloy gate, globe, and check valves for ASME pressure classes 150, 300, 400, 600, 900, 1500, and 2500. Guidelines contained in this RP apply to flanged and butt weld cast or forged valves. This RP does not cover reconditioning or remanufacturing of used or surplus valves intended for resale. The only intent of this RP is to provide guidelines for refurbishing an end user's (Owner) valves for continued service in the Owner's facility. Valves reconditioned or remanufactured to this RP may not meet API Standard requirements for new valves. Pages: 54

5th Edition | October 2022 | Product Number: C62105 | Price: \$162.00

Std 622

Type Testing of Process Valve Packing for Fugitive Emissions (includes Addendum 1 dated March 2022)

Specifies the requirements for comparative testing of block valve stem packing for process applications where fugitive emissions are a consideration. Packing(s) shall be suitable for use at -29 °C to 538 °C (-20 °F to 1000 °F). Factors affecting fugitive emissions performance that are considered by this standard include temperature, pressure, thermal cycling, mechanical cycling, and corrosion. Pages: 37

3rd Edition | October 2018 | Product Number: C62203 | Price: \$162.00

Std 623

Steel Globe Valves—Flanged and Butt-Welding Ends, Bolted Bonnets

Specifies the requirements for a heavy-duty series of bolted bonnet steel globe valves for petroleum refinery and related applications where corrosion, erosion, and other service conditions would indicate a need for heavy wall sections and large stem diameters. Pages: 39

2nd Edition | January 2021 | Product Number: C62302 | Price: \$94.00

Std 624

Type Testing of Rising Stem Valves Equipped with Flexible Graphite Packing for Fugitive Emissions

Specifies the requirements and acceptance criteria (100 ppmv) for fugitive emission type testing of rising and rising-rotating stem valves equipped with packing previously tested in accordance with Std 622. Packing shall be suitable for use at service temperatures -29 °C to 538 °C (-20 °F to 1000 °F). The type testing requirements contained herein are based upon elements of EPA Method 21. Valves larger than NPS 24 or valves greater than class 1500 are outside the scope of this standard. Pages: 12

1st Edition | February 2014 | Product Number: C62401 | Price: \$93.00

Std 641

Type Testing of Quarter-Turn Valves for Fugitive Emissions

Specifies the requirements and acceptance criteria for fugitive emission type testing of quarter-turn valves. The type testing requirements contained herein are based on elements of EPA Method 21. Valves larger than NPS 24 and valves greater than ASME B16.34 class 1500 are outside the scope of this standard. Valves with a pressure rating at ambient temperature less than 6.89 barg (100 psig) are outside the scope of this standard. Repacking or resealing of valves is outside the scope of this standard. Pages: 14

1st Edition | October 2016 | Product Number: C64101 | Price: \$81.00

ELECTRICAL INSTALLATIONS AND EQUIPMENT

RP 500

Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2

(includes Errata 1 dated January 2014)

Provides guidelines for determining the degree and extent of Class I, Division 1 and Class I, Division 2 locations at petroleum facilities, for the selection and installation of electrical equipment. Basic definitions provided in the *National Electric Code* have been followed in developing this document which applies to the classification of locations for both temporarily and permanently installed electrical equipment. RP 500 is intended to be applied where there may be a risk of ignition due to the presence of flammable gas or vapor, mixed with air under normal atmospheric conditions. Pages: 146

3rd Edition | December 2012 | Reaffirmed; July 2021

Product Number: C50003 | Price: \$302.00

RP 500 *

Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2—Kazakh

(includes Errata 1 dated January 2014)

Kazakh translation of RP 500.

3rd Edition | December 2012 | Reaffirmed; July 2021

Product Number: C50003K | Price: \$302.00

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Refining

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RP 505

Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2

Provides guidelines for determining the degree and extent of Class I, Zone 0, Zone 1, and Zone 2 locations at petroleum facilities for the selection and installation of electrical equipment. Basic definitions provided in the *National Electrical Code* have been followed in developing this document, which applies to the classification of locations for both temporarily and permanently installed electrical equipment.

RP 505 is intended to be applied where there may be a risk of ignition due to the presence of flammable gas or vapor mixed with air under normal atmospheric conditions. Pages: 177

2nd Edition | August 2018 | Product Number: C50502 | Price: \$224.00

RP 540

Electrical Installations in Petroleum Processing Plants

Provides information on electrical installations in petroleum processing plants. It is intended for all individuals and organizations concerned with the safe design, installation, and operation of electrical facilities in petroleum processing plants. Pages: 107

4th Edition | April 1999 | Reaffirmed: August 2013

Product Number: C54004 | Price: \$204.00

Std 541

Form-Wound Squirrel Cage Induction Motors—375 kW (500 Horsepower) and Larger

Covers the minimum requirements for all form-wound squirrel-cage induction motors 500 Horsepower and larger for use in petroleum industry services. This standard may be applied to adjustable speed motors and induction generators with appropriate attention to the specific requirements of such applications. Pages: 160

5th Edition | December 2014 | Reaffirmed: May 2021

Product Number: C54105 | Price: \$206.00

Std 541 *

Form-Wound Squirrel Cage Induction Motors—375 kW (500 Horsepower) and Larger—Russian

Russian translation of Std 541.

5th Edition | December 2014 | Reaffirmed: May 2021

Product Number: C54105R | Price: \$206.00

Std 546 ■

Brushless Synchronous Machines—500 kVA and Larger

Covers the minimum requirements for form-wound and bar-wound brushless synchronous machines 500 kVA and larger for use in petroleum, chemical, and other industrial applications. This standard includes synchronous motors and generators with two different rotor designs: salient-pole type rotors with solid or laminated poles; and cylindrical type rotors with solid or laminated construction. Pages: 269

4th Edition | April 2022 | Product Number: C54604 | Price: \$225.00

Std 547 ◆

General Purpose Form-Wound Squirrel Cage Induction Motors—185 kW (250 hp) Through 2240 kW (3000 hp)

Covers the requirements for form-wound induction motors for use in general-purpose petroleum, chemical, and other industrial severe duty applications. These motors:

- are rated 250 hp (185 kW) through 3000 hp (2250 kW) for 4, 6, and 8 pole speeds,

- are rated less than 800 hp (600 kW) for two-pole (3000 or 3600 RPM) motors of totally-enclosed construction,
- are rated less than 1250 hp (930 kW) for two-pole motors of WP-II type enclosures,
- drive centrifugal loads,
- drive loads having inertia values within those listed in NEMA MG 1 Part 20),
- are not induction generators. Pages: 62

2nd Edition | May 2017 | Effective Date: November 1, 2017

Reaffirmed: October 2022 | Product Number: C54702 | Price: \$128.00

HEAT TRANSFER EQUIPMENT STANDARDS FOR REFINERY SERVICE

Std 530

Calculation of Heater-Tube Thickness in Petroleum Refineries

(includes Addendum 1 dated July 2019 and Addendum 2 dated December 2021)

Specifies the requirements and gives recommendations for the procedures and design criteria used for calculating the required wall thickness of new tubes and associated component fittings for fired heaters for the petroleum, petrochemical, and natural gas industries. These procedures are appropriate for designing tubes for service in both corrosive and non-corrosive applications. These procedures have been developed specifically for the design of refinery and related fired heater tubes (direct-fired, heat-absorbing tubes within enclosures). These procedures are not intended to be used for the design of external piping. This standard does not give recommendations for tube retirement thickness; Annex A describes a technique for estimating the life remaining for a heater tube. Pages: 264

7th Edition | April 2015 | Product Number: C53007 | Price: \$314.00

RP 534

Heat Recovery Steam Generators

Provides guidelines for the selection and evaluation of heat recovery steam generator (HRSG) systems. Details of related equipment designs are considered only where they interact with the HRSG system design. The document does not provide rules for design, but indicates areas that need attention and offers information and descriptions of HRSG types available to the designer/user for purposes of selecting the appropriate HRSG. Pages: 60

2nd Edition | February 2007 | Reaffirmed: October 2013

2-Year Extension: April 2013 | Product Number: C53402 | Price: \$103.00

RP 535

Burners for Fired Heaters in General Refinery Services

Provides guidelines for the selection and/or evaluation of burners installed in fired heaters in general refinery services. Details of fired heater and related equipment designs are considered only where they interact with the burner selection. This RP does not provide rules for design, but indicates areas that need attention. It offers information and descriptions of burner types available to the designer/user for purposes of selecting the appropriate burner for a given application.

The burner types discussed are those currently in industry use. It is not intended to imply that other burner types are not available or recommended. Many of the individual features described in these guidelines are applicable to most burner types.

In addition to specification of burners, this RP has been updated to include practical guidelines for troubleshooting in service burners as well as including considerations for safe operation. Pages: 84

3rd Edition | May 2014 | Product Number: C53503 | Price: \$163.00

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Std 536

Post-Combustion NOx Control for Equipment in General Refinery and Petrochemical Services

Specifies requirements and provides guidance for the selection, design specification, mechanical description, operation, maintenance, and test procedures for post-combustion NOx control equipment and related mechanical systems and components used for fired equipment in petrochemical and general refinery service.

This document covers the following methods of post combustion NOx reduction for both new and retrofit applications:

- Selective Non-catalytic Reduction (SNCR), and
- Selective Catalytic Reduction (SCR).

This standard is primarily intended for direct application to fired process heaters, reformers, industrial, and power boilers in petrochemical and general refinery services. The same fundamental NOx control technologies and systems may also be applied to Fluid Catalytic Cracking Units (FCCUs), incinerators, gas turbine exhaust, and other exhaust gas process systems however SCRs may require additional considerations beyond the scope of this standard to address unique aspects, such as high particulate content and corrosive chemicals, in the flue gas stream.

This document does not cover:

- Reduced NOx formation through combustion controls and design techniques such as low NOx burners, flue gas recirculation (FGR), and staged combustion; and
- Non-selective Catalytic Reduction (NSCR) for the control of NOx and other pollutant emissions. Pages: 117

3rd Edition | September 2017 | Reaffirmed: October 2022

Product Number: C53603 | Price: \$182.00

Std 537

Flare Details for Petroleum, Petrochemical, and Natural Gas Industries (ANSI/API Std 537)

(includes Addendum 1 dated June 2020)

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.

Annexes A through 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 data sheets provided in Annex F; it is intended that these data sheets be used to communicate and record design information. Pages: 170

3rd Edition | March 2017 | Product Number: C53703 | Price: \$260.00

Std 537 *

Flare Details for Petroleum, Petrochemical, and Natural Gas Industries—Russian

(ANSI/API Std 537)

(includes Addendum 1 dated June 2020)

Russian translation of Std 537.

3rd Edition | March 2017 | Product Number: C53703R | Price: \$260.00

RP 538

Industrial Fired Boilers for General Refinery and Petrochemical Service

Specifies requirements and gives recommendations for design, operation, maintenance, and troubleshooting considerations for industrial fired boilers used in refineries and chemical plants. Covers waterside control, combustion control, burner management systems, feedwater preparation, steam purity, emissions, and more.

This recommended practice (RP) is based on the accumulated knowledge and experience of manufacturers and users of industrial fired boilers. It directly meets the business needs of refining and petrochemical industry operator-users, equipment vendors and manufacturers, and contractors. This RP reflects prevailing technical expertise.

This RP does not apply to fire tube boilers, gas turbine exhaust boilers, or fluidized bed boilers. It does not cover boiler mechanical construction, nor does it cover forced circulation boilers. Pages: 348

1st Edition | October 2015 | Reaffirmed: April 2021

Product Number: C53801 | Price: \$330.00

Std 560

Fired Heaters for General Refinery Service

(includes Addendum 1 dated May 2021)

Specifies requirements and gives recommendations for the design, materials, fabrication, inspection, testing, preparation for shipment, and erection of fired heaters, air preheaters (APHs), fans, and burners for general refinery service. This standard does not apply to the design of steam reformers or pyrolysis furnaces. Pages: 327

5th Edition | February 2016 | Product Number: C56005 | Price: \$363.00

Std 565 ■

Thermal Reactors for Sulfur Recovery Units in General Refinery Services

Provides recognized industry requirements and guidance for the design, specification, fundamental operation, instrumentation, control, safeguarding, and maintenance of sulfur recovery unit (SRU) thermal reactors used in general refinery services. The scope of this standard includes application in both air-only and oxygen-enriched modified-Claus process operations. Pages: 160

1st Edition | June 2022 | Product Number: C56501 | Price: \$181.00

RP 573 ◆

Inspection of Fired Boilers and Heaters

Covers inspection practices for fired boilers and process heaters (furnaces) used in petroleum refineries and petrochemical plants. The practices described in this document are focused to improve equipment reliability and plant safety by describing the operating variables which impact reliability, and to ensure that inspection practices obtain the appropriate data, both on-stream and off-stream, to assess current and future performance of the equipment. Pages: 129

4th Edition | January 2021 | Product Number: C57304 | Price: \$175.00

Std 660

Shell-and-Tube Heat Exchangers

(includes Addendum 1 dated August 2020)

Specifies requirements and gives recommendations for the mechanical design, material selection, fabrication, inspection, testing, and preparation for shipment of shell-and-tube heat exchangers for the petroleum, petrochemical, and natural gas industries. This standard is applicable to the following types of shell-and-tube heat exchangers: heaters, condensers, coolers, and reboilers. This standard is not applicable to vacuum-operated steam surface condensers and feed-water heaters. Pages: 62

9th Edition | March 2015 | Product Number: C66009 | Price: \$201.00

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Refining

To purchase individual API standards, visit apiwebstore.org

Std 660 *

Shell-and-Tube Heat Exchangers—Russian
(includes Addendum 1 dated August 2020)

Russian translation of Std 660.

9th Edition | March 2015 | Product Number: C66009R | Price: \$201.00

Std 661

Petroleum, Petrochemical, and Natural Gas Industries—Air-Cooled Heat Exchangers for General Refinery Service
(ANSI/API Std 661)

Gives requirements and recommendations for the design, materials, fabrication, inspection, testing, and preparation for shipment of air-cooled heat exchangers for use in the petroleum, petrochemical, and natural gas industries. This standard is applicable to air-cooled heat exchangers with horizontal bundles, but the basic concepts can also be applied to other configurations. Pages: 147

7th Edition | July 2013 | Reaffirmed: November 2018

Product Number: C66107 | Price: \$271.00

Std 661 *

Petroleum, Petrochemical, and Natural Gas Industries—Air-Cooled Heat Exchangers for General Refinery Service—Russian
(ANSI/API Std 661)

Russian translation of Std 661.

7th Edition | July 2013 | Reaffirmed: November 2018

Product Number: C66107R | Price: \$271.00

Std 663 ■

Hairpin Type Heat Exchangers

Specifies requirements and gives recommendations for the mechanical design, materials selection, fabrication, inspection, testing, and preparation for shipment of hairpin heat exchangers for use in the petroleum, petrochemical, and natural gas industries. Hairpin heat exchangers include double-pipe and multi-tube heat exchangers. Pages: 67

2nd Edition | August 2022 | Product Number: C66302 | Price: \$208.00

Std 664

Spiral Plate Heat Exchangers

(includes Errata 1 dated February 2021)

Specifies the requirements and gives recommendations for the mechanical design, materials selection, fabrication, inspection, testing, and preparation for shipment of spiral plate heat exchangers for the petroleum, petrochemical, and natural gas industries. It is applicable to standalone spiral plate heat exchangers and those integral with a pressure vessel. Pages: 39

1st Edition | March 2014 | Reaffirmed: June 2019

Product Number: C66401 | Price: \$189.00

Std 667 ■

Plate-and-Frame Heat Exchangers

(formerly Std 662, Part 1)

Gives requirements and recommendations for the mechanical design, materials selection, fabrication, inspection, testing, and preparation for shipment of plate-and-frame heat exchangers for use in petroleum, petrochemical, and natural gas industries. Pages: 55

1st Edition | March 2022 | Product Number: C66701 | Price: \$100.00

Std 668

Brazed Aluminum Plate-Fin Heat Exchangers

Gives requirements and recommendations for the mechanical design, materials selection, fabrication, inspection, testing, and preparation for shipment of brazed aluminum plate-fin heat exchangers for use in the petroleum, petrochemical, and natural gas industries. This edition is a revision of the First Edition of Std 662, Part 2. Pages: 49

1st Edition | November 2018 | Product Number: C66801 | Price: \$147.00

Std 669 ■

Heat Recovery Systems

Provides guidelines for heat transfer equipment used in waste heat recovery systems in the petroleum, petrochemical, and natural gas industries. Details of related equipment designs are included only where these are necessary to ensure proper design and operation and safe interaction with the heat recovery system. It indicates areas that need attention and offers information and descriptions of various types of heat transfer equipment available to aid in the selection of the appropriate heat recovery system. Pages: 84

1st Edition | June 2022 | Product Number: C66901 | Price: \$137.00

INSTRUMENTATION AND CONTROL SYSTEMS

RP 551

Process Measurement Instrumentation

Provides procedures for the installation of the more generally used measuring and control instruments and related accessories. Pages: 233

2nd Edition | February 2016 | Product Number: C55102 | Price: \$171.00

RP 551 *

Process Measurement Instrumentation—Russian

Russian translation of RP 551.

2nd Edition | February 2016 | Product Number: C55102R | Price: \$171.00

RP 552

Transmission Systems

Reviews the recommended practices for the installation of electronic and pneumatic measurement and control-signal transmission systems. It does not discuss leased wire, radio, and telemetering transmission. Pages: 39

1st Edition | October 1994 | Reaffirmed: November 2022

2-Year Extension: November 2012

Product Number: C55201 | Price: \$118.00

RP 553

Refinery Valves and Accessories for Control and Safety Instrumented Systems

Addresses the special needs of automated valves in refinery services. The knowledge and experience of the industry has been captured to provide proven solutions to well-known problems. This document provides recommended criteria for the selection, specification, and application of piston (i.e. double-acting and spring-return) and diaphragm-actuated (spring-return) control valves. Control valve design considerations are outlined such as valve selection, material selection, flow characteristic evaluation, and valve accessories. It also discusses control valve sizing, fugitive emissions, and consideration of the effects of flashing, cavitation, and noise. Recommendations for emergency block and vent valves, on/off valves intended for safety instrumented systems, and special design valves for refinery services, such as Fluid Catalytic Cracking Unit (FCCU) slide valves and vapor depressurizing systems, are also included in this recommended practice. Pages: 109

2nd Edition | October 2012 | Product Number: C55302 | Price: \$157.00

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Refining

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RP 553 *

Refinery Valves and Accessories for Control and Safety Instrumented Systems—Russian

Russian translation of RP 553.

2nd Edition | October 2012 | Product Number: C55302R | Price: \$157.00

RP 554, Part 1

Process Control Systems, Part 1—Process Control Systems Functions and Functional Specification Development

Addresses the processes required to successfully implement process control systems (PCSs) for oil and gas production, refinery, and petrochemical services. The major topics addressed in Part 1 are the basic functions that a process control system may need to perform, and recommended methodologies for determining the functional and integration requirements for a particular application. Pages: 53

3rd Edition | April 2021 | Product Number: C55403 | Price: \$151.00

RP 554, Part 2

Process Control Systems, Part 2—Process Control System Design

Addresses the processes required to successfully implement process control systems for refinery and petrochemical services. The major topic addressed in Part 2 is practices to select and design the installation for hardware and software required to meet the functional and integration requirements. Pages: 65

1st Edition | October 2008 | Reaffirmed: November 2016

2-Year Extension: November 2012

Product Number: C554201 | Price: \$151.00

RP 554, Part 2 *

Process Control Systems, Part 2—Process Control System Design—Russian

Russian translation of RP 554, Part 2.

1st Edition | October 2008 | Reaffirmed: November 2016

Product Number: C554201R | Price: \$151.00

RP 554, Part 3

Process Control Systems, Part 3—Project Execution and Process Control System Ownership

Addresses the processes required to successfully implement process control systems for oil and gas production, refinery, and petrochemical services. The major topic addressed is the project organization, skills, and management required to first execute a process control project and then to own and operate a PCS. Pages: 48

2nd Edition | January 2021 | Product Number: C554302 | Price: \$116.00

API 555

Process Analyzers

Addresses the considerations in the application of analyzers and associated systems, installation, and maintenance. Process monitors that measure and transmit information about chemical composition, physical properties, or chemical properties are known as process analyzer systems. Process analyzers are now used widely in the refining industry for

- monitoring and controlling product quality,
- implementing advanced control strategies in improving process operations,
- enhancing area safety, and
- continuous emission monitoring and environmental measurement of air and water quality. Pages: 314

3rd Edition | June 2013 | Reaffirmed: June 2020

Product Number: C55503 | Price: \$206.00

RP 556

Instrumentation, Control, and Protective Systems for Gas Fired Heaters

Provides guidelines that specifically apply to instrument, control, and protective system installations for gas fired heaters in petroleum production, refineries, petrochemical, and chemical plants. Includes primary measuring and actuating instruments, controls, alarms, and protective systems as they apply to fired heaters. Not covered in this RP are the following: oil fired and combination fired heaters; water tube boilers which consist of single or multiple burners and are designed for utility operation or where the primary purpose is steam generation; fired steam generators used to recover heat from combustion turbines; oven and furnaces used for the primary purpose of incineration, oxidation, reduction, or destruction of the process medium; water bath or oil bath indirect fired heaters; and CO boilers, pyrolysis furnaces, and other specialty heaters. Pages: 66

2nd Edition | April 2011 | Reaffirmed: April 2019

Product Number: C55602 | Price: \$165.00

RP 556 *

Instrumentation, Control, and Protective Systems for Gas Fired Heaters—Russian

Russian translation of RP 556.

2nd Edition | April 2011 | Reaffirmed: April 2019

Product Number: C55602R | Price: \$165.00

RP 557

Guide to Advanced Control Systems

Addresses the implementation and ownership of advanced control systems for refinery purposes. The document also described commonly used practices for the opportunity identification, justification, project management, implementation, and maintenance of advanced control system applications in refinery service. Pages: 45

2nd Edition | October 2013 | Product Number: C55702 | Price: \$119.00

TECHNICAL DATA BOOK PETROLEUM REFINING

Electronic Version of the API Technical Data Book

Improve the overall design and operations in today's highly complex petroleum refinery process systems with the API Technical Database. Version 1.0 of the API Technical Database replaces the printed format of the popular API Tech Data Books with a modern Windows interface that is so unique it is patented. This single screen approach provides access to the latest API physical property estimation methods and the software is critically reviewed and approved by the API Technical Data Committee. Included is a database of property data for nearly 900 components, characterization of petroleum fractions, and petroleum fraction distillation interconversions. Users can quickly determine petroleum fraction physical property data such as critical properties, vapor pressure, density, liquid enthalpy, gas enthalpy, heat of vaporization, liquid heat capacity, gas heat capacity, surface tension, liquid viscosity, gas viscosity, liquid thermal conductivity, gas thermal conductivity, and heat of combustion. Temperature-dependent properties can be tabulated and graphed over any range, and distillation interconversions are displayed graphically. This data can then be exported for use in simulation and engineering software programs.

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TECHNICAL DATA BOOK PETROLEUM REFINING: RELATED ITEMS

Reports Issued by Research Project 49 1951

API Research Project 49, Reference Clay Minerals, issued a series of eight reports, as follows:

- No. 1, Glossary of Mineral Names
- No. 2, Reference Clay Localities-United States
- No. 3, Differential Thermal Analysis of Reference Clay Mineral Specimens
- No. 4, Reference Clay-Europe
- No. 5, Occurrence and Microscopic Examination of Reference Clay Mineral Specimens
- No. 6, Electron Micrographs of Reference Clay Minerals
- No. 7, Analytical Data on Reference Clay Minerals
- No. 8, Infrared Spectra of Clay Minerals

TR 997

Comprehensive Report of API Crude Oil Characterization Measurements

A consortium of API member companies has sponsored a research program consisting of a series of projects on the characterization of crude oils. The goal of this program was to obtain complete sets of assay and thermophysical property data on a few widely varying crude oil refining and refining facilities. This report provides descriptions of the test procedures, discussions of their accuracy, and comprehensive compilation of the data for the crude oils measured under this program. Pages: 129

1st Edition | August 2000 | Product Number: C99701 | Price: \$228.00

CHARACTERIZATION AND THERMODYNAMICS

API Monograph Series

Each publication discusses the properties of solid, liquid, and gaseous phases of one or a few closely related, industrially important compounds in a compact, convenient, and systematic form. In addition to the basic physical properties, each publication covers density, molar volume, vapor pressure, enthalpy of vaporization, surface tension, thermodynamic properties, viscosity, thermal conductivity, references to properties of mixtures, and spectrographic data.

- Publ 705, Tetralin, 1978
- Publ 706, cis- and trans-Decalin, 1978
- Publ 707, Naphthalene, 1978
- Publ 708, Anthracene and Phenanthrene 9, 1979
- Publ 709, Four-Ring Condensed Aromatic Compounds, 1979
- Publ 710, Pyridine and Phenylpyridines, 1979
- Publ 711, Quinoline, 1979
- Publ 712, Isoquinoline, 1979
- Publ 713, Indanols, 1980
- Publ 714, Indan and Indene, 1980
- Publ 715, Acenaphthylene, Acenaphthene, Fluorene, and Fluoranthene, 1981
- Publ 716, Carbazole, 9-Methylcarbazole, and Acridine, 1981
- Publ 717, Thiphenes, 2,3- and 2,5-Dihydrothiophene, and Tetrahydrothiophene, 1981
- Publ 718, Aniline, 1982
- Publ 719, Indole, 1982
- Publ 720, 2-, 3-, and 4-Methylaniline, 1983
- Publ 721, Benzofuran, Dibenzofuran, and Benzonaphthofurans, 1983
- Publ 722, Isopropylbenzene, and 1-Methyl-2-, -3-, and -4-Isopropylbenzene, 1984
- Publ 723, tert-Butyl methyl ether, 1984
- Publ 724, 1- and 2-Methylnaphthalene and Dibenzanthracenes, 1985

Thermodynamic Properties and Characterization of Petroleum Fractions

February 1988

MATERIALS ENGINEERING PUBLICATIONS

API Coke Drum Survey 1996

Final Report

In 1996 a survey was sent by the API Subcommittee on Inspection, Coke Drum Task Group, to companies operating coke drums in the United States and abroad. This was the third survey of similar nature conducted by API. Fifty-four surveys were returned representing 17 operating companies and a total of 145 drums. The purpose of the survey was to collect data covering a broad range of issues including: 1. General Information; 2. Design; 3. Operating Information; 4. Inspection Practices; 5. Deterioration Experience; and 6. Repair Procedures.

Three of the six areas, Operation Information, Inspection Practices and Deterioration Experience, were not covered in previous industry surveys. Additionally, this survey requested more detailed information than previous surveys. Pages: 61

October 2003 | Product Number: C096C1 | Price: \$134.00

Impact of Gasoline Blended with Ethanol on the Long-Term Structural Integrity of Liquid Petroleum Storage Systems and Components

Summarizes the results of a literature review conducted for the American Petroleum Institute on the impact of gasoline blended with ethanol on the long-term structural integrity of liquid petroleum storage systems and components. It is anticipated that the use of ethanol in motor fuels will continue to increase. This has generated interest about the potential long-term structural effects of ethanol on liquid petroleum storage systems, including underground storage tanks (USTs), underground piping, and associated components. The objective of the literature review is to determine the state of industry knowledge and research on the effects of ethanol/gasoline blends on the long-term structural integrity of UST systems and components. This review is intended to assist decision-makers on further research requirements and needed changes or supplements to existing standards for underground storage system components used for storing and dispensing gasoline blended with ethanol. Appendix A may be purchased separately as an electronic database file. The database synopsis' and bibliographic information for all articles reviewed for the project. The report is organized by article index number. Reference numbers cited in this report refer to the article index number.

January 2003 | Executive Summary | Price: \$71.00

Appendix A—Literature Review | Price: \$138.00

RP 571 ♦

Damage Mechanisms Affecting Fixed Equipment in the Refining Industry

Provides background information on damage that can occur to equipment in the refining process. It is intended to supplement Risk-Based Inspection (RP 580 and Publ 581) and Fitness-for-Service (API 579-1/ASME FFS-1) technologies developed in recent years by API to manage existing refining equipment integrity. It is also an excellent reference for inspection, operations, and maintenance personnel. This RP covers over 60 damage mechanisms. Each write-up consists of a general description of the damage, susceptible materials, construction, critical factors, inspection method selection guidelines, and control measures. Wherever possible, pictures are included and references are provided for each mechanism. In addition, generic process flow diagrams have been included that contain a summary of the major damage flow mechanism expected for typical refinery process units. Pages: 376

3rd Edition | March 2020 | Product Number: C57103 | Price: \$374.00

RP 582

Welding Guidelines for the Chemical, Oil, and Gas Industries

Provides supplementary guidelines and practices for welding and welding related topics for shop and field fabrication, repair, and modification of the following:

- pressure-containing equipment, such as pressure vessels, heat exchangers, piping, heater tubes, and pressure boundaries of rotating equipment and attachments welded thereto;
- tanks and attachments welded thereto;
- non-removable internals for process equipment;
- structural items attached and related to process equipment;
- other equipment or component items, when referenced by an applicable purchase document.

This document is general in nature and augments the welding requirements of ASME BPVC Section IX and similar codes, standards, specifications, and practices, such as those listed in Section 2. The intent of this document is to be inclusive of chemical, oil, and gas industry standards, although there are many areas not covered herein, e.g. pipeline welding and offshore structural welding are intentionally not covered. This document is based on industry experience, and any restrictions or limitations may be waived or augmented by the purchaser. Pages: 38

3rd Edition | May 2016 | Product Number: C58203 | Price: \$149.00

TR 932-A

A Study of Corrosion in Hydroprocess Reactor Effluent Air Cooler Systems

Provides technical background for controlling corrosion in hydroprocesses reactor effluent systems based on industry experience and consensus practice. Information for this report has been gathered from open literature, private company reports, and interviews with representatives of major refining companies. The findings in this report are the basis for the guidance in Bull 932-B. Pages: 49

2nd Edition | September 2002 | Product Number: C932A0 | Price: \$164.00

RP 932-B

Design, Materials, Fabrication, Operation, and Inspection Guidelines for Corrosion Control in Hydroprocessing Reactor Effluent Air Cooler (REAC) Systems

Provides guidance to engineering and plant personnel on equipment and piping design, material selection, fabrication, operation, and inspection practices to manage corrosion and fouling in the wet sections of hydroprocessing reactor effluent systems. The reactor effluent system includes the equipment and piping subject to ammonium salting, NH_4HS corrosion, and associated fouling. This system usually begins at the last feed/effluent exchanger or first water injection point and continues through the cold high-pressure separator (1, 2, and 3 separator designs) or cold high- and low-pressure separators (4 and 5 separator designs). The reactor effluent system specifically excludes the stripper, fractionator, and final separation sections. However, guidance in this document may be applicable to ammonium salt corrosion mitigation in those areas, as well. The majority of these systems have an air cooler; however, some systems utilize only shell and tube heat exchangers. Reactor effluent systems are prone to fouling and corrosion by ammonium bisulfide (NH_4HS) and ammonium chloride (NH_4Cl) salts.

This recommended practice is applicable to process streams in which NH_4Cl and NH_4HS salts can form and deposit in equipment and piping or dissolve in water to form aqueous solutions of these salts. Included in this practice are: details of deterioration mechanisms; methods to assess and monitor the corrosivity of systems; details on materials selection, design, and fabrication of equipment for new and revamped processes; considerations in equipment repairs; and details of an inspection plan. Pages: 70

3rd Edition | June 2019 | Product Number: C932B03 | Price: \$278.00

TR 932-C ■

Use of Duplex Stainless Steels in Hydroprocessing Reactor Effluent Air Coolers (REACs)

Covers results of a survey of the petroleum refining industry concerning the use of duplex stainless steel (DSS) in hydroprocessing reactor effluent air cooler (REAC) systems. The API Committee on Refining Equipment Subcommittee on Corrosion and Materials (SCCM) commissioned this survey after several industry reports of weldment cracking failures with DSS REAC system components, including REAC header boxes, tube-to-tubesheet welds, and associated piping. REAC component weldment cracking has been addressed in SCCM documents, including TR 932-B and TR 938-C, in published conference papers, and in a report issued by the Materials Technology Institute (MTI). Pages: 48

1st Edition | August 2022 | Product Number: C932C01 | Price: \$109.00

RP 934-A

Materials and Fabrication of 2 1/4Cr-1Mo, 2 1/4Cr-1Mo-1/4V, 3Cr-1Mo, and 3Cr-1Mo-1/4V Steel Heavy Wall Pressure Vessels for High-Temperature, High-Pressure Hydrogen Service (includes Errata 1 dated September 2021)

Covers materials and fabrication requirements for new 2 1/4Cr and 3Cr steel heavy wall pressure vessels for high-temperature, high-pressure hydrogen service. For this recommended practice (RP), "heavy wall" is defined as a shell thickness of 4 in. (100 mm) or greater, and high-temperature is considered to be operating temperatures of 650 °F (345 °C) and above. This RP applies to vessels that are designed, fabricated, certified, and documented in accordance with ASME Section VIII, Division 2, including Paragraph 3.4, Supplemental Requirements for Cr-Mo Steels, and ASME Code Case 2151, as applicable.

Materials covered by this RP are conventional steels including standard 2 1/4Cr-1Mo and 3Cr-1Mo steels, and advanced steels which include 2 1/4Cr-1Mo-1/4V, 3Cr-1Mo-1/4V-Ti-B, and 3Cr-1Mo-1/4V-Nb-Ca steels. This document may be used as a reference document for the fabrication of vessels made of enhanced steels (steels with mechanical properties increased by special heat treatments such as ASME SA-542, Grade B, Class 4) at the purchaser's discretion. However, no attempt has been made to cover specific requirements for the enhanced steels and they may be different than the requirements for vanadium grade. Pages: 57

3rd Edition | January 2019 | Product Number: C934A03 | Price: \$135.00

TR 934-B ■

Fabrication Considerations for Vanadium-Modified Cr-Mo Steel Heavy Wall Pressure Vessels

Best practice guideline to be used by fabricators, in conjunction with RP 934-A, when constructing new heavy wall pressure vessels with vanadium-modified Cr-Mo steels intended for service in petroleum refining, petrochemical, or chemical facilities. These materials are primarily used in high-temperature, high-pressure services that contain hydrogen. The document provides typical practices to be followed during fabrication, based upon experience and the knowledge gained from actual problems that have occurred during the fabrication of vanadium-modified Cr-Mo steels. Pages: 44

2nd Edition | January 2022 | Product Number: C934B02 | Price: \$160.00

RP 934-C

Materials and Fabrication of 1 1/4Cr-1/2Mo Steel Heavy Wall Pressure Vessels for High-Pressure Hydrogen Service Operating at or Below 825 °F (440 °C)

Covers materials and fabrication requirements for new 1 1/4Cr-Mo steel heavy wall pressure vessels and heat exchangers for high-temperature, high-pressure hydrogen service. It applies to vessels that are designed, fabricated, certified, and documented in accordance with ASME Section VIII, Division 1 or Division 2. This document may also be used as a resource for equipment fabricated of 1Cr-1/2Mo Steel. This document may also be used as a resource when planning to modify an existing heavy wall pressure vessel.

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The interior surfaces of these heavy wall pressure vessels may have an austenitic stainless steel or ferritic stainless steel weld overlay or cladding to provide additional corrosion resistance.

For this recommended practice, “heavy wall” is defined as a shell thickness 2 in. (50 mm) or greater, but less than or equal to 4 in. (100 mm) at the time of mill heat treatment.

Although outside of its scope, this document can be used as a resource for vessels down to 1 in. (25 mm) or lower in shell thickness, with changes defined by the purchaser. Pages: 25

2nd Edition | February 2019 | Product Number: C934C02 | Price: \$118.00

TR 934-D

Technical Report on the Materials and Fabrication Issues of $1^{1/4}\text{Cr-}^{1/2}\text{Mo}$ and $1\text{Cr-}^{1/2}\text{Mo}$ Steel Pressure Vessels

Numerous $1^{1/4}\text{Cr-}^{1/2}\text{Mo}$ and $1\text{Cr-}^{1/2}\text{Mo}$ vessels have been constructed and successfully used in various applications in petroleum industry and in other types of service applications. These vessels have been constructed to the requirements of the ASME *Boiler & Pressure Vessel Code*, Section VIII, Divisions 1 and 2, and to various international pressure vessel codes and standards. The $1^{1/4}\text{Cr-}^{1/2}\text{Mo}$ and $1\text{Cr-}^{1/2}\text{Mo}$ vessels are typically used in service conditions (e.g., high temperature and/or high pressure hydrogen), which require heavy walls and cause in service deterioration. As such, the steels are subject to special requirements, such as notch toughness, elevated temperature tensile properties, hardness, fabrication heat treatments, etc., which may limit the maximum thickness to be able to meet the desired properties. Corrosion protection by stainless steel weld overlay or cladding may also be required.

This report provides background information and guidance on the implementation of RP 934-C. In recent years it has been recognized that there are important distinctions that need to be considered for $1^{1/4}\text{Cr-}^{1/2}\text{Mo}$ steels. Whereas RP 934-A continues to provide materials and fabrication requirements for new $2^{1/4}\text{Cr-}1\text{Mo}$ and $2^{1/4}\text{Cr-}1\text{Mo-}^{1/4}\text{V}$ steel heavy wall pressure vessels in high temperature, high pressure hydrogen service, different material, and fabrication requirements have been developed for $1^{1/4}\text{Cr-}^{1/2}\text{Mo}$ steel heavy wall pressure vessels. These requirements are covered in RP 934-C and 934-E. This document contains a description of key damage mechanisms that relate specifically to $1^{1/4}\text{Cr-}^{1/2}\text{Mo}$ pressure vessels used in a variety of services. These damage mechanisms include elevated temperature damage such as “reheat cracking” or “creep embrittlement,” as well as other damage mechanisms that may occur at lower temperatures. This document provides information and guidance on successful practices for fabrication of $1^{1/4}\text{Cr-}^{1/2}\text{Mo}$ steel heavy wall pressure vessels for the intended services of both RP 934-C and RP 934-E. The survey of steel producers and vessel fabricators (Annex 1) indicates that there is a need to evaluate the effect of heat treat cycles on materials properties (CVN toughness, tensile and yield strength). Pages: 56

1st Edition | September 2010

Product Number: C934D01 | Price: \$146.00

RP 934-E

Recommended Practice for Materials and Fabrication of $1^{1/4}\text{Cr-}^{1/2}\text{Mo}$ Steel Pressure Vessels for Service Above 825 °F (440 °C)

Includes materials and fabrication requirements for new $1^{1/4}\text{Cr-}^{1/2}\text{Mo}$ and $1\text{Cr-}^{1/2}\text{Mo}$ steel pressure vessels, including heat exchanger shells and channels for elevated temperature service. It applies to vessels that are designed, fabricated, and documented in accordance with ASME Code Section VIII, Division 1, or Division 2 (hereafter referred to as “Code”). This document may also be used as a resource when planning to modify existing pressure vessels. The interior surfaces of these pressure vessels and heat exchangers (i.e. the surfaces exposed to the process) may or may not have an austenitic stainless steel (SS), ferritic SS, or nickel alloy weld overlay or cladding to provide additional corrosion resistance.

This RP is primarily intended for wall thicknesses less than 4 in. (100 mm), and a preferred option for thicker components is to use $2^{1/4}\text{Cr-}1\text{Mo}$ alloys. This RP is applicable to shell thicknesses greater than 1 in. (25 mm).

Although outside of the scope, this document can be used as a resource for vessels down to lower shell thicknesses with changes defined by the purchaser. Pages: 27

2nd Edition | January 2018 | Product Number: C934E02 | Price: \$147.00

TR 934-F, Part 1

Impact of Hydrogen Embrittlement on Minimum Pressurization Temperature for Thick-Wall Cr-Mo Steel Reactors in High-Pressure H_2 Service—Initial Technical Basis for RP 934-F

In support of API Recommended Practice 934-F [*Guidance for Establishing a Minimum Pressurization Temperature (MPT) for Heavy Wall Reactors in High Temperature Hydrogen Service During Startups and Shutdowns*, not yet published], the objective of this study is to establish the technical basis for determining a minimum pressurization temperature necessary to avoid Internal Hydrogen Assisted Cracking (IHAC) of weld metal and base plate of temper embrittled $2^{1/4}\text{Cr-}1\text{Mo}$ steel in high pressure H_2 service. The threshold condition for the onset of subcritical crack propagation—and its dependencies on dissolved hydrogen concentration, temperature, and steel purity/temper embrittlement—are targeted as particularly important to pressure vessel safe operations. A second objective is to improve the underlying database for fracture mechanics fitness-for-service (FFS) modeling of IHAC. Both analyses are built on the conservative rising-displacement threshold stress intensity factor for IHAC (KIH).

This investigation has accomplished 5 tasks, leading to conclusions that are sufficient to establish RP 934-F on MPT to conservatively avoid IHAC in $2^{1/4}\text{Cr-}1\text{Mo}$ steel.

Task 1—Summarize and clarify the technical approach, assumptions, data, and modeling results used in Phase II JIP research to quantitatively establish the H concentration and temperature dependencies of the threshold stress intensity, KIH, for IHAC and the concentration dependence of MPT for moderate-impurity $2^{1/4}\text{Cr-}1\text{Mo}$ steel.

Task 2—Validate the Phase II correlation of KIH and critical temperature vs H concentration, based on new analyses of post-Phase-II IHAC data.

Task 3.0—Enhance the Phase II analysis of KIH vs crack tip H concentration, and thus MPT, by describing the interaction between temper embrittlement and IHAC using JIP Phase I data so as to predict the influence of modern steel purity.

Task 4.0—Build on the hydrogen-damage-mechanism-based master correlation between KIH and crack tip stress field/microstructure-trapped H to develop a H concentration similitude parameter that is useful in engineering analysis of thick-wall reactor FFS and MPT.

Task 5.0—Validate the empirically based trends and predictions of the effects of temperature and steel purity on the threshold stress intensity through consideration of state-of-the-art theory and micromechanical modeling of IHAC. Pages: 118

1st Edition | September 2017

Product Number: C934F101 | Price: \$202.00

TR 934-F, Part 2

Literature Review of Fracture Mechanics-Based Experimental Data for Internal Hydrogen-Assisted Cracking of Vanadium-Modified $2^{1/4}\text{Cr-}1\text{Mo}$ Steel

Documents a critical assessment of the existing literature on IHAC of V-modified Cr-Mo steels for use in interpreting the results of the present laboratory work and so as to establish a definitive characterization of the H cracking resistance of this steel class. Since these modern Cr-Mo-V steels are of relatively high purity, and thus retain a low FATT after laboratory simulation of in-service temper embrittlement, the database for $2^{1/4}\text{Cr-}1\text{Mo}$ provides a context for assessment of the IHAC performance of V-modified grades. Hydrogen cracking of less pure V-modified Cr-Mo steels was not considered in this review. The content that follows is chronologically organized into initial and more modern works, as justified by improvement in test execution, data analysis, and reporting, as well as the evolution from laboratory to commercial scale heats of Cr-Mo-V. Pages: 46

1st Edition | August 2017 | Product Number: C934F201 | Price: \$135.00

TR 934-F, Part 3

Subcritical Cracking of Modern 2¼Cr-1Mo-¼V Steel Due to Dissolved Internal Hydrogen and H₂ Environment, Research Report

Conveys the results of API-sponsored research to: (a) quantitatively characterize the internal hydrogen assisted cracking (IHAC) resistance of modern 2¼Cr-1Mo-¼V steel, in both base metal and weld metal product forms and including the effect of stressing temperature, (b) scope the hydrogen environment assisted cracking (HEAC) resistance of 2¼Cr-1Mo-¼V base metal, (c) understand the mechanism(s) for the IHAC and HEAC behaviors of Cr-Mo and Cr-Mo-V steels, centered on H interactions with microstructure-scale trap sites, and (d) assess application of data and understanding of IHAC and HEAC to determine the role of subcritical H-assisted cracking on a minimum pressurization temperature estimate relevant to thick-wall hydro-treating reactor vessels. Pages: 170

1st Edition | December 2017 | Product Number: C934F01 | Price: \$189.00

TR 934-F, Part 4

The Effects of Hydrogen for Establishing a Minimum Pressurization Temperature (MPT) for Heavy Wall Steel Reactor Vessels

Hydrogen, dissolved in the thick wall of a steel pressure vessel during steady-state operation in elevated temperature, high-pressure H₂, can cause both slow-subcritical crack advance as well as unstable-catastrophic fracture during shutdown and startup. This behavior is defined in Section 2. It follows that modern fracture-mechanics assessments of the minimum pressurization temperature (MPT) and fitness for service (FFS) must include the deleterious effect of H on both subcritical and unstable internal hydrogen assisted cracking (IHAC). Two approaches are in draft stage to develop standard procedures that address this need; an API 934-F recommended practice and a WRC Bulletin 562 basis for ASME/API 579. The objective of this technical report is to establish the technical basis necessary to enable and validate these best practices for quantifying the effects of hydrogen on (a) the MPT and (b) FFS of a thick wall hydroprocessing reactor. Pages: 112

1st Edition | November 2018

Product Number: C934F401 | Price: \$189.00

RP 934-G

Design, Fabrication, Operational Effects, Inspection, Assessment, and Repair of Coke Drums and Peripheral Components in Delayed Coking Units

Includes information and guidance on the practices used by industry practitioners on the design, fabrication, operation, inspection, assessment, and repair of coke drums and peripheral components in delayed coking units. The guidance is general and does not reflect specific details associated with a design offered by licensors of delayed coking technology, or inspection tools, operating devices/components, repairs techniques, and/or engineering assessments offered by contractors. For details associated with the design offered by a licensor or services provided by contractors, the licensor or contractor should be consulted for guidance and recommendations for their design details and operating guidance. This document is a technical report and as such provides generally used practices in industry and is not an API recommended practice for coke drums in delayed coking units. Pages: 57

1st Edition | April 2016 | Product Number: C934G01 | Price: \$163.00

TR 934-H ■

Inspection, Assessment, and Repair of Heavy Wall Reactor Vessels in High-Temperature High-Pressure Hydrogen Service

Documents guidance for the inspection, assessment, and repair of heavy wall reactor vessels [nominally considered a wall thickness of 50 mm (2 in.) and greater] in high-pressure hydrogen service operating at temperatures below 455 °C (850 °F). It provides industry practices dealing with reactor vessels after construction and exposure to operating conditions. It focuses on reactor vessels fabricated from 2¼Cr-1Mo, 3Cr-1Mo, 2¼Cr-1Mo-¼V, and 3Cr-1Mo-¼V steels. It also offers some guidance for heavy wall reactor vessels fabricated from 1Cr-½Mo and 1¼Cr-½Mo steels, but specifically does not pertain to C-½Mo steel vessels. However, guidance included in this document

can be used for C-½Mo steel reactor vessels at the owner's discretion and with modifications as appropriate. Since this is a technical report, it does not provide recommendations, but instead presents industry experience with case histories of repairs and recognized practices, much of which was documented as part of a Joint Industry Program (JIP) on Aging Reactor Vessels, conducted in two phases between 1995 and 2004. Pages: 77

1st Edition | May 2022 | Product Number: C934H01 | Price: \$115.00

TR 934-J

Inspection, Assessment and Repair of Coke Drums and Peripheral Components in Delayed Coking Units

Includes information and guidance on the practices used by industry practitioners on the inspection, assessment, and repair of coke drums and peripheral components in delayed coking units. The guidance is general and does not reflect specific details associated with a design offered by licensors of delayed coking technology or inspection tools, repair techniques, and/or engineering assessments offered by contractors. Pages: 94

1st Edition | September 2021 | Product Number: C934J01 | Price: \$132.00

Publ 935

Thermal Conductivity Measurement Study of Refractory Castables

Compares the differences between measurement techniques used to develop thermal conductivity of refractory castables. The following procedures were examined: Water Calorimeter, Calorimeter-Pilkington Method, Hot Wire Method, Comparative Thermal Conductivity Method, and Panel Test. The refractory industry uses various methods for measuring and reporting thermal conductivity. The accuracy of reporting and understanding thermal conductivity are vital to developing the most cost effective, efficient, and reliable equipment. The study makes no attempt to rank, classify or assign accuracy to each of the measurement techniques. Pages: 22

1st Edition | September 1999 | Product Number: C93501 | Price: \$66.00

Std 936 ◆

Refractory Installation Quality Control—Inspection and Testing Monolithic Refractory Linings and Materials

Provides installation quality control procedures for monolithic refractory linings and may be used to supplement owner specifications. Materials, equipment, and personnel are qualified by the methods described, and applied refractory quality is closely monitored, based on defined procedures and acceptance criteria. The responsibilities of inspection personnel who monitor and direct the quality control process are also defined. In addition, this standard provides guidance for the establishment of quality control elements necessary to achieve the defined requirements. Pages: 49

4th Edition | June 2014 | Reaffirmed: January 2022

Product Number: C93604 | Price: \$163.00

Publ 937-A

Study to Establish Relations for the Relative Strength of API 650 Cone Roof, Roof-to-Shell and Shell-to-Bottom Joints

Investigates the relative strengths of the roof-to-shell and shell-to-bottom joints, with the goal of providing suggestions for frangible roof design criteria applicable to smaller tanks. Pages: 68

1st Edition | August 2005 | Product Number: C937A0 | Price: \$133.00

Publ 938-A

An Experimental Study of Causes and Repair of Cracking of 1¼Cr-½Mo Steel Equipment

Gives the results of an experimental study conducted to provide the petroleum industry with solutions to recurring incidents of cracking in the application of welded 1¼Cr-½Mo steel for hydrogen processing equipment. Pages: 220

1st Edition | May 1996 | Product Number: C93801 | Price: \$178.00

Publ 938-B

Use of 9Cr-1Mo-V (Grade 91) Steel in the Oil Refining Industry

Provides guidelines on the proper specifications for base metal and welding consumables and successful fabrication, including welding and heat treatment requirements, for use of 9Cr-1Mo-V alloy steel in oil refinery services. This includes guidelines for preheat, postweld heat treatment, procedure qualification, and mechanical and nondestructive testing. It covers the basic material and metallurgical properties of 9Cr-1Mo-V steel, including a summary of the physical and mechanical properties, corrosion and oxidation resistance, indicating possible corrosion and/or mechanical failure mechanisms and how to avoid them. The appropriate base metal heat treatment is also given. This document also defines hardness limits for the base material and welds in order to avoid cracking failures due to wet sulfide stress corrosion cracking or due to other possible failure mechanisms. A discussion of both proper and improper refinery service applications for these steels is also provided. Pages: 40

1st Edition | June 2008 | Product Number: C938B01 | Price: \$118.00

TR 938-C

Use of Duplex Stainless Steels in the Oil Refining Industry

Covers many of the "lean," "standard," "super," and "hyper" grades of duplex stainless steels (DSSs) most commonly used within refineries. DSSs are finding increasing use in the refining industry, primarily because they often offer an economical combination of strength and corrosion resistance. These stainless steels typically have an annealed structure that is generally half ferrite and half austenite, although the ratios can vary from approximately 35/65 to 55/45. Most refinery applications where DSSs are used are corrosive, and DSSs or other higher alloys are required for adequate corrosion resistance. However, some plants are also starting to consider DSS as a "baseline" material. These plants are using DSS in applications where carbon steel may be acceptable, but DSSs have been shown to be more economical considering their higher strength and better long-term reliability.

The product forms within the scope are tubing, plate, sheet, forgings, pipe, and fittings for piping, vessel, exchanger, and tank applications. The Third Edition of this report has added castings and hot isostatically-pressed (HIP) components for pumps, valves, and other applications. The limited use of DSSs as a cladding is also briefly covered within the document. Pages: 59

3rd Edition | February 2015 | Product Number: C938C03 | Price: \$195.00

Publ 939-A

Research Report on Characterization and Monitoring of Cracking in Wet H₂S Service

Demonstrates the ability to characterize and monitor various aspects of crack propagation in pressurized process equipment exposed to wet hydrogen sulfide environments. It represents one of several significant industry-wide efforts to study and to better understand this phenomenon. Pages: 136

1st Edition | October 1994 | Product Number: C93901 | Price: \$170.00

Publ 939-B

Repair and Remediation Strategies for Equipment Operating in Wet H₂S Service

Presents data relative to the fabrication requirements for 2¹/₄ 3Cr alloy steel heavy wall pressure vessels for high temperature, high pressure hydrogen services. It summarizes the results of industry experience, experimentation, and testing conducted by independent manufacturers, fabricators, and users of heavy wall pressure vessels. This recommended practice applies to equipment in refineries, petrochemical, and chemical facilities in which hydrogen or hydrogen-containing fluids are processed at elevated temperature and pressure. Pages: 236

1st Edition | June 2002 | Product Number: C939B0 | Price: \$185.00

RP 939-C

Guidelines for Avoiding Sulfidation (Sulfidic) Corrosion Failures in Oil Refineries

Applies to hydrocarbon process streams with sulfur-containing compounds, without the presence of hydrogen, that operate at temperatures above approximately 500 °F (260 °C) up to about 1000 °F (540 °C). There is considerable debate in the industry as to the correct threshold temperature for hydrogen-free sulfidation and, in a change in this edition, the API 571 threshold of 500 °F (260 °C) is adopted herein. Experience has shown that little significant corrosion will occur at operating temperatures below 500 °F (260 °C) for hydrogen free sulfidation services without the influence of naphthenic acid corrosion. Mercaptan corrosion, particularly in condensate service, has been reported below this temperature, but is not explicitly covered in the 2nd Edition of RP 939-C. For hydrogen-containing services, the threshold temperature is set at 450 °F (230 °C).

A lower threshold limit for sulfur content is not provided because significant corrosion has occurred in the reboiler/fractionator sections of some hydroprocessing units (which do not contain hydrogen) at measured sulfur or H₂S levels as low as 1 ppm. Pages: 59

2nd Edition | January 2019 | Product Number: C939C02 | Price: \$150.00

TR 939-D

Stress Corrosion Cracking of Carbon Steel in Fuel-Grade Ethanol: Review, Experience Survey, Field Monitoring, and Laboratory Testing (includes Addendum 1 dated October 2013)

Addresses stress corrosion cracking (SCC) in carbon steel equipment used in distribution, transportation, storage, and blending of denatured fuel ethanol. API, with assistance from the Renewable Fuels Association (RFA), conducted research on the potential for metal cracking and product leakage in certain portions of the fuel ethanol distribution system. TR 939-D contains a review of existing literature, results of an industry survey on cracking events and corrosion field monitoring, and information on mitigation and prevention. Pages: 172

2nd Edition | May 2007 | Product Number: C939D0 | Price: \$174.00

Bull 939-E

Identification, Repair, and Mitigation of Cracking of Steel Equipment in Fuel Ethanol Service

Usage of fuel ethanol as an oxygenate additive in gasoline blends is increasing, both in the United States and internationally. This document discusses stress corrosion cracking (SCC) of carbon steel tanks, piping and equipment exposed to fuel ethanol as a consequence of being in the distribution system, at ethanol distribution facilities, or end user facilities where the fuel ethanol is eventually added to gasoline. Such equipment includes but is not limited to:

- storage tanks,
- piping and related handling equipment, and
- pipelines that are used in distribution, handling, storage, and blending of fuel ethanol.

However, data for pipelines in ethanol service is limited and caution should be used when applying guidelines from this document, which have been derived mainly from applications involving piping and tanks in ethanol storage and blending facilities. SCC of other metals and alloys is beyond the scope of this document, as is the corrosion of steel in this service. Pages: 42

2nd Edition | August 2013 | Product Number: C939E02 | Price: \$174.00

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RP 941

Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants

(includes Errata 1 dated June 2016, Errata 2 dated December 2017, and Addendum 1 dated August 2020)

Summarizes the results of experimental tests and actual data acquired from operating plants to establish practical operating limits for carbon and low alloy steels in hydrogen service at elevated temperatures and pressures. The effects on the resistance of steels to hydrogen at elevated temperature and pressure that result from high stress, heat treating, chemical composition, and cladding are discussed. This recommended practice (RP) does not address the resistance of steels to hydrogen at lower temperatures [below about 400 °F (204 °C)], where atomic hydrogen enters the steel as a result of an electrochemical mechanism.

This RP applies to equipment in refineries, petrochemical facilities, and chemical facilities in which hydrogen or hydrogen-containing fluids are processed at elevated temperature and pressure. The guidelines in this RP can also be applied to hydrogenation plants such as those that manufacture ammonia, methanol, edible oils, and higher alcohols.

The steels discussed in this RP resist high temperature hydrogen attack (HTHA) when operated within the guidelines given. However, they may not be resistant to other corrosives present in a process stream or to other metallurgical damage mechanisms that can occur in the operating HTHA range. This RP also does not address the issues surrounding possible damage from rapid cooling of the metal after it has been in high temperature, high pressure hydrogen service (e.g. possible need for outgassing hydroprocessing reactors). This RP will discuss in detail only the resistance of steels to HTHA.

Presented in this document are curves that indicate the operating limits of temperature and hydrogen partial pressure for satisfactory resistance of carbon steel and Cr-Mo steels to HTHA in elevated temperature, hydrogen service. In addition, it includes a summary of inspection methods to evaluate equipment for the existence of HTHA. Pages: 45

8th Edition | February 2016 | Product Number: C94108 | Price: \$152.00

TR 941-A

The Technical Basis Document for API RP 941

(includes Addendum 1 dated June 2019)

Even before the first edition of API Publ 941, *Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants* appeared in 1970, there had been fundamental questions regarding the technical basis for the material performance curves contained in the document (1–6). Based upon sparse laboratory data combined with plant experience, with only a few exceptions, the curves have done an exceptionally good job at safely directing the refining industry in selecting materials based upon operating temperature, hydrogen partial pressure, and the metallurgy of the equipment being considered. Pages: 301

1st Edition | September 2008 | Product Number: C09410 | Price: \$215.00

TR 942-A

Materials, Fabrication, and Repair Considerations for Hydrogen Reformer Furnace Outlet Pigtailed and Manifolds

Addresses materials, fabrication, and repair issues related to hydrogen and syngas reformer furnace outlet pigtailed and manifolds. High reliability of outlet pigtailed and manifold components, such as headers, tees, and fittings, is important to the successful long-term operation of hydrogen and syngas reformer furnaces. These components typically operate at high temperatures in the range of 750 to 950 °C (1382 to 1742 °F) where they are potentially subject to high-temperature creep, stress relaxation, hot corrosion, and thermal fatigue damage. In recent years a number of reformer furnace operators have encountered problems of in-service degradation and cracking of outlet pigtailed and manifold components, while others have had little or no problems of this type. Both direct experience in addressing specific cases of outlet pigtail and manifold cracking problems and indirect experience gained from surveying industry with regard to these problems were used in preparing this report. The objective of the project was to develop an understanding, based on published literature and industry

experience, of why some reformer furnaces have had problems with embrittlement and cracking of outlet pigtailed and manifold components in service, while others have not had such problems. Pages: 53

1st Edition | June 2014 | Product Number: C942A01 | Price: \$152.00

TR 942-B

Material, Fabrication, and Repair Considerations for Austenitic Alloys Subject to Embrittlement and Cracking in High Temperature 565 °C to 760 °C (1050 °F to 1400 °F) Refinery Services

Focuses on the materials, fabrication, and repair of austenitic stainless steels and nickel-iron-chromium alloys in high temperature 565 °C to 760 °C (1050 °F to 1400 °F) refinery services. Many of these alloys are subject to embrittlement and cracking after prolonged exposure to these temperatures. Susceptible equipment in the following processing units are addressed: fluid catalytic cracking units, hydrogen/syngas plants, catalytic reformers, cokers, and hydroprocessing units. This report summarizes industry experience and recommends methods to improve reliability and process safety, and increases industry awareness to high temperature embrittlement issues.

As a basis of this report, technical literature, industry experience, and published case studies were reviewed. The review included materials of construction, damage mechanisms, and component-specific fabrication and repair issues.

The scope of this report includes the following wrought austenitic alloys: Alloys 800, 800H, 800HT, and 300 series austenitic stainless steels, and corresponding welding consumables. Limits in chemical composition, microstructural requirements, and heat treating practices that mitigate susceptibility to embrittlement and cracking are identified. Potentially viable upgrades to commonly used alloys are identified where applicable.

The remainder of this report is organized as follows: Section 3, Process Units, gives a brief process overview followed by an explanation of the various damage mechanisms found in that unit. Component specific considerations and examples of in-service damage are also included. Inspection recommendations and general repair method considerations are also included. Section 4, Damage Mechanisms, contains detailed discussions of high-temperature damage mechanisms, including fundamental details of the solid state reactions, their rate of reaction, and recommended mitigation measures. Section 4 also incorporates fabrication and repair practices that can be used for cracked or embrittled equipment. Pages: 88

1st Edition | May 2017 | Effective Date: November 1, 2017

Product Number: C942B01 | Price: \$187.00

RP 945 ■

Avoiding Environmental Cracking in Amine Units

Discusses environmental cracking problems of carbon steel equipment in amine units. This publication provides guidelines for carbon steel construction materials, including, fabrication, inspection, and repair, to help assure safe and reliable operation. The steels referred to in this document are defined by the ASTM designation system, or equivalent materials contained in other recognized codes or standards. This document is based on current engineering practices and insights from recent industry experience. Pages: 46

4th Edition | September 2022 | Product Number: C94504 | Price: \$110.00

Publ 959

Characterization Study of Temper Embrittlement of Chromium-Molybdenum Steels

Evaluates the temper embrittlement characteristics of Cr-Mo pressure vessel steels. The steels are designated A387 in Part 4 of the ASTM Book of Standards. Most of the samples studied were of Grade 22 (2^{-1/4}-1Mo) and a few samples of Grades 11 and 21 were also included, (1^{-1/4}Cr-1/2Mo, 3Cr-1Mo). The 64 samples studied represented a wide range of commercially available steel, including qualification welds in 1-in. and 6-in. steel plate, large nozzle cut-outs, and randomly-shaped pieces of forging material. These materials received heat treatment typical of hydro-treater reactor fabrication.

Refining

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The objective of this program was to characterize typical commercial reactor steels and weldments in terms of toughness and other physical properties prior to being placed in service and the changes anticipated in toughness due to long-time service at elevated temperatures.

It is important to note that the materials studied were typical of commercial production and fabrication up to about 1975 and are not representative of plate, forgings, and weld metal having low temper embrittlement susceptibility, generally available after 1975. Pages: 145

1st Edition | January 1982 | Product Number: C95900 | Price: \$171.00

RP 970

Corrosion Control Documents

Provides users with the basic elements for developing, implementing and maintaining a Corrosion Control Document (CCD) for refining, and at the owner's discretion, may be applied at petrochemical and chemical process facilities. A CCD is a document or other repository or system that contains all the necessary information to understand materials damage susceptibility issues in a specific type of operating process unit at a plant site.

CCDs are a valuable addition to an effective Mechanical Integrity Program. They help to identify the damage mechanism susceptibilities of pressure containing piping and equipment, factors that influence damage mechanism susceptibilities, and recommended actions to mitigate the risk of loss of containment or unplanned outages.

This recommended practice serves as the basis for tracking CCD development, implementation, and maintenance to maintain consistency and to integrate the CCD work process with other plant integrity programs, such as Management of Change (MOC), Process Hazards Analysis (PHA), and Reliability Centered Maintenance (RCM). Some of these programs have significant overlap with the development of CCDs, including Risk-Based Inspection studies (see RP 580 and RP 581), Integrity Operating Windows (see RP 584), in-house unit corrosion reviews, circuitization/systemization programs, and similar types of corrosion studies. Development of CCDs can serve as a useful starting point for establishing these programs if they have not been undertaken.

This recommended practice provides the owner/user with information and guidance on the work processes for development and implementation of CCDs for the owners'/users' process units. Pages: 59

1st Edition | December 2017 | Product Number: C97001 | Price: \$202.00

Std 975

Refractory Installation Quality Control—Inspection and Testing of Refractory Brick Systems and Materials

Provides installation quality control (QC) procedures for aluminum silicate dense and insulating fire brick refractory systems and may be used to supplement owner specifications. Materials, equipment, and personnel are qualified by the methods described, and applied refractory quality is closely monitored, based on defined procedures and acceptance criteria. The responsibilities of inspection personnel who monitor and direct the QC process are also defined. Pages: 40

1st Edition | November 2021 | Product Number: C97501 | Price: \$94.00

Std 976

Refractory Installation Quality Control—Inspection and Testing of AES/RCF Fiber Linings and Materials

Provides installation quality control procedures and lining system design requirements for AES/RCF fiber linings and may be used to supplement owner specifications. Materials, equipment, and personnel are qualified by the methods described, and applied refractory quality is closely monitored, based on defined procedures and acceptance criteria. The responsibilities of inspection personnel who monitor and direct the quality control process are also defined. The lining described in this standard is for internal refractory linings on the process side of the equipment. External insulation and jacketing are not covered in this standard. Pages: 34

1st Edition | March 2018 | Product Number: C97601 | Price: \$131.00

TR 977

ASTM C704 Test Variability Reduced to Allow Further Optimization of Erosion-Resistant Refractories for Critical Oil Refining Applications

Documents the results of a joint project conducted by the API CRE Subcommittee on Refractory Materials and the ASTM C08 Committee to improve the reproducibility of the 2015 edition of ASTM C704/C704M, *Standard Test Method for Abrasion Resistance of Refractory Materials at Room Temperature*. Erosion-resistant refractories are used in many oil refining applications, such as Fluid Catalytic Cracking Units (FCCUs), to resist the wearing effects of solids particles circulating at elevated velocities in a high-temperature process environment. This technical report also reviews the drivers for continuing improvement in erosion-resistant refractories and the role of ASTM C704/C704M for the selection and installation quality control of refractories used in these installations. This report documents changes made to the setup and procedures to improve the reproducibility of the test. These changes are designed to achieve this end, while providing a rough equivalency consistent with historical data before the changes were made. These results are validated by the results of extensive international round-robin and ruggedness testing, and are reported herein. Pages: 27

1st Edition | February 2018 | Product Number: C97701 | Price: \$120.00

TR 978

Monolithic Refractories: Manufacture, Properties, and Selection

Covers the installation and dryout of monolithic refractory lining materials for Hydrocarbon Processing Industry (HPI) applications. It discusses the best practice procedures and techniques used in the installation of refractory concrete, as well as those for air and heat setting plastics and ramming mixes. In addition, it addresses the need for curing and dryout procedures to achieve successful results. This instruction is consistent with API 936, which is the HPI industry standard for the installation quality control of monolithic refractories. Pages: 82

1st Edition | March 2019 | Product Number: C97801 | Price: \$115.00

TR 979

Applications of Refractory Lining Materials

Covers the use of refractory concrete (castables), plastics, and ramming mixes for applications for the hydrocarbon processing industry (HPI). Its content is complemented by the two other reports in this series:

- API TR 978, *Monolithic Refractories: Manufacture, Properties and Selection*;
- API TR 980, *Monolithic Refractories: Installation and Dryout*.

These technical reports update and add to the original reports written by Committee 547 of the American Concrete Institute (ACI) in 1979 and 1989. These are ACI 547.R-79, *State-of-the Art Report: Refractory Concrete*, and ACI 547.1R-89, *State-of-the Art Report: Refractory Plastics and Ramming Mixes*. TR 979 focuses specifically on the information on the applications of refractories contained in ACI 547.R-79 and ACI 547.1R-89.

The original content of these reports was focused primarily on steel- and glass-making applications, which represent the largest refractory markets. API, in tailoring the revision of this content to the HPI, has greatly expanded the text pertaining to the specialized oil-refining and petrochemical-processing applications. At the same time, API has retained and updated the information covering applications outside of the HPI (see Section 5) because of the similarities and applicability that this information has for refractory professionals in these other industries. Pages: 63

1st Edition | October 2018 | Product Number: C97901 | Price: \$135.00

Refining

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TR 980

Monolithic Refractories: Installation and Dryout

Covers the installation and dryout of monolithic refractory lining materials for hydrocarbon processing industry (HPI) applications. It discusses the best practice procedures and techniques used in the installation of refractory concrete, as well as those for air-and heat-setting plastics and ramming mixes. In addition, it discusses the need for curing and dryout and procedures to achieve successful results. This instruction is consistent with Std 936, which is the HPI industry standard for the installation quality control of monolithic refractories. It also serves as the body of knowledge document for the API 936 Refractory Personnel Certification Program. This report is the last in a series of three API reports covering the use of refractory concrete (castables), plastics, and ramming mixes for applications for the hydrocarbon processing industry. Its content is complemented by the two other reports in this series:

- API TR 978, *Monolithic Refractories: Manufacture, Properties and Selection*, and
- API TR 979, *Applications of Refractory Lining Materials*. Pages: 66

1st Edition | April 2018 | Product Number: G98001 | Price: \$157.00

TR 981

Thermal Expansion Under Load and Creep of Refractories—An Evaluation and Comparison of Testing Methods

Documents the results of thermal expansion under load (TEUL) and creep in compression testing conducted by ASTM C832 and DIN 993-9 (same test as ISO 3187). The prime objective for this study is to determine if one or both tests should replace the ASTM C16 method. ASTM C16, modified from 1.5-hour to 100-hour hold, has been widely used to qualify brick for sulfur reaction furnace use. In addition to deformation after 100 hours, the creep tests will provide additional information of TEUL and evidence of mineralogical changes during their early life cycle in process operation. Pages: 28

1st Edition | March 2021 | Product Number: C98101 | Price: \$88.00

PETROLEUM PRODUCTS AND PETROLEUM PRODUCT SURVEYS

API/NPRA Survey

Final Report: 1996 API/NPRA Survey of Refining Operations and Product Quality

A survey of industry refining data for the period May 1 through August 31, 1996. The report includes information on domestically produced gasoline and diesel product quality as well as aggregate domestic refining capacity and average operating data. Pages: 190

1st Edition | July 1997 | Product Number: F10001 | Price: \$67.00

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Publ 4261

Alcohols and Ethers: A Technical Assessment of Their Application as Fuels and Fuel Components

Summarizes information from the technical literature on producing and applying alcohols and ethers as fuels and fuel components for the transportation sector. It assesses the technical advantages and disadvantages of alcohols and ethers with respect to hydrocarbon fuels. Since the amendment of the Clean Air Act in 1977, and subsequently in 1990, public interest in the role of oxygenates in transportation has significantly increased. This edition of Publ 4261 has been updated and expanded to include a review of the oxygenate regulations and the technical literature that has been published since 1988. It provides a technical assessment suitable for policy discussions related to alcohols and ethers in transportation. Pages: 119

3rd Edition | June 2001 | Product Number: C42613 | Price: \$176.00

Publ 4262

Methanol Vehicle Emissions

December 1990 | Product Number: F42620 | Price: \$136.00

PROCESS SAFETY STANDARDS

RP 752

Management of Hazards Associated with Location of Process Plant Permanent Buildings

Provides guidance for managing the risk from explosions, fires and toxic material releases to on-site personnel located in new and existing buildings intended for occupancy. This RP was developed for use at refineries, petrochemical and chemical operations, natural gas liquids extraction plants, natural gas liquefaction plants, and other onshore facilities covered by the OSHA Process Safety Management of Highly Hazardous Chemicals, 29 CFR 1910.119.

Buildings covered by this RP are rigid structures intended for permanent use in fixed locations. Tents, fabric enclosures and other soft-sided structures are outside the scope of this document. This 3rd Edition of RP 752:2009 supersedes all previous editions, including the technical data provided in those documents.

Significant research and development of technology pertinent to building siting evaluations has been performed since the publication of the previous editions of RP 752. Examples of updated technology include prediction of blast damage to buildings, determination of occupant vulnerabilities, and estimates of event frequencies. Prior versions of RP 752 and the technical data included in them should not be used for building siting evaluations. The 2nd Edition of RP 752 covered all building types both permanent and portable. This 3rd Edition of RP 752 does not cover portable buildings. Portable buildings are now covered by RP 753. It is recognized, however, that portable buildings specifically designed for significant blast load represent a potential area of overlap between RP 753 and RP 752. In accordance with 1.3 of this document:

“Buildings described in API RP 753, Management of Hazards Associated with Location of Process Plant Portable Buildings, First Edition, June 2007, as ‘portable buildings specifically designed to resist significant blast loads’ and intended for permanent use in a fixed location are covered in this document (API RP 752). All other portable buildings are covered by API RP 753.” Pages: 27

3rd Edition | December 2009 | Reaffirmed: August 2020

Product Number: K75203 | Price: \$153.00

Refining

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RP 753

Management of Hazards Associated with Location of Process Plant Portable Buildings

Provides guidance for reducing the risk to personnel located in portable buildings from potential explosion, fire and toxic release hazards. While occupied permanent buildings (e.g. control rooms, operator shelters) located near covered process area are typically constructed to be blast and fire resistant, conventional portable buildings (i.e. light wood trailers) are typically not constructed to be blast and fire resistant. Past explosion accidents have demonstrated that occupants of conventional portable buildings are susceptible to injuries from structural failures, building collapse, and building debris and projectiles.

Guidance is provided based on the following principles.

- Locate personnel away from covered process areas consistent with safe and effective operations.
- Minimize the use of occupied portable buildings in close proximity to covered process areas.
- Manage the occupancy of portable building especially during periods of increased risk including unit start up or planned shut-down operations.
- Design, construct, install, and maintain occupied portable buildings to protect occupants against potential hazards.
- Manage the use of portable buildings as an integral part of the design, construction, and maintenance operation of a facility. Pages: 22

1st Edition | June 2007 | Reaffirmed: August 2020

Product Number: K75301 | Price: \$153.00

RP 754

Process Safety Performance Indicators for the Refining and Petrochemical Industries (ANSI/API RP 754)

Identifies leading and lagging process safety indicators useful for driving performance improvement. As a framework for measuring activity, status, or performance, this document classifies process safety indicators into four tiers of leading and lagging indicators. Tiers 1 and 2 are suitable for nationwide public reporting and Tiers 3 and 4 are intended for internal use at individual facilities. Guidance on methods for development and use of performance indicators is also provided. This RP was developed for the refining and petrochemical industries, but may also be applicable to other industries with operating systems and processes where loss of containment has the potential to cause harm. Applicability is not limited to those facilities covered by the OSHA Process Safety Management Standard, 29 CFR 1910.119, or similar national and international regulations. Pages: 134

3rd Edition | August 2021 | Product Number: K75403 | Price: \$182.00

RP 755

Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries (ANSI/API RP 755)

Provides guidance to all stakeholders (e.g. employees, managers, supervisors) on understanding, recognizing, and managing employee fatigue in the workplace. Should sites decide to use this document, the owners/operators shall establish policies and procedures to meet the purpose of this recommended practice.

This document was developed for refineries, petrochemical and chemical operations, natural gas liquefaction plants, and other facilities such as those covered by the OSHA Process Safety Management Standard, 29 CFR 1910.119. This document is intended to apply to a workforce that is commuting daily to a job location.

ANSI/API RP 755 applies to all employees working night shifts, rotating shifts, extended hours/days, or call outs who are involved in process safety-sensitive actions. It should also be considered for others making process

safety-sensitive decisions. On-site contractors involved in process safety-sensitive actions shall have fatigue risk management systems equivalent to the criteria outlined in this document. Pages: 17

2nd Edition | May 2019 | Product Number: K75502 | Price: \$145.00

TR 755-1

Technical Support Document for ANSI/API RP 755, *Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries*

Identifies and explains the scientific and operational issues considered during the preparation of RP 755. By providing the reasoning behind the specific wording in the RP 755 document, this document supports each key statement in RP 755 in sequence so that it can be used in parallel with the RP 755 text. To make this document accessible and manageable, key scientific sources and references are provided to help readers gain access to the scientific literature.

Fatigue Risk Management Systems (FRMS) have emerged and been widely recognized as a more effective approach to managing and mitigating employee fatigue risk in the 24/7 workplace. The core feature of the FRMS is that it is a data-driven, risk-informed, safety performance-based system. The FRMS implementation process first identifies all sources of fatigue risk in the business operation, then introduces mitigating policies, technologies, and procedures to reduce the risk, and most importantly then maintains them in a proactively managed continuous improvement system. The history of FRMS was recently summarized.

This method represents a significant step change from the traditional approaches of either relying on maximum limits to hours of work or minimum limits to hours of rest (variously called Hours of Service, Work-Rest Rules, Working Time Directives), or adopting intermittent or piece-meal solutions (e.g. a fatigue training program or a shift schedule redesign), depending on the interests and initiative of local site managers.

One essential feature of FRMS is that it is a system meant to be improved upon on a regular and continuous basis. It is not a set of guidelines designed for one-time compliance but instead provides a framework that will evolve over time, driven by the collection of data on fatigue risk and fatigue outcomes (e.g. fatigue-related incidents). Pages: 49

1st Edition | April 2010 | Product Number: K755101 | Price: \$112.00

RP 756

Management of Hazards Associated with Location of Process Plant Tents

Provides guidance for managing the risk from explosions, fires and toxic material releases to on-site personnel located in tents. The term "tent" is used to describe a wide range of structures and is defined in §3.15. This RP was developed for use at refineries, petrochemical and chemical operations, natural gas liquids extraction plants, natural gas liquefaction plants, and other onshore facilities covered by OSHA 29 CFR 1910.119.

The focus of this RP is primarily on process related hazards. However, non-process related hazards may exist which could present risks to tent occupants. Previous accidents have demonstrated that tent occupants are susceptible to injuries from fires originating inside the tent, from tent collapse due to extreme weather, and from falling objects. Some of these hazards are addressed by tent design standards, manufacturer's recommendations, and local regulations. Pages: 25

1st Edition | September 2014 | Reaffirmed: August 2020

Product Number: C75601 | Price: \$136.00

Refining

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TR 756-1

Process Plant Tent Responses to Vapor Cloud Explosions—Results of the American Petroleum Institute Tent Testing Program

Beginning in 2011, the American Petroleum Institute (API) performed vapor cloud explosion (VCE) tests to determine the response of tents to the potential explosion hazards that may be present at refineries, petrochemical and chemical operations, natural gas and other onshore process facilities covered by OSHA 29 CFR 1910.119. The testing was conducted to provide data for use by the API committee developing RP 756. This publication, TR 756-1, contains information on the results of the API tent testing program. Pages: 597

1st Edition | September 2014 | Product Number: C756101 | Price: \$206.00

HEALTH, ENVIRONMENT, AND SAFETY: GENERAL

Cumulative Impact of Environmental Regulations on the U.S. Petroleum Refining, Transportation and Marketing Industries

1st Edition | Product Number: C00015 | available at <https://www.api.org>

RP 751

Safe Operation of Hydrofluoric Acid Alkylation Units

Provides requirements (shall) and recommendations (should) for practices and procedures related to safety, operations, design, inspection, and maintenance to support the safe and reliable operation of hydrofluoric acid (HF) alkylation units. Topics include hazard management; operating procedures and worker protection; materials, construction, inspection, and work practices; transportation and inventory control; pressure-relief, product treatment, and utility systems; and risk mitigation. This document contains requirements and recommendations that have been found effective based on broad industry acceptance, proven effective industry practices, testing, and regulatory requirements. Pages: 181

5th Edition | August 2021 | Product Number: K75105 | Price: \$194.00

Std 2350

Overfill Protection for Storage Tanks in Petroleum Facilities

(includes Errata 1 dated April 2021)
(ANSI/API Std 2350))

Applies to storage tanks associated with marketing, refining, pipeline, and terminals operations and with tanks containing Class I or Class II petroleum liquids and use is recommended for Class III petroleum liquids. This standard addresses overfill protection for petroleum storage tanks. It recognizes that prevention provides the most basic level of protection, thus while using both terms "protection" and "prevention," the document emphasizes prevention. The standard's scope covers overfill (and damage) prevention practices for aboveground storage tanks in petroleum facilities, including refineries, marketing terminals, bulk plants, and pipeline terminals that receive flammable and combustible liquids. The fourth edition continues to build on experience and new technology through the use of management systems. Since operations are the primary overfill prevention safeguard, new definitions and requirements are established for alarms. Risk reduction is also addressed by current and generally accepted industry practices.

The essential elements of this document are based on current industry safe operating practices and existing consensus standards. Federal, state, and local regulations or laws may contain additional requirements for tank overfill protection programs. For existing facilities, the results of a risk-based analysis of aboveground atmospheric petroleum storage tanks may indicate the need for more protection against overfilling. In such cases, some provisions from this standard may be suitable.

The purpose of this standard is to assist owner/operators and operating personnel in the prevention of tank overfills by implementation of a comprehensive overfill prevention process (OPP). The goal is to receive product into the intended storage tank without overfill or loss of containment.

This standard does not apply to: underground storage tanks; aboveground tanks of 1320 U.S. gallons (5000 liters) or less; aboveground tanks which comply with PEI 600; pressure vessels; tanks containing non-petroleum liquids; tanks storing LPG and LNG; tanks at service stations; tanks filled

exclusively from wheeled vehicles (i.e. tank trucks or railroad tank cars); and tanks covered by OSHA 29 CFR 1910.119 and EPA 40 CFR 68, or similar regulations. Pages: 75

5th Edition | September 2020

Product Number: K235005 | Price: \$135.00

HEALTH, ENVIRONMENT, AND SAFETY: SOIL AND GROUNDWATER

Publ 422

Groundwater Protection Programs for Petroleum Refining and Storage Facilities: A Guidance Document

Reflects continuing industry action and commitment to positively address groundwater protection by developing and implementing individual groundwater protection plans. Provides additional guidance to help petroleum facilities identify the types of issues that may need to be addressed in a groundwater protection plan. Intended to help refineries, terminals associated with transportation pipelines, product distribution terminals, and other downstream petroleum storage units develop groundwater protection plans that are tailored to their individual circumstances. Pages: 9

1st Edition | October 1994 | Product Number: C42201 | Price: \$71.00

Publ 800

Literature Survey: Subsurface and Groundwater Protection Related to Petroleum Refinery Operations

This report is the principal product of an API-sponsored project to prepare a background basis for the development of further information on subsurface and groundwater protection at refineries. It contains an explanation of how the literature survey was conducted; annotations for pertinent articles; a discussion of applicable federal statutes and regulations; and annotations for pertinent regulatory programs under the 5 principal statutes that apply to refinery operations. Pages: 145

1st Edition | September 1988 | Product Number: C80000 | Price: \$100.00

SECURITY

Std 780

Security Risk Assessment Methodology for the Petroleum and Petrochemical Industries

Prepared by a Security Risk Assessment (SRA) Committee of the American Petroleum Institute (API) to assist the petroleum and petrochemical industries in understanding security risk assessment and in conducting SRAs. The standard describes the recommended approach for assessing security risk widely applicable to the types of facilities operated by the industry and the security issues the industry faces. The standard is intended for those responsible for conducting security risk assessments and managing security at these facilities. The method described in this standard is widely applicable to a full spectrum of security issues from theft to insider sabotage to terrorism. The API SRA Methodology was developed for the petroleum and petrochemical industry, for a broad variety of both fixed and mobile applications. This recommended practice describes a single methodology, rather than a general framework for SRAs, but the methodology is flexible and adaptable to the needs of the user. This methodology constitutes one approach for assessing security vulnerabilities at petroleum and petrochemical industry facilities. However, there are other risk assessment techniques and methods available to industry, all of which share common risk assessment elements. Pages: 113

1st Edition | May 2013 | Reaffirmed: February 2022

Product Number: K78001 | Price: \$206.00

Refining

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RP 781

Facility Security Plan Methodology for the Oil and Natural Gas Industries

Provides the framework to establish a secure workplace. The plan provides an overview of the threats facing the facility and describes the security measures and procedures designed to mitigate risk and protect people, assets, operations, and company reputation. This API standard was prepared with guidance and direction from the API Security Committee, to assist the petroleum and petrochemical industries in the preparation of a Facility Security Plan (FSP). This standard specifies the requirements for preparing an FSP as well as a discussion of the typical elements included in an FSP.

This standard is intended to be flexible and adaptable to the needs of the user. It is noted that the content of an FSP can vary depending on circumstances such as facility size, location, and operations. This methodology is one approach for preparing an FSP at petroleum and petrochemical facilities. There are other security plan formats available for the industry. It is the responsibility of the user to choose the format and content of the FSP that best meets the needs of a specific facility. The format and content of some FSPs should be dictated by government regulations for covered facilities. This standard is not intended to supersede the requirements of any regulated facility but may be used as a reference document. Pages: 82

1st Edition | September 2016 | Product Number: K78101 | Price: \$157.00