



Changes Between API STD 520 – Part II 6th Ed and 5th Ed Cataloged

**Dustin Smith
Smith & Burgess LLC
7600 W Tidwell, Houston, TX
Dustin.Smith@smithburgess.com**

**John Burgess
Jessye Palladino
Smith & Burgess LLC
7600 W Tidwell, Houston, TX**

Smith & Burgess LLC grants AIChE permission for itself and its designated agents to reproduce, sell, or distribute this paper. Copyright to this paper is retained by Smith & Burgess LLC, from whom permission to reproduce must be obtained by any other party. All information deemed reliable but may not be applicable to any given installation. Any risk assessment or safety analysis should be independently verified by a qualified engineer.

Prepared for Presentation at
American Institute of Chemical Engineers
2015 Spring Meeting
11th Global Congress on Process Safety
Austin, Texas
April 27-30, 2015

UNPUBLISHED

AIChE shall not be responsible for statements or opinions contained
in papers or printed in its publications

Changes Between API STD 520 – Part II 6th Ed and 5th Ed Cataloged

Dustin Smith
John Burgess
Jessye Palladino
Smith & Burgess LLC
7600 W Tidwell, Houston, TX
Dustin.Smith@smithburgess.com

Keywords: API STD 520 – Part II, PSM Compliance, Relief Device Installation, Relief Device Inlet Pressure Losses, Relief Device Backpressure Limits

Abstract

American Petroleum Institute (API) STD 520 – Part II, Sizing, Selection, and Installation of Pressure-Relieving Devices in Part II—Installation, is perhaps the most thorough published guideline on how to install relief devices. This paper reviews the differences between the 6th Edition of API STD 520 Part II (Published in 2015) and the 5th edition (Published in 2003, Reaffirmed in 2011). The authors will review changes and highlight several new requirements that are deemed critical to relief system installations. The paper is based on a comprehensive review of the two documents and is a valuable resource for any engineer or process designer who needs to be knowledgeable of the latest relief systems recommendations.

1. Background

This paper provides the reader with a summarized listing of the changes between the current (6th edition) and past (5th edition) of *API Standard 520 Part II- Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries Part II—Installation* (hereafter referred to as “520-Part II”) [1, 2]. This API document provides guidance for the installation of pressure relief valves, rupture disks, and inlet and outlet piping considerations for pressure relief devices.

As Table 1 shows, a considerable amount of guidance has been added to the 6th edition of 520-Part II.

Table 1. Summary of Guidance in the 6th/5th Editions of API STD 520-Part II

Items	5 th Edition (2011)	6 th Edition (2015)
“Should” Appears	102	172
“Shall” Appears	38	58
Pages	29	55

In addition, note that the 5th edition was issued as an API recommended practice. The current (as of the time of writing) 6th Edition is issued as a API standard.

Note: Do not add page numbers. Do not refer to page numbers when referencing different portions of the paper

In addition, the scope of the document was further clarified to ensure that the users knew that the standard covers the installation methods of pressure relief devices (PRDs) for systems with maximum allowable working pressure (MAWP) equal to or greater than 15 psig. This edition of API 520-II discusses the installation of PRDs for the use with compressible, incompressible, and 2-phase systems. However, it is noted that the standard does not cover systems with special applications that need unique installations. Additionally, this standard is stated to be used in tandem with sound business, scientific, engineering, and safety judgments.

1.1 Terms and usage

The following helps the reader of this paper with some of the acronyms and terms.

1.1.1 SCPRS

The API Committee on Refinery Equipment (CRE) subcommittee that is responsible for this document is the Subcommittee on Pressure-Relieving Systems (SCPRS).

1.1.2 PRDs

Pressure relieving devices, that refers to pressure relief valves (PRVs) and/or rupture disks (RDs).

1.1.3 Section References

Unless otherwise mentioned, the section numbers referred to are for the 6th ed. of 520-Part II. Section numbers that are prefaced by “§” reference the API standard and not this paper.

2. Summary of changes

The changes are broken down by categories in Table 2. The remainder of this paper will follow the order shown in the following table.

Table 2. Organization of the Summary of the Changes

Paper Section	Topic	Items
2.1	Moved Material	64
2.1	Clarified	53
2.2	New Figures	10
2.3	Deleted	8
2.4	Equation Modifications	2
2.5	New Sections	23
2.6	New Requirements	4
	Total	164

2.1 *Moved Material / Clarified*

The SCPRS spent a lot of time on this document to try and organize and clarify this standard. This work was performed to ensure that it was more useful to the end users. As a result a majority of the changes are text moving from one section to another. These changes are numerous, pervasive and do not change the guidance. Therefore, they are not further elaborated in this paper.

2.2 *New Figures*

The 6th edition of API STD 520-Part II has added additional figures throughout the standard. The following figures have been added:

- Figure 3 Typical Rupture Disk Device Installation: Atmospheric (Open) Discharge Disk
- Figure 3B Typical Rupture Disk Device Installation: Closed System Discharge
- Figure 19 Bonnet Vent for Bellows Valves with Vent Located at the PRV
- Figure 20 Bonnet Vent for Bellows Valves Handling Vapor with Remote Vent Location
- Figure 21 Bonnet Vent for Bellows Valves Handling Liquids Where a Leak Needs to Be Routed Away from the PRV
- Figure 22 Bonnet Vent for Bellows Valves Handling Liquids or Flashing Liquid and Vapor with Remote Vent Location
- Figure A.1 Typical Configuration of Companion Flanges, Gaskets and Rupture Disk Assembly
- Figure A.2 Proper Handling of a Rupture Disk
- Figure A.3 Improper Handling of a Rupture Disk
- Figure A.4 Proper Alignment of Rupture Disk indicated by Tag Arrows
- Figure 8 Typical Rupture Disk Device in Combination with Relief Valve: Inlet Side Installation

2.3 *Deleted*

The following items were in the 5th edition of 520-Part II and have not made it to the 6th edition. The section numbers refer to the 5th edition.

- §4.8 Turbulence in Pressure Relief Device Inlets (See section 9.3 in 6th edition)
- §6.3.1a* Inlet isolation valves full bore requirement
- §6.3.2a* Outlet isolation valves full bore requirement
- §Appendix C Technical Inquiries

* There is still the requirement that the inner diameter all fittings be at least as large as the inlet/outlet diameter of the relief device. Thus while the verbiage changed, the logic was to allow for the use of non-full bore valves are of a larger diameter such that the minimum flow diameter of piping and fittings are all greater than the associated relief device connection. A

requirement of a full bore relief device would not allow for this installation type in the 5th edition of 520 Part 2.

2.4 Equation Modifications

The following equations were modified between the 5th and 6th editions. The updates correspond to unit updates only.

2.4.1 Reaction Force Due to Vapor Discharge §5.8.2.1 Equation 1, 6th edition (§4.4.1.1 Equation 1, 5th edition)

For the SI units equation the units for the outlet pressure and the associated constants were updated from bar(g) in the 5th edition to kPa(g) in the 6th edition.

2.4.2 Reaction Force Due to 2-Phase Discharge §5.8.2.2 Equation 1, 6th edition (§4.4.1.2 Equation 1, 5th edition)

The mass flow units were updated from kg/hr in the 5th edition to kg/s in the 6th edition. Additionally, in the 5th edition the static pressure at the pipe is depicted as absolute pressure minus atmospheric pressure. In contrast, the static pressure at the pipe exit is given solely in gauge pressure.

2.5 New Sections

The following equations were added or significantly modified between the 5th and 6th editions

2.5.1 Operating Environment (§4.5)

The 6th edition provides a new recommendation for installing rupture disks. The location of rupture disk should be taken into consideration, as different process conditions can affect rupture disk reliability. Cleaner or cooler areas of a process may be preferred.

2.5.2 Free Draining (§4.6)

The 6th edition provides a new recommendation for the inlet and outlet piping of a PRD. Both the inlet and outlet of the PRD should not be pocketed and be free draining away from the PRD.

2.5.3 Maintainability (§4.7)

The 6th edition provides a new recommendation that a PRD should be located in an area that enables access for proper maintenance.

2.5.4 Backpressure Limitation and Sizing of Pipe - Thermal Relief Valves (§6.3.2)

The 6th edition provides new guidance on the applicability of backpressure limits for thermal relief valves. This is mirrored in §7.3.7.3 for inlet pressure requirements.

2.5.5 PRV Stability (§7)

The 6th edition provides a comprehensive clarification to the 3% rule along with suggests to the components of a proper engineering analysis. The sub-sections of §7 have also been thoroughly re-written these subsections are:

- 7.1 General [PRV Stability]
- 7.2 Potential Causes of PRV Instability
- 7.3 PRV Inlet Pressure Drop Limitations
- 7.4 PRV Trim Selection

In 7.3.6 the standard provides more guidance to the requirements for an engineering analysis. This combined with Annex C add specificity to the engineering analysis which in the 5th edition was lacking.

2.5.6 Rupture Disk Installations (§9)

The 6th edition provides new guidance on various rupture disk installation configurations. This new section incorporates the 5th edition §4.6.

2.5.7 Rupture Disk in Series (§9.2)

The 6th edition provides new guidance on using rupture disks in series.

2.5.8 Bonnet Vent for Bellows Valve Handling Non-Hazardous Vapors (§10.3.2)

The 6th edition provides new guidance on venting a bonnet vent when non-hazardous vapors are relieved.

2.5.9 Bonnet Vent for Bellows Valve Handling Hazardous Vapors (§10.3.3)

The 6th edition provides new guidance on venting a bonnet vent when hazardous vapors are relieved.

2.5.10 Bonnet Vent for Bellows Valve Handling Non-Hazardous Liquids (§10.3.4)

The 6th edition provides new guidance on venting a bonnet vent when non-hazardous liquids are relieved.

2.5.11 Bonnet Vent for Bellows Valve Handling Hazardous Liquids (§10.3.5)

The 6th edition provides suggestion that bonnet vents for hazardous liquids be consider on a case by case basis to ensure safe routing.

2.5.12 Annex A.2 – Companion Flanges

The 6th edition has a new annex that provides new guidance for the pipe flanges that a rupture disk is to be installed into.

2.5.13 Annex A.3 – Gasket Selection

The 6th edition has a new annex that provides guidance on the gasket selection for rupture disks.

2.5.14 Annex A.4 – Rupture Disk Holder Serviceability

The 6th edition has a new annex that provides guidance about the serviceability of the rupture disk holder to maintain proper function.

2.5.15 Annex A.5 – Rupture Disk Suitability for Application

The 6th edition has a new annex that provides guidance on the suitability of a rupture disk for the given application and the importance of the compatibility between a rupture disk and rupture disk holder.

2.5.16 Annex A.6 – Preparing the Rupture Disk for Installation

The 6th edition has a new annex that provides guidance on how to prepare the rupture disk for the given installation.

2.5.17 Annex A.7 – Installation of the Rupture Disk into the Rupture Disk Holder

The 6th edition has a new annex that provides guidance on installing the rupture disk into the holder.

2.5.18 Annex A.8 – Installation of the Rupture Disk Device into a Piping/Pressure-Relief System

The 6th edition has a new annex that provides guidance on installing the rupture disk into a piping/pressure-relief system.

2.5.19 Annex A.9 – Rupture Disk Life-Cycle and Maintenance

The 6th edition has a new annex that provides guidance on the life cycle and maintenance of a rupture disk.

2.5.20 Annex C – PRV Acoustic Interactions

The 6th edition has a new annex that is an informative section about a type of acoustic interaction with direct spring loaded PRVs. Research still being done in this area.

2.6 New Requirements

The following sections were added that, in the opinion of the Authors, provide additional requirements or guidance. If the reader of this paper designs or audits relief systems, then he or she is encouraged to purchase a copy of the 6th edition of API STD 520-Part II to ensure designs are per the most recent guidance. The information contained herein is insufficient to design by.

2.6.2 Pilot-Operated Valves (§10.5)

Provides an additional recommendation that if a pilot valve is a balanced bellows type the vent of the pilot valve bonnet should follow 10.3 bonnet venting guidelines.

2.6.3 Gate Valves (§8.3.2(c))

The 6th edition provides guidance on the installation of gate valve related to the position of the stems when the gate valves are used as an isolation valve from recommendation to requirement.

2.6.4 Gate Valves (§8.3.2(d))

The 6th edition provides guidance on the installation of bleed valve between isolation valve and PRD.

3. Conclusion

The 6th Edition of API STD 520-Part II has been reformatted and updated. This document has changed extensively from the previous addition.

The expansion of the inlet pressure loss and stability guidance along with provide information on valve stability really increases the usability of this document.

4. References

[1] API Recommended Practice 520-Part II, FIFTH ED., AUGUST 2003, REAFFIRMED FEBRUARY 2011, Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries – Part II Installation

[2] API Standard 520-Part II, SIXTH ED., MARCH 2015, Sizing, Selection, and Installation of Pressure-relieving Devices-Part II—Installation