

Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries

Part II—Installation

API RECOMMENDED PRACTICE 520
FIFTH EDITION, AUGUST 2003

REAFFIRMED, FEBRUARY 2011



AMERICAN PETROLEUM INSTITUTE

Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries

Part II—Installation

Downstream Segment

API RECOMMENDED PRACTICE 520
FIFTH EDITION, AUGUST 2003

REAFFIRMED, FEBRUARY 2011



AMERICAN PETROLEUM INSTITUTE

SPECIAL NOTES

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations under local, state, or federal laws.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet.

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. Sometimes a one-time extension of up to two years will be added to this review cycle. This publication will no longer be in effect five years after its publication date as an operative API standard or, where an extension has been granted, upon republication. Status of the publication can be ascertained from the API Downstream Segment [telephone (202) 682-8000]. A catalog of API publications and materials is published annually and updated quarterly by API, 1220 L Street, N.W., Washington, D.C. 20005, www.api.org.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this standard or comments and questions concerning the procedures under which this standard was developed should be directed in writing to the standardization manager, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005, [standards, api.org](http://standards.api.org). Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the general manager.

API standards are published to facilitate the broad availability of proven, sound engineering and operating practices. These standards are not intended to obviate the need for applying sound engineering judgment regarding when and where these standards should be utilized. The formulation and publication of API standards is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

All rights reserved. No part of this work may be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 1220 L Street, N.W., Washington, D.C. 20005.

FOREWORD

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any federal, state, or municipal regulation with which this publication may conflict.

Suggested revisions are invited and should be submitted to the Director, Standards Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005, standards@api.org.

CONTENTS

	Page
1 SCOPE.....	1
2 REFERENCES	1
3 DEFINITION OF TERMS	1
4 INLET PIPING TO PRESSURE-RELIEF DEVICES.....	1
4.1 General Requirements	1
4.2 Pressure-Drop Limitations and Piping Configurations.....	1
4.3 Inlet Stresses that Originate from Static Loads in the Discharge Piping	4
4.4 Inlet Stresses that Originate from Discharge Reaction Forces	5
4.5 Isolation Valves in Inlet Piping	8
4.6 Rupture Disk Devices in Combination with Pressure-Relief Valves	9
4.7 Process Laterals Connected to Inlet Piping of Pressure-Relief Valves.....	9
4.8 Turbulence in Pressure-Relief Device Inlets.....	9
5 DISCHARGE PIPING FROM PRESSURE-RELIEF DEVICES.....	9
5.1 General Requirements	9
5.2 Safe Disposal of Relieving Fluids.....	9
5.3 Back Pressure Limitations and Sizing of Pipe	9
5.4 Considerations for Pilot-Operated Pressure-Relief Valves.....	9
5.5 Stresses in Discharge Piping During Release.....	11
5.6 Isolation Valves in the Discharge Piping.....	11
5.7 Rupture Disks Installed at Outlet of Pressure-Relief Valves.....	11
6 ISOLATION (STOP) VALVES IN PRESSURE-RELIEF PIPING	13
6.1 General.....	13
6.2 Application.....	13
6.3 Isolation Valve Requirements	13
6.4 Examples of Isolation Valve Installations	18
6.5 Administrative Controls Related to Isolation Valves	18
7 BONNET OR PILOT VENT PIPING	18
7.1 General.....	18
7.2 Conventional Valves.....	18
7.3 Balanced Bellows Valves.....	18
7.4 Balanced Piston Valves	18
7.5 Pilot-Operated Valves	20
8 DRAIN PIPING.....	20
8.1 Installation Conditions that Require Drain Piping	20
8.2 Safe Practice for Installation of Drain Piping	21
9 PRESSURE-RELIEF DEVICE LOCATION AND POSITION.....	22
9.1 Inspection and Maintenance	22
9.2 Proximity to Pressure Source	22
9.3 Proximity to Other Equipment	22
9.4 Mounting Position	22
9.5 Test or Lifting Levers.....	22

	Page
9.6 Heat Tracing and Insulation	22
10 BOLTING AND GASKETING	23
10.1 Care in Installation.	23
10.2 Proper Gasketing and Bolting for Service Requirements.	23
11 MULTIPLE PRESSURE-RELIEF VALVES WITH STAGGERED SETTINGS.	23
12 PRE-INSTALLATION HANDLING AND INSPECTION	23
12.1 General.	23
12.2 Storage and Handling of Pressure-Relief Devices	23
12.3 Inspection and Testing of Pressure-Relief Valves	23
12.4 Inspection of Rupture Disk Devices	23
12.5 Inspection and Maintenance of Pin-Actuated Devices	24
12.6 Inspection and Cleaning of Systems Before Installation	24
APPENDIX A RUPTURE DISK INSTALLATION GUIDELINES	25
APPENDIX B INSTALLATION AND MAINTENANCE OF PIN-ACTUATED NON-RECLOSING PRESSURE-RELIEF DEVICES	27
APPENDIX C TECHNICAL INQUIRIES	29

Figures

1 Typical Pressure-Relief Valve Installation: Atmospheric (Open) Discharge	2
2 Typical Pressure-Relief Valve Installation: Closed System Discharge	3
3 Typical Rupture Disk Device Installation: Atmospheric (Open) Discharge	4
4 Typical Pressure-Relief Valve Mounted on Process Line.	5
5 Typical Pressure-Relief Valve Mounted on Long Inlet Pipe	6
6 Typical Pilot-Operated Pressure-Relief Valve Installation	7
7 Typical Pressure-Relief Valve Installation with Vent Pipe	8
8 Typical Rupture Disk Device in Combination with Relief Valve: Inlet Side Installation	10
9 Avoiding Process Laterals Connected to Pressure-Relief Valve Inlet Piping	11
10 Typical Pressure-Relief Device Installation with an Isolation Valve	12
11 Typical Pressure-Relief Device Installation for 100 Percent Spare Relieving Capacity	14
12 Alternate Pressure-Relief Device Arrangement for 100 Percent Spare Relieving Capacity	15
13 Alternate Pressure-Relief Device Installation Arrangement for 100 Percent Spare Relieving Capacity	16
14 Three-Way Changeover Valve—Shuttle Type	17
15 Three-Way Changeover Valve—Rotor Type	17
16 Three-Way Changeover Valve—Ball Types	19
17 Typical Flare Header Block Valves.	19
18 Typical Isolation Block Valves for Spare Compressor.	20
19 Typical Installation Avoiding Unstable Flow Patterns at Pressure-Relief Valve Inlet	21

Sizing, Selection, and Installation of Pressure-relieving Devices in Refineries

Part II—Installation

1 Scope

This recommended practice covers 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 103 kPA) 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. As used in this recommended practice, 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. This recommended practice covers gas, vapor, steam, two-phase and incompressible fluid service; it does not cover special applications that require unusual installation considerations.

2 References

The current editions of the following standards, codes, and specifications are cited in this recommended practice:

API

- RP 520 *Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries, Part I—Sizing and Selection*
- RP 521 *Guide for Pressure-Relieving and Depressuring Systems*
- RP 576 *Inspection of Pressure-Relieving Devices*

ASME¹

- B31.3 *Process Piping*
- Boiler and Pressure Vessel Code*, Section VIII, “Pressure Vessels”

3 Definition of Terms

The terminology for pressure-relief devices that is used in this recommended practice is in general agreement with the definitions given in API Recommended Practice 520 Part I.

4 Inlet Piping to Pressure-Relief Devices

4.1 GENERAL REQUIREMENTS

For general requirements for inlet piping, see Figures 1 through 3.

4.1.1 Flow and Stress Considerations

Inlet piping to the pressure-relief devices should provide for proper system performance. This requires design consideration of the flow-induced pressure drop in the inlet piping. Excessive pressure losses in the piping system between the protected vessel and a pressure-relief device will adversely affect the system-relieving capacity and can cause valve instability. In addition, the effect of stresses derived from both pressure-relief device operation and externally applied loads must be considered. For more complete piping design guidelines, see ASME B31.3.

4.1.2 Vibration Considerations

Most vibrations that occur in inlet piping systems are random and complex. These vibrations may cause leakage at the seat of a pressure-relief valve, premature opening, or premature fatigue failure of certain valve parts, inlet and outlet piping, or both. Vibration in inlet piping to a rupture disk may adversely affect the burst pressure and life of the rupture disk.

Detrimental effects of vibrations on the pressure-relief device can be reduced by minimizing the cause of vibrations, by additional piping support, by use of either pilot-operated relief valves or soft-seated pressure-relief valves, or by providing greater pressure differentials between the operating pressure and the set pressure.

4.2 PRESSURE-DROP LIMITATIONS AND PIPING CONFIGURATIONS

For pressure-drop limitations and piping configurations, see Figures 1, 2, 4, and 5.

4.2.1 Pressure Loss at the Pressure-Relief Valve Inlet

Excessive pressure loss at the inlet of a pressure-relief valve can cause rapid opening and closing of the valve, or chattering. Chattering will result in lowered capacity and damage to the seating surfaces. The pressure loss that affects valve performance is caused by non-recoverable entrance losses (turbulent dissipation) and by friction within the inlet piping to the pressure-relief valve.

Chattering has sometimes occurred due to acceleration of liquids in long inlet lines.

4.2.2 Size and Length of Inlet Piping to Pressure-Relief Valves

When a pressure-relief valve is installed on a line directly connected to a vessel, the total non-recoverable pressure loss

¹ASME International, Three Park Avenue, New York, NY 10016-5990, www.asme.org.