

Inspection of Pressure-relieving Devices

API RECOMMENDED PRACTICE 576
FOURTH EDITION, APRIL 2017



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.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

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 authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications 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.

Users of this recommended practice should not rely exclusively on the information contained in this document.

Sound business, scientific, engineering, and safety judgment should be used in employing the information contained herein.

All rights reserved. No part of this work may be reproduced, translated, 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, NW, Washington, DC 20005.

Copyright © 2017 American Petroleum Institute

Foreword

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.

Shall: As used in a standard, “shall” denotes a minimum requirement in order to conform to the specification.

Should: As used in a standard, “should” denotes a recommendation or that which is advised but not required in order to conform to the specification.

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 publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 1220 L Street, NW, Washington, DC 20005.

Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.

Contents

Page

1	Scope	1
2	Normative References	1
3	Terms and Definitions	2
4	Pressure-relieving Devices	4
4.1	General	4
4.2	Pressure-relief Valve	4
4.3	Direct-acting Pressure-relief Valve	6
4.4	Pilot-operated Pressure-relief Valves	10
4.5	Rupture Disk Device	11
4.6	Pin-actuated Devices	22
5	Causes of Improper Performance	23
5.1	Corrosion	23
5.2	Damaged Seating Surfaces	27
5.3	Failed Springs	28
5.4	Improper Setting and Adjustment	30
5.5	Plugging and Fouling	30
5.6	Galling	34
5.7	Misapplication of Materials	34
5.8	Improper Location, History, or Identification	34
5.9	Improper Handling	34
5.10	Improper Differential Between Operating and Set Pressures	37
5.11	Improper Inlet/Outlet Piping Test Procedures	37
6	Inspection and Testing	37
6.1	Reasons for Inspection and Testing	37
6.2	Shop Inspection/Overhaul	38
6.3	Inspection, Testing, Maintenance, and Setting of Direct-acting Spring-loaded Valves on Equipment ..	48
6.4	Inspection, Testing, Maintenance, and Setting of Direct Spring-operated Safety Valves Used on Fired Pressure Vessels	50
6.5	Inspection, Testing, Maintenance, and Setting of Pilot-operated Pressure-relief Valves	51
6.6	Inspection, Testing, Maintenance, and Setting of Weight-loaded Pressure and/or Vacuum Vents on Tanks	52
7	Inspection and Replacement of Rupture Disk Devices	53
7.1	Rupture Disk Removal and Replacement	53
7.2	Examples of Rupture Disk Failure Modes	53
7.3	Rupture Disk Holder	57
7.4	Inspection and Replacement of Rupture Disks	57
8	Pressure-relief Valve Visual On-stream Inspection	57
8.1	General	57
8.2	Post-relief Event	58
9	Inspection Frequency	58
9.1	General	58
9.2	Frequency of Shop Inspection/Overhaul	59
9.3	Time of Inspection	60
9.4	Inspection and Servicing Deferral	61

Contents

	Page
10 Records and Reports	61
10.1 General	61
10.2 The Need to Keep Records	62
10.3 Responsibilities	62
10.4 Sample Record and Report System	63
Annex A (informative) Pressure-relief Valve Testing	64
Annex B (informative) Sample Record and Report Forms	67
Bibliography	73
Figures	
1 Pressure-/Vacuum-relief Valve	6
2 Weight-loaded Emergency Vent	7
3 Open Bonnet, Direct-acting Spring-loaded Pressure-relief Valve	8
4 Closed Bonnet, Direct-acting Spring-loaded Relief Valve	9
5 Balanced Bellows Direct-acting Spring-loaded Pressure-relief Valve	10
6 Unbalanced Piston Main Valve, Pilot-operated Pressure-relief Valve	12
7 Diaphragm Main Valve, Pilot-operated Pressure-relief Valve	13
8 Diaphragm Main Valve, Pilot-operated Pressure- and Vacuum-relief Valve	14
9 Forward-acting Conventional Rupture Disk	14
10 Forward-acting Scored Rupture Disk	15
11 Reverse-acting Knife Blade Rupture Disk	16
12 Reverse-acting Scored Rupture Disk	17
13 Graphite Rupture Disk	18
14 Rupture Disk in Union Holder	19
15 Rupture Disk in Screw-type Holder	19
16 Rupture Disk with Insert-type Holder	19
17 Insert-type Holder Installation	19
18 Conventional Domed Rupture Disk	20
19 Piston-type Pin-actuated Device	22
20 Butterfly-type Pin-actuated Device	23
21 Acid Corrosion in Carbon Steel Bonnet Caused by Leaking Seating Surfaces	24
22 Chloride Corrosion on 18Cr-8Ni Steel Nozzle (with Machined Seating Surface)	24
23 Sulfide Corrosion on Carbon Steel Disc from Crude Oil Distillation Unit	25
24 Chloride Attack on 18Cr-8Ni Steel Disc	25
25 Pit-type Corrosion on 18Cr-18Ni Steel Bellows	25
26 Alloy 400 Rupture Disks Corroded in Sour Gas Service	26
27 Body and Bonnet Coated with Epoxy for Corrosion Protection	26
28 Seating Surface of Disc Deformed by Chattering	27
29 Seating Surface of Disc Damaged by Frequent Operation of Valve Too Close to Operating Pressure	28
30 Spring Failure Due to Corrosion	29
31 Spring Failure Due to Stress Corrosion	29
32 Inlet Nozzle Plugged with Coke and Catalyst After Nine Months in Reactor Vapor Line	32
33 Outlet Valve Plugged with Deposits from Other Valves in Common Discharge Header	32
34 Moving Parts of Valve Fouled with Iron Sulfide (FeS ₂)	33
35 Disc Frozen in Guide Because of Buildup of Products of Corrosion in Sour Oil Vapor Service	33
36 Improper Storage of Valves	35
37 Example of Improper Storage of Valves	35

Contents

Page

38	Identification Tag for Pressure-relieving Device	39
39a	Identification Tag for Pressure-relieving Device (pre-2013)	39
39b	Identification Tag for Pressure-relieving Device (mandatory Jan. 1, 2013)	39
40a	Identification Tag for Pressure-relieving Device (pre-2013)	40
40b	Identification Tag for Pressure-relieving Device (mandatory Jan. 1, 2013)	40
41	Block Valves on Pressure-relief Valve Inlet and Outlet Sealed Open	42
42	Sulfur Deposits in Body of Valve	43
43	Safety Valve and Relief Valve Leak Detector	49
44	Operating Ratio Exceeded, Then Subjected to Vacuum	53
45	Operating Ratio Exceeded—Tabs Are Stretched	54
46	Disk Subjected to Corrosion	54
47	Dent Caused by Water Freezing in Discharge Line	55
48	Rupture Disk Holder Subjected to Excessive Corrosion	55
49	Rupture Disk Holder Subjected to Corrosion	56
50	Rupture Disk Holder Corrosion Due to Leakage	56
51	Rupture Disk Holder Subjected to Overtorque	57
A.1	Typical Safety Valve and Relief Valve Test Block Using Air as a Test	66
B.1	Sample Form for Recording Pressure-relieving Device Specifications	68
B.2	Sample Historical Record	69
B.3	Sample Inspection and Repair Work Order Form	70
B.4	Sample Testing Report	71
B.5	Sample In-service Report	72

Inspection of Pressure-relieving Devices

1 Scope

This recommended practice (RP) 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 and API 570, which give the requirements for a quality control system and specify that the repair organization maintain and document a training program ensuring that personnel are qualified.

2 Normative References

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

API 510, *Pressure Vessel Inspection Code: In-service Inspection, Rating, Repair, and Alteration*

API Standard 520 (all parts), *Sizing, Selection, and Installation of Pressure-relieving Devices*

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

API Standard 526, *Flanged Steel Pressure-relief Valves*

API Standard 527, *Seat Tightness of Pressure Relief Valves*

API 570, *Piping Inspection Code: In-service Inspection, Rating, Repair, and Alteration of Piping Systems*

API Recommended Practice 580, *Risk-Based Inspection*

API Standard 620, *Design and Construction of Large, Welded, Low-pressure Storage Tanks*

API Standard 2000, *Venting Atmospheric and Low-pressure Storage Tanks*

ASME *Boiler and Pressure Vessel Code (BPVC)*¹, *Section VIII: Rules for Construction of Pressure Vessels; Division 1: Pressure Vessels*

ASME PTC 25, *Pressure Relief Devices*

NB-18², *Pressure Relief Device Certification*

¹ ASME International, 2 Park Avenue, New York, New York 10016-5990.

² The National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, Ohio 43229, www.nationalboard.org.