

shall include material checks, replacement parts, conversion parts (or both), reference to items such as the welding procedure specifications (WPS), fitup, NDE technique, heat treatment, and pressure test methods to be used. Application of the “VR” stamp to the repair nameplate shall be recorded in this document. Specific conversions performed with the new Type/Model number shall be recorded on the document. There shall be a space for “signoffs” at each operation to verify that each step has been properly performed.

- 3) The system shall include a method of controlling the repair or replacement of critical valve parts. The method of identifying each spring shall be indicated on the repair document described in 4.8.5.4 i). Such identification shall be based on the Manufacturer’s spring chart current at the time of the repair, except that the spring removed from the valve during the repair bearing different identification may be reinstalled provided the “VR” Certificate Holder has verified the spring is acceptable to the Manufacturer. Such verification shall be documented on the repair document described in 4.8.5.4 i).
- 4) The system shall also describe the controls used to ensure that any personnel engaged in the repair of pressure relief valves are trained and qualified in accordance with this section.

j) Welding, NDE, and Heat Treatment (when applicable)

The quality system manual shall indicate the title of the person(s) responsible for and describe the system used in the selection, development, approval, and qualification of welding procedure specifications, and the qualification of welders and welding operators in accordance with the provisions of 4.4.

- 1) The quality system manual may include controls for the “VR” Certificate Holder to have the pressure relief valve part repaired by a National Board “R” Certificate Holder, per 4.4.7.
- 2) The completed Form R-1 shall be noted on and attached to the “VR” Certificate Holder’s document required in 4.8.5.4 i). Similarly, NDE and heat treatment techniques must be covered in the quality system manual. When outside services are used for NDE and heat treatment, the quality system manual shall describe the system whereby the use of such services meet the requirements of the applicable section of the ASME Code.

k) Valve Testing, Setting, and Sealing

The system shall include provisions that each valve shall be tested, set, and all external adjustments sealed according to the requirements of the applicable ASME Code Section and the National Board. The seal shall identify the “VR” Certificate Holder making the repair. Abbreviations or initials shall be permitted, provided such identification is acceptable to the National Board.

l) Valve Repair Nameplates

An effective valve stamping system shall be established to ensure proper stamping of each valve as required by 4.7.2. The manual shall include a description of the nameplate or a drawing.

m) Calibration

- 1) The manual shall describe a system for the calibration of examination, measuring, and test equipment used in the performance of repairs. Documentation of these calibrations shall include the standard used and the results. Calibration records shall be retained in accordance with Table 4.8.5.4 s).
- 2) All calibration standards shall be calibrated against certified equipment having known valid relationships to nationally recognized standards.

## n) Manual Control

The quality system shall include:

- 1) Measures to control the issuance of and revisions to the quality system manual;
- 2) Provisions for a review of the system in order to maintain the manual current with these rules and the applicable sections of the ASME Code;
- 3) The title(s) of the individual(s) responsible for control, revisions, and review of the manual;
- 4) Provision of a controlled copy of the written quality system manual to be submitted to the National Board; and
- 5) Revisions shall be submitted to and accepted by the National Board prior to being implemented.

## o) Nonconformities

The system shall establish measures for the identification, documentation, evaluation, segregation, and disposition of nonconformities. A nonconformity is a condition of any material, item, product, or process in which one or more characteristics do not conform to the established requirements. These may include, but are not limited to, data discrepancies, procedural and/or documentation deficiencies, or material defects. Also, the title(s) of the individual(s) involved in this process shall be included.

## p) Exhibits

Forms used in the quality system shall be included in the manual with a written description. Forms exhibited should be marked SAMPLE and completed in a manner typical of actual valve repair procedures.

## q) Testing Equipment

The system shall include a means to control the development, addition, or modification of testing equipment to ensure the requirements of 4.6.1 b) and 4.6.3 c) are met.

(See Supplement 5 for a guide on the sizing of pressure vessels used as part of pressure relief valve test equipment)

## r) Field Repairs

If field repairs are included in the scope of work, the system shall address any differences or additions to the quality system required to properly control this activity, including the following:

- 1) Provisions for annual audits of field activities shall be included;
- 2) Provisions for receipt and inspection of replacement parts, including parts received from the owner-user, shall be addressed;
- 3) If owner-user personnel will assist with repairs, provisions for the use of owner user personnel shall be included; and
- 4) Provisions for use of owner-user measurement and test equipment, if applicable, shall be addressed.

## s) Records Retention

The quality manual shall describe a system for filing, maintaining, and easily retrieving records supporting or substantiating the administration of the Quality System within the scope of the "VR" *Certificate of Authorization*. The record retention schedule described in the Quality System Manual is to follow the instructions identified in Table 4.8.5.4.s).

TABLE 4.8.5.4 s)

Reports, Records, or Documents for "VR" Certificate Holders	Instructions	Minimum Retention Period
Form "R" reports associated with a pressure relief valve that required welding as part of the repair	Record retention shall be in accordance with Part 3, Table 1.5.1	Refer to Part 3, Table 1.5.1
Record of repair or inspection	The repair and inspection program section shall include reference to a document (such as a report, traveler, or checklist) that outlines the specific repair and inspection procedures used in the repair of pressure relief valves.	5 years
Records related to equipment qualification and instrument calibration	Prior to use, all performance testing equipment shall be qualified by the certificate holder to ensure that the equipment and testing procedures will provide accurate results when used within the ranges established for that equipment. This qualification may be accomplished by benchmark testing, comparisons to equipment used for verification testing as specified in the quality system, or comparisons to field performance.	5 years after the subject piece of equipment or instrument is retired.
Record of lift assist device qualification	Prior to use, all lift assist devices shall be qualified by the certificate holder to ensure that the equipment and testing procedures will provide accurate results when used within the ranges established for that equipment used for verification testing as specified in the quality system or comparisons to field performance. This qualification shall be documented.	5 years after the lift assist device is retired.
Records of employee training and qualification	Each repair organization shall establish minimum qualification requirements for those positions within the organization as they directly relate to pressure relief valve repair. Each repair organization shall document the evaluation and acceptance of an individual's qualification for the applicable position.	5 years after termination of employment.

#### 4.8.6 FIELD REPAIR

Repair organizations may obtain a “VR” *Certificate of Authorization* for field repair, either as an extension to their in-shop/plant scope, or as a field-only scope, provided that:

- a) Qualified technicians in the employ of the Certificate Holder perform such repairs;
- b) An acceptable quality system covering field repairs, including field audits, is maintained; and
- c) Functions affecting the quality of the repaired valves are supervised from the address of record where the “VR” certification is issued.

##### 4.8.6.1 AUDIT REQUIREMENTS

Upon issuance of a *Certificate of Authorization*, provided field repairs are performed, annual audits of the work carried out in the field shall be performed to ensure that the requirements of the Certificate Holder's quality system are met. The audit shall include, but not be limited to performance testing in accordance with 4.6 of valve(s) that were repaired in the field. The audits shall be documented.

##### 4.8.6.2 USE OF OWNER OR USER PERSONNEL

For the repair of pressure relief valves at an owner or user's facility for the owner or user's own use, the “VR” Certificate Holder may utilize owner or user personnel to assist Certificate Holder technician(s) in the performance of repairs provided:

- a) The use of such personnel is addressed in the “VR” Certificate Holder's quality system;
- b) The owner or user personnel are trained and qualified;
- c) Owner or user personnel work under direct supervision and control of the “VR” Certificate Holder's technician(s) during any stage of the repair when they are utilized;
- d) The “VR” Certificate Holder shall have the authority to assign and remove owner or user personnel at its own discretion; and
- e) The names of the owner or user personnel utilized are recorded on the document as required for a quality system.

#### 4.9 TRAINING AND QUALIFICATION OF PERSONNEL

##### 4.9.1 CONTENTS OF TRAINING PROGRAM

The repair organization shall establish a documented in-house training program. This program shall establish training objectives and provide a method of evaluating training effectiveness. As a minimum, training objectives for knowledge level shall include:

- a) Applicable ASME Code and NBIC requirements;
- b) Responsibilities within the organization's quality system; and
- c) Knowledge of the technical aspects and mechanical skills for the applicable position held.

#### **4.9.2 QUALIFICATION OF PERSONNEL**

Each repair organization shall establish minimum qualification requirements for those positions within the organization as they directly relate to pressure relief valve repair. Each repair organization shall document the evaluation and acceptance of an individual's qualification for the applicable position.

#### **4.9.3 ANNUAL REVIEW OF QUALIFICATION**

The repair organization shall annually review the qualifications of repair personnel to verify proficiency as well as compliance with the Certificate Holder's quality system. This review shall include training records, documented evidence of work performed, and when necessary, monitoring job performance. The review shall be documented.

## PART 4, SECTION 5 PRESSURE RELIEF VALVES

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## PART 4, SECTION 6

### PRESSURE RELIEF DEVICES — SUPPLEMENTS

#### SUPPLEMENT 1

#### PRESSURE RELIEF VALVES ON THE LOW PRESSURE SIDE OF STEAM PRESSURE REDUCING VALVES

##### S1.1 SCOPE

This supplement provides requirements and guidelines for the installation of safety valves on the low-pressure side of steam pressure reducing valves.

- a) The subject of protection of vessels in steam service connected to the low-pressure side of a steam-pressure-reducing valve is of considerable importance to proper operation of auxiliary equipment such as pressure cookers, hot-water heating systems, etc., operating at pressures below that which the primary boiler generating unit is operating.
- b) To automatically reduce the primary boiler pressure for such processing equipment, pressure reducing valves are used. The manufacturers of such equipment have data available listing the volume of flow through reducing valves manufactured by them, but such data are not compiled in a form that the results can be deduced readily. To protect the equipment operating on the low pressure side of a pressure reducing valve, pressure relief valves of a relieving capacity sufficient to prevent an unsafe pressure rise in case of failure of the pressure reducing valve, should be installed.
- c) The pressure reducing valve is a throttling device, the design of which is based on certain diaphragm pressures opposed by spring pressure which, in turn, controls the opening through the valve. If the spring, the diaphragm, or any part of the pressure reducing valve fails, steam will flow directly through the valve and the low pressure equipment will be subjected to the boiler pressure. To protect the equipment operating on the low pressure side of the pressure reducing valve, pressure relief valve(s) should be installed on the low pressure side of the pressure reducing valve, which will provide a relieving capacity sufficient to prevent the pressure from rising above the system design pressure.
- d) In most cases pressure reducing valves used for the reduction of steam pressures have the same pipe size on the inlet and outlet. In case of failure of a pressure reducing valve, the pressure relief valve on the low-pressure side must have a capacity to take care of the volume of steam determined by the high pressure side and the area of the pipe.

##### S1.2 PRESSURE RELIEF VALVE CAPACITY

- a) The capacity of the pressure relief valve(s) on the low-pressure side of the pressure reducing valve should be based on the capacity of the pressure reducing valve when wide open or under maximum flow conditions or the flow capacity through the bypass valve.
- b) By using the formula in S1.3 below, Inspectors may calculate the required relieving capacities of the pressure relief valve(s) installed on the low-pressure side of the pressure reducing valve.
- c) Usually a pressure reducing valve has a bypass arrangement so that in case of failure of the pressure reducing valve the boiler pressure may be short circuited into the low-pressure line without passing through the pressure reducing valve. When determining the required relieving capacity of pressure relief valves for the low-pressure side of the pressure reducing valve, the steam flow through the bypass must be taken into consideration.

### S1.3 CALCULATION OF PRESSURE RELIEF VALVE RELIEVING CAPACITY

- a) When a pressure reducing valve is installed, there are two possibilities of introducing boiler pressure into the low-pressure system:
- 1) The failure of the pressure reducing valve so that it remains wide open; and
  - 2) The possibility of the bypass valve being open.
- b) It is necessary therefore, to determine the flow under both circumstances in paragraph a) above and check that the size of the pressure relief valve under either condition will be adequate. The following formulas should be used:

- 1)  $W$  = steam flow in lbs/hr (kg/hr) through the pressure reducing valve

$$W = AKC$$

where,

$A$  = internal area in in.<sup>2</sup> (mm<sup>2</sup>) of the inlet pipe size of the pressure reducing valve (see Table S1.5)

$K$  = flow coefficient for the pressure reducing valve (see S1.4)

$C$  = flow capacity of saturated steam through a pipe in lbs/hr/in<sup>2</sup> (kg/hr/mm<sup>2</sup>) at various pressure differentials from Tables S1.3-a, S1.3-b, or S1.3-c. (for U.S. Customary units) or Tables S1.3M-a, S1.3M-b, or S1.3M-c ( for metric units).

- 2)  $W$  = steam flow in lbs/hr (kg/hr) through the by-pass valve

$$W = A_1 K_1 C_1$$

where,

$A_1$  = internal area in in.<sup>2</sup> (mm<sup>2</sup>) of the pipe size of the bypass around the pressure reducing valve

$K_1$  = flow coefficient for the bypass valves (see S1.4)

$C_1$  = flow capacity of saturated steam through a pipe in lbs/hr/in<sup>2</sup> (kg/hr/mm<sup>2</sup>) at various pressure differentials from Tables S1.3-a, S1.3-b, or S1.3-c. (for U.S. Customary units) or Tables S1.3M-a, S1.3M-b, or S1.3M-c ( for metric units).



TABLE S1.3-a

CAPACITY OF SATURATED STEAM, IN LBS/HR, PER IN.2 OF PIPE AREA

Outlet Pressure, psi	Pressure-reducing valve inlet pressure, psi												
	1,500	1,450	1,400	1,350	1,300	1,250	1,200	1,150	1,100	1,050	1,000	950	900
1,000	76,560	72,970	69,170	64,950	60,540	55,570	49,930	43,930	35,230	25,500	.....	.....	.....
950	77,430	74,180	70,760	63,100	63,100	58,770	53,920	48,610	42,380	34,890	.....	.....	.....
900	77,750	74,810	71,720	68,340	64,870	61,040	56,820	52,260	47,050	41,050	33,490	23,960	.....
850	77,830	74,950	72,160	69,130	66,020	62,610	58,900	54,930	50,480	45,470	39,660	29,080	23,190
800	.....	75,070	72,330	69,490	66,700	63,680	60,390	56,910	53,060	48,800	43,980	38,340	31,610
750	.....	.....	.....	69,610	66,880	64,270	61,260	58,200	54,840	51,170	47,080	42,420	37,110
700	.....	.....	.....	.....	66,900	64,270	61,520	58,820	55,870	52,670	49,170	45,230	40,860
650	.....	.....	.....	.....	.....	.....	61,550	58,860	56,260	53,480	50,440	47,070	43,400
600	.....	.....	.....	.....	.....	.....	.....	58,980	56,270	53,660	51,020	48,470	45,010
550	.....	.....	.....	.....	.....	.....	.....	.....	.....	53,810	51,040	48,470	45,800
500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45,850
450	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45,870
400	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
350	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
300	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
250	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
200	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
175	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
150	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
110	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.													

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

TABLE S1.3M-a

CAPACITY OF SATURATED STEAM, IN KG/HR, PER MM<sup>2</sup>. OF PIPE AREA

Outlet Pressure, MPa	Pressure-reducing valve inlet pressure, MPa														
	10.25	10.00	9.75	9.5	9.25	9.00	8.75	8.5	8.25	8.00	7.75	7.50	7.25	7.00	6.75
6.75	53.44	51.68	49.82	47.85	45.77	43.63	41.28	38.73	36.01	33.09	29.47	25.37	20.89	.....	6.25
6.50	53.87	52.23	50.52	48.69	46.79	44.83	42.69	40.40	37.95	35.30	32.33	29.02	25.31	20.46	6.50
6.25	54.07	52.55	50.96	49.27	47.51	45.71	43.75	41.67	39.46	37.08	34.46	31.59	28.43	24.45	6.75
6.00	54.15	52.67	51.19	49.62	47.99	46.33	44.53	42.63	40.62	38.74	36.12	33.59	30.83	27.53	7.00
5.75	54.19	52.74	51.32	49.85	48.33	45.80	45.14	43.40	41.56	39.62	37.51	35.25	32.82	30.04	7.25
5.50	54.20	52.78	49.97	49.610	48.53	47.11	45.60	44.00	42.32	40.55	38.56	36.63	34.48	32.05	7.50
5.25	.....	.....	.....	50.00	48.60	47.20	45.82	44.35	42.78	41.17	39.44	37.62	35.68	33.52	7.75
5.00	.....	.....	.....	50.01	48.62	47.23	45.89	44.49	43.02	41.55	39.98	38.33	36.57	34.64	8.00
4.75	.....	.....	.....	.....	.....	47.24	.....	44.52	43.13	41.75	40.31	38.81	37.22	35.50	8.25
4.50	.....	.....	.....	.....	.....	.....	.....	44.53	43.14	41.77	40.43	39.08	37.63	36.07	8.5
4.25	.....	.....	.....	.....	.....	.....	.....	.....	43.15	41.82	40.46	39.10	37.74	36.33	8.75
4.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	41.84	40.48	39.12	37.82	36.45	9.00
3.75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.14	37.88	36.48	9.25
3.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.5
3.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.75
3.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10.00

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.

TABLE S1.3-b

CAPACITY OF SATURATED STEAM, IN LBS/HR, PER IN<sup>2</sup> OF PIPE AREA

Outlet Pressure, psi	Pressure-reducing valve inlet pressure, psi												
	850	800	750	700	650	600	550	500	450	400	350	300	250
1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
950	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
850	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
800	22,550	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
750	30,600	21,800	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
700	35,730	29,420	21,020	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
650	39,200	34,250	28,260	20,190	.....	.....	.....	.....	.....	.....	.....	.....	.....
600	41,500	37,470	32,800	27,090	19,480	.....	.....	.....	.....	.....	.....	.....	.....
550	42,480	39,850	35,730	31,310	25,940	18,620	.....	.....	.....	.....	.....	.....	.....
500	43,330	40,530	37,610	33,880	29,760	24,630	17,720	.....	.....	.....	.....	.....	.....
450	43,330	40,730	38,150	35,260	31,980	28,080	23,290	16,680	.....	.....	.....	.....	.....
400	.....	40,760	38,220	35,680	33,050	29,980	26,380	21,870	15,760	.....	.....	.....	.....
350	.....	.....	.....	.....	33,120	30,690	27,910	24,570	20,460	14,790	.....	.....	.....
300	.....	.....	.....	.....	33,240	.....	28,140	25,610	22,620	18,860	13,630	.....	.....
250	.....	.....	.....	.....	.....	.....	28,150	25,650	23,200	21,000	17,100	10,800	.....
200	.....	.....	.....	.....	.....	.....	.....	.....	.....	21,350	18,250	15,350	10,900
175	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18,250	16,000	12,600
150	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18,250	16,200	13,400
110	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18,780	.....	13,600
100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,600
85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,600
75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,600
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,600
50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,630
40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.													

Where capacities are not shown for inlet and outlet conditions, use the highest capacity shown under the applicable inlet pressure column.