

85TH MEETING OF THE
CALIFORNIA BOILER INSPECTORS ASSOCIATION
CONVENTION 2018



**“ANTIQUE AND MODERN INSPECTIONS”
SAN DIEGO, CALIFORNIA**



LP-Gas Safety Valves – Micah Davidian – Senior Safety Engineer – State of California

- What is the history behind the 275 PSI set point allowed by Title 8 prior to adopting NFPA 58 in 1997?
- What are the requirements of NFPA 58 past and present?
- What are the requirements of the ASME code for LP-Gas safety relief valves?

4951. Safety Valves. (a) All vessels and all vaporizers (except motor fuel vaporizers) shall be provided with one or more spring loaded safety valves set to begin to discharge at not more than 125% of the working pressure of the vessel and to full open at 150% of the working pressure of the vessel.

(b) (1) The total free discharge area of any safety valve, on any vessel other than a vaporizer, shall be not less than that computed by the formula: $a = \frac{0.77A}{P}$

P

Where:

a = free discharge area, sq. in.

P = working pressure plus 15.

A = total outside area of tank, sq. ft.

NOTE.—The free discharge area of a safety valve is equal to the circumference of the seat multiplied by the lift at the discharge pressure, but it is not more than the smallest clear area of the nozzle or the inlet pipe.

Between 1948 – 1958 Title 8 allowed safety relief valves 125% of working pressure of the vessel.

NFPA 58 Annex D

Table D.2.1.5 Container Pressure and Safety Factors/Design Margin for Various Editions of the ASME Code

Year ASME Code Edition Published	Maximum Allowable Working Pressure (MAWP)				Safety Factor/Design Margin
	Butane		Propane		
	psig	MPag	psig	MPag	
1931 through 1945 ^a	100 ^a	0.7	200	1.4	5:1
1949, paragraphs U-68 and U-69 ^b	100	0.7	200	1.4	5:1
1949, paragraphs U-200 and U-201 ^c	125	0.9	250	1.7	4:1
1952 through 1998	125	0.9	250	1.7	4:1
1998 to current					3.5:1

^aUntil December 31, 1947, containers designed for 80 psig (0.6 MPag) under prior (5:1 safety factor) codes were authorized for butane. Since that time, either 100 psig (0.7 MPag) (under prior codes) or 125 psig (0.9 MPag) (under present codes) is required.

^bContainers constructed in accordance with the 1949 edition and prior editions of the ASME Code were not required to be in compliance with paragraphs U-2 to U-10, inclusive, or with paragraph U-19. Construction in accordance with paragraph U-70 of these editions was not authorized.

^cHigher MAWP [312.5 psig (2.2 MPag)] is required for small ASME containers used for vehicular installations, because they can be exposed to higher temperatures and, consequently, develop higher internal pressure.

Most LP-Gas tanks built prior to 1949 had a safety factor or design margin of 5:1.

56.16

INDUSTRIAL RELATIONS

TITLE 8

(Register 77, No. 14-42-77)

485. Safety Valves. (a) Unless covered elsewhere in these orders, every LP-Gas vessel shall be provided with one or more springloaded safety relief valves set to open as follows with relation to the allowable working pressure:

<i>Type of Vessel</i>	<i>Minimum Safety Relief Valve Setting</i>	<i>Maximum Safety Relief Valve Setting</i>
ASME Code, Paragraphs U-68, U-69 1949 Edition; and those tanks built to earlier or later standards with a factor of safety of 5 or more	100%	125%
ASME Code, Paragraphs U-200, U-201, 1949 and earlier Editions.....	100%	110%
ASME Code, 1950, 1952, 1956, 1959, 1962, 1965, and 1968 Editions, built with a factor of safety of less than 5.....	100%	110%
API-ASME Code, all Editions.....	100%	110%
DOT Cylinders.....	As required by Bureau of Explosives and DOT Regulations	

ASME Code U-68 and U-69 Vessels have a MAWP of 200 PSI, built to a factor of safety of 5 and are allowed safety relief valves set at 250 PSI (200 psi x 125%)





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 ASME Code, Paragraphs U-200, U-201, 1949 and earlier Editions.....	100%	110% 
 ASME Code, 1950, 1952, 1956, 1959, 1962, 1965, and 1968 Editions, built with a factor of safety of less than 5.....	100%	110% 
API-ASME Code, all Editions.....	100%	110%
DOT Cylinders.....	As required by Bureau of Explosives and DOT Regulations	

ASME Code U-200 and U-201 1949 and earlier along with ASME Code 1950 and later, Vessels have a MAWP of 250 PSI, built to a factor of safety of 4 and were allowed safety relief valves set at 275 PSI (250 psi x 110%) from 1958 – 1997.

GOODWIN J. KNIGHT
Governor of California
ERNEST B. WEBB
Director of Department
A. C. BLACKMAN
Chief of Division

STATE OF CALIFORNIA
DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF INDUSTRIAL SAFETY
965 MISSION STREET, SAN FRANCISCO 3
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INDUSTRIAL SAFETY BOARD
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May 23, 1957

Circular Letter
3-57-2

TO: Whom it May Concern:

A question has been raised concerning the intent of Order 4951(a) of the LP-Gases Safety Orders. This order reads as follows:

"All vessels and all vaporizers (except motor fuel vaporizers) shall be provided with one or more spring loaded safety valves set to begin to discharge at not more than 125% of the working pressure of the vessel and to full open at 150% of the working pressure of the vessel."

Careful study of the transcript of Public Hearing held in 1945, when this order was discussed, indicates quite clearly that the intent was to make this order consistent with the requirements of NFBU Pamphlet 58.

The section covering safety valve settings in Pamphlet 58 at that time read as follows:

"Container safety relief valves shall be set to start to discharge as follows, with relation to the design working pressure of the container:

	<u>Minimum</u>	<u>Maximum</u>
ASME - U-68, U-69	100%	125%
ASME - U-200, U-201	90	100
API-ASME	80	100

ICC As approved by Bureau of Explosives"

The basic difference between ASME U-68, U-69 tanks, ASME U-200, U-201 and API-ASME tanks was the factor of safety. Paragraph U-68 and U-69 tanks were constructed

Circular Letter from 1957 explained the change in safety factors or design margins. The new maximum relief valve setting was to be 100% of maximum working pressure of the vessel.

How did we end up with 110% of maximum in the 1958 Edition of Title 8?

A.S.M.E. CODE
Unfired Pressure Vessels
1943

All vessels, irrespective of size or pressure, shall be equipped with safety devices in accordance with the requirements of this section of the Code.

(b) In the absence of definite rules in this section on the construction of unfired pressure vessels, the specific provisions of Section I of the Code may be used wherever they apply, and the vessel may then be stamped as conforming with the Code.

(c) This section of the Code does not cover all types of vessels. The Code symbol shall not be applied to any vessel the material for the pressure parts of which does not all comply with the Code rules or the type of construction is not sanctioned by the rules.

(d) A vessel may be designed and constructed by a combination of the types of construction given in the Code provided that the rules applying to each type of construction are followed and the vessel is stamped as may be required by the Code to indicate the most restrictive construction requirements that have been used in its fabrication.

Such a vessel should be limited to the service permitted by that detail of construction having most restrictive requirements.

U-2 (a) All pressure vessels shall be protected by such safety and relief valves, and indicating and controlling devices, as will insure their safe operation. These devices shall be so constructed, located, and installed that they cannot readily be rendered inoperative. The relieving capacity of safety valves shall be such as to prevent a rise of pressure in the vessel of more than 10 per cent above the maximum allowable working pressure and their discharges shall be carried to a safe place.

(b) Safety valves shall be connected to a vessel in the vapor space above any contained liquid. Additional liquid relief valves may be connected below the normal liquid level if a vessel is to contain liquid, and such relief valves may be set higher than the maximum allowable working pressure (See Par. U-19).

(c) An unfired pressure vessel which generates steam for power or heat to be used externally to itself shall be classed as an unfired steam boiler. Such vessels may be constructed under the appropriate classification of this section of the Code and shall be equipped with the safety devices required by Section I of the Code in so far as they are applicable to the service of the particular installation.

(d) The dial of a pressure gage shall be graduated to approximately double the pressure at which the relieving device

The 1943 Edition of the ASME Code had limited information regarding relief valves. It stated that you need one to insure safe operation. The Safety Relief valve shall have the capacity to prevent the pressure from rising more than 10% above the MAWP.

STANDARD
OF THE
National Board of Fire Underwriters
FOR THE
STORAGE AND HANDLING OF
**LIQUEFIED
PETROLEUM GASES**
AS RECOMMENDED BY THE
NATIONAL FIRE PROTECTION ASSOCIATION

NATIONAL BOARD OF FIRE UNDERWRITERS

85 John Street, New York 38, N. Y.
222 West Adams Street, Chicago 6, Ill.
465 California Street, San Francisco 4, Calif.

JULY, 1963

(b) Container and vaporizer safety relief valves shall be set to start to discharge as follows, with relation to the design pressure of the container:

Containers	Minimum	Maximum †
ASME Code; Par. U-68, U-69—1949 and earlier editions	110%	125%
ASME Code; Par. U-200, U-201—1949 edition	88	100
ASME Code; 1950, 1952, 1956 and 1959 editions	88	100
API-ASME Code; All editions	88	100
I.C.C.	As approved by Bureau of Explosives	

† Note: A plus tolerance of 10% is permitted.

(c) Safety relief devices used with systems employing containers other than those constructed according to I.C.C. specifications shall be so constructed as to discharge at not less than the rates shown in Appendix A, before the pressure is in excess of 120 per cent of the maximum (not including the 10 per cent referred to in Paragraph B.10 (b)) permitted start to discharge pressure setting of the device.

(d) In certain locations sufficiently sustained high temperatures prevail which will require the use of a lower vapor pressure product to be stored or the use of a higher designed pressure vessel in order to prevent the safety valves opening as the result of these temperatures. As an alternative the tanks may be protected by cooling devices such as by spraying, by shading or other effective means.

(e) Safety relief valves shall be so arranged that the possibility of tampering will be minimized; if pressure setting or adjustment is external, the relief valves shall be provided with approved means for sealing adjustment.

(f) Shut-off valves shall not be installed between the safety relief valves and the container, or the equipment or piping to which the safety relief device is connected except that a shut-off valve may be used where the arrangement of this valve is such that full required capacity flow through the safety relief device is always afforded.

Note: The above exception is made to cover such cases as a three-way valve installed under two safety relief valves, each of which has the required rate of discharge and is so installed as to allow either of the safety relief valves to be closed off but does not allow both safety valves to be closed off at the same time. Another exception to this may be where two separate relief valves are installed with individual shut-off valves. In this case the two shut-off valve stems shall be mechanically interconnected in a manner which will allow full required flow of one relief valve at all times.

(g) Safety relief valves shall have direct communication with the vapor space of the container at all times except as permitted in Paragraph 3.18(a)1.

(h) Each container safety relief valve used with systems covered by Divisions II, III, IV, VI, VII and VIII, except as provided in Paragraphs 4.2(d) and 6.1(a), shall be plainly and permanently marked

The 1963 Edition of NFPA 58 shows the Maximum safety relief valve set point of 100% MAWP. There is a note: "A plus tolerance of 10% is permitted"

Does $100\% + 10\%$ (plus tolerance) = 110% Maximum Relief Valve Setting?

Does $250 \text{ psi} + 10\% = 275 \text{ psi}$ Safety Relief Valve Set Point?

2017 ASME Code Sec VIII, Div. 1

OVERPRESSURE PROTECTION UG-125 GENERAL

UG-125(c)(3) Pressure relief devices, intended primarily for protection against exposure of a pressure vessel to fire or other unexpected sources of external heat installed on vessels having no permanent supply connection and used for storage at ambient temperatures of nonrefrigerated liquefied compressed gases, are excluded from the requirements of (1) and (2) above, provided:

(-a) the pressure relief devices are capable of preventing the pressure from rising more than 20% above the maximum allowable working pressure of the vessels;

(-b) the set pressure marked on these devices shall not exceed the maximum allowable working pressure of the vessels;

(-c) the vessels have sufficient ullage to avoid a liquid full condition;

(-d) the maximum allowable working pressure of the vessels on which these pressure relief devices are installed is greater than the vapor pressure of the stored liquefied compressed gas at the maximum anticipated temperature that the gas will reach under atmospheric conditions; and

(-e) pressure relief valves used to satisfy these provisions also comply with the requirements of UG-129(a)(5), UG-131(c)(2), and UG-134(d)(2).

UG-129 MARKING

(a)(5) certified capacity (as applicable):
(-c) SCFM (standard cubic feet per minute at 60°F and 14.7 psia), of air at an overpressure of 10% or 3 psi (kPa), whichever is greater. Valves that are capacity certified in accordance with UG-131(c)(2) shall be marked "at 20% overpressure."

UG-131 CERTIFICATION OF CAPACITY OF PRESSURE RELIEF DEVICES

(c)(2) Capacity certification tests of pressure relief devices for use in accordance with UG-125(c)(3) may be conducted at a pressure not to exceed 120% of the stamped set pressure of the device.

UG-134 PRESSURE SETTINGS AND PERFORMANCE REQUIREMENTS

(d)(2) The set pressure tolerance of pressure relief valves which comply with UG-125(c)(3) shall be within -0%, +10%.

ASME requirements for
LP-Gas relief valves

UG-134(d)(2) Gives the +
- tolerance -0% up to
+10%, notice UG-125(-b)
the set pressure marked
on the valve shall not
exceed the maximum
allowable working
pressure of the vessels.

1998 NFPA 58 Table 2-3.2.3

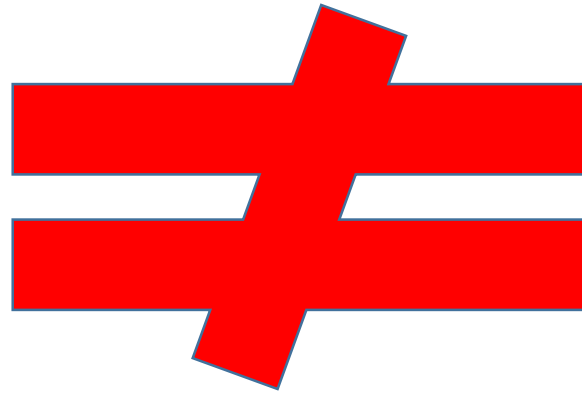
Table 2-3.2.3

Containers	Minimum	Maximum
All ASME Codes prior to the 1949 edition, and the 1949 edition, paragraphs U-68 and U-69	110%	125%*
ASME Code, 1949 edition, paragraphs U-200 and U-201, and all ASME Codes later than 1949	100%	100%*

*Manufacturers of pressure relief valves are allowed a plus tolerance not exceeding 10 percent of the set pressure marked on the valve.

The maximum set point of relief valves for 1949 Edition of the ASME Code U-200 and U-201 tanks and all ASME Codes later than 1949 shall be a maximum of 100% of the tanks Maximum Allowable Working Pressure (MAWP). The 10% plus tolerance is determined by the relief valve manufacturer based on the opening and flow characteristics of their valve. The set pressure marked on the valve shall be the same as the MAWP per ASME UG-125.

250 psig + 10%



275 psig

ASME allows a plus tolerance of up to +10% over the set point marked on the valve. The set point marked on the valve shall not exceed the maximum allowable working pressure of the vessel. 2017 ASME Code Sec. VIII Div. 1, UG-125(-b) and UG-134(d)(2)



Sherwood – Dual Stamped LP-Gas safety relief valve. When inspecting tanks with these valves, record the set point as 250 psi.



2015 Marshall Excelsior Company relief valve set at 275 psi these valve shall be removed from service.



Marshall Excelsior Company – SCFM valve capacity is missing.



Relief Valves for Mobile Tanks and Transports

Primarily for trucks transporting LPG, Anhydrous Ammonia (NH₃) or other compressed gases.

Types H722, H733 and H5118 stainless steel relief valves resist rust and corrosion, including a 300 Series stainless steel spring for additional resistance to product contaminants. A thickly molded main seal improves service life and resistance to severe applications. Stainless steel makes it easy to remove the valve from the tank for periodic testing (as prescribed by DOT) and permits standard tank couplings instead of the more costly flanged tank openings. The Type H733 has an optional CL300 RF Flange connection. Standard product temperature rating is -20 to 160°F / -29 to 71°C.

Type H5118: Semi-Internal relief valve for 2 in. threaded recessed well-head connections on transports.

Tight fitting protective caps (Types P297, P298 and P299) are standard on the valve to ensure no debris blocks the valve discharge. Standard setpoints listed with UL for the Type H722 include 125, 156, 250, 265, 275 and 312 psig / 8.6, 10.8, 17.2, 18.3, 19.0 and 21.5 bar. Standard set points listed with UL for the Types H733 and H5118 include 250 and 265 psig / 17.2 and 18.3 bar. All set points between 100 and 400 psig / 6.9 and 27.6 bar are available with ASME approvals.

A 1-1/2 and 2-1/2 in. hex size (Type P304 or P305) wrench can be inserted into the valve socket when installing/removing the valve to provide a means of attaching a standard wrench.

UL® Approved Internal Relief Valves							
TYPE	CONTAINER CONNECTION, IN.	START-TO-DISCHARGE SETTING		FLOW CAPACITY, SCFM / SCMH AIR		FOR TANK WITH AREA UP TO ⁽³⁾ : Ft ² / m ²	PROTECTIVE CAP (INCLUDED)
		psig	bar	UL	ASME		
H722-250	2 MNPT ⁽¹⁾	250	17.2	3635 / 6176	3203 / 5136	171 / 15.9	Type P297
H722-265		265	18.3	3556 / 6042	3386 / 5753	166 / 15.4	
H722-275		275	19.0	3714 / 6310	3508 / 5960	175 / 16.3	
H733-250	3 MNPT ⁽²⁾	250	17.2	10,150 / 17,245	9369 / 15,918	598 / 55.6	Type P298
H733-265		265	18.3	10,940 / 18,587	9904 / 16,827	655 / 60.9	
H733F3-250	3 in. CL300 RF Flange	250	17.2	10,150 / 17,245	9369 / 15,918	598 / 55.6	Type P298
H733F3-265		265	18.3	10,940 / 18,587	9904 / 16,827	655 / 60.9	
H5118-250 ⁽⁴⁾	2 MNPT	250	17.2	10,530 / 17,891	9724 / 16,521	625 / 58.1	Type P299
H5118-265 ⁽⁴⁾		265	18.3	11,300 / 19,199	10,280 / 17,466	681 / 63.3	

1. Order Type P304 (1-1/2 in. hex bar) Installation wrench.
 2. Order Type P305 (2-1/2 in. hex bar) Installation wrench.
 3. Based on UL flow capacities.
 4. Use with a 3.5 in. hex size Installation tool.

Fisher Controls markets safety relief valves in 3 set points, 250, 265 and 275. The set point marked on the valve shall be the same as the MAWP of the tank.

15465 CERTIFIED BY S/N T14593 1145-8

MISSISSIPPI TANK COMPANY
HATTIESBURG, MISSISSIPPI

MAWP	265	PSIG	AT	125	°F	CORR ALLOW	0"
MDMT	-20	°F	AT	265	PSIG	YEAR MFG	2018
U HEAD: TYPE	HEMI	MIN THK	.250"	MIN	MAT'L	SA-517E	
W SHELL: OD	80.756"	MIN THK	.378"	NOM	MAT'L	SA-517E	
RT1 TANK: WG	10,600	OSSA	910	SQ FT	OL	516"	
HT QT DOT	MC 331	ORIGINAL TEST DATE	03-19-2018				
UHT MAX LADING DENSITY	15.00	LB/GAL	WATER CAP IN LBS	88,298			
0.55595 N	ABOVEGROUND	TARE WT	21,140				

THIS CONTAINER SHALL NOT CONTAIN A PRODUCT HAVING A VAPOR PRESSURE IN EXCESS OF 215 PSIG AT 100 °F.

CTMV MFR. MISSISSIPPI TANK COMPANY
CT-0322

CTMV MFR. SERIAL	T14593
CTMV CERT. DATE	03-2018
CT MFR.	MTC
CT SERIAL	T14593
CT DATE OF MFR.	03-19-2018
MAX. PAYLOAD	48,860 LBS
VIN CODE	355074

18-1403

TO WRITE ON THIS LABEL USE AN INDELIBLE, PERMANENT INK MARKER, PEN OR PENCIL THAT WILL NOT FADE IN DIRECT SUNLIGHT

ANNUAL VEHICLE INSPECTION LABEL NO. 40268608

COMPLETED: MONTH March YEAR 2018

A RECORD OF THIS VEHICLE'S ANNUAL VEHICLE INSPECTION REPORT IS MAINTAINED AT: MOTOR CARRIER OTHER ENTITY

Frontier Trailer Associates
Po Box 7456
Rocky Mount, NC 27804-0456

Propane transport tank with MAWP of 265. Safety relief valve can be 265 as long as the manufacturer of the valve recommends it for LP-Gas



GISO 3328(B) Machinery and equipment in service shall be inspected and maintained as recommended by the manufacturer where such recommendations are available.

GISO 3328(C) Machinery and equipment with defective parts which create a hazard shall not be used.

Replace Pressure Relief Valves In 10 Years Or Less

The safe useful life of pressure relief valves can vary greatly depending on the environment in which they live.

Relief valves are required to function under widely varying conditions. Corrosion, aging of the resilient seat disc and friction all proceed at different rates depending upon the nature of the specific environment and application. Gas impurities, product misuse and improper installations can shorten the safe life of a relief valve.

Predicting the safe useful life of a relief valve obviously is not an exact science. The conditions to which the valve is subjected will vary widely and will determine its useful life. In matters of this kind, only basic guidelines can be suggested. For example, the Compressed Gas Association Pamphlet S-1.1 Pressure Relief Device Standards — Cylinders, section 9.1.1 requires all cylinders used in industrial motor fuel service to have the cylinder's pressure relief valves replaced by new or unused relief valves within twelve years of the date of manufacture of cylinder and within each ten years thereafter. The LP-Gas dealer must observe and determine the safe useful life of relief valves in his territory. The valve manufacturer can only make recommendations for the continuing safety of the industry.

WARNING: Under normal conditions, the useful safe service life of a pressure relief valve is 10 years from the original date of manufacture. However, the safe useful life of the valve may be shortened and replacement required in less than 10 years depending on the environment in which the valve lives. Inspection and maintenance of pressure relief valves is very important. Failure to properly inspect and maintain pressure relief valves could result in personal injuries or property damage.

For Additional Information Read:

1. CGA Pamphlet S-1.1 Pressure Relief Standards - Cylinders, Section 9.1.1.
2. REGO® Catalog L-500.
3. REGO® Warning # 8545-500.
4. NPGA Safety Pamphlet 306 "LP-Gas Regulator and Valve Inspection and Maintenance" and "LP-Gas Training Guidebooks".
5. NFPA # 58, "Storage and Handling of Liquefied Petroleum Gases".
6. NFPA # 59, "LP-Gases at Utility Gas Plants".
7. ANSI K61.1 Safety Requirements for Storage and Handling of Anhydrous Ammonia.

The state is still allowing relief valves to stay in service up to 30 years provided they are properly maintained and are in good condition. Relief valve manufacturers recommend either 10 or 15 year replacement depending on manufacturer.



1998 NFPA 58 3-2.6.3(a) Rain caps are supposed prevent water or extraneous matter from entering the relief restricting flow or making it inoperative.



1998 NFPA 58 3-2.6.3(a)(b)(e)(f)
Relief valve rain caps are required
Current NFPA requires 7 foot stacks
Discharge terminals located to
provide protection against physical
damage
Discharge piping sized to provide
proper flow rate
Discharge piping shall be metallic
and have a melting point over 1500
deg F



In both pictures the outlet of the relief valves is restricted.



3" PVC pipe painted with galvanized paint was going to be installed on bulk LP-Gas tank. Discharge piping shall be metallic and have a melting point over 1500 deg F. 3-2.6.3(e)



1998 NFPA 58 3-2.6.3
any gas released
vented away from the
container upward and
unobstructed to the
open air

- Safety relief valve set point marked on valve shall not exceed the Maximum Allowable Working Pressure (MAWP) of the vessel.
- Dual stamped (250 psi / 275 psi) LP-Gas relief valves are acceptable for use. 250psi set point would be recorded on the inspection report.
- Safety relief valves set at 265 psi can be used on bobtails and transport tanks having a MAWP of 265.
- Safety relief valves set at 275 psi are not acceptable for use in California.



Safety Relief valves play an important role in protecting pressure vessels and human lives. It is essential they have the correct set point, relief capacity and are properly installed, Inspected and maintained.

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**“ANTIQUE AND MODERN INSPECTIONS”
SAN DIEGO, CALIFORNIA**