Prepared by: [redacted]

PRESSURE RELIEF DEVICES

H-70

Department:	Gas System Maintenance and Technical Support	**Section:** System Integrity	**Date:** 03-24-00
Approved by:	M. K. Johnson	**Approved by:**	[redacted]

Rev. #01: This document replaces Revision #00. For a description of the changes, see Page 3.

Purpose and Scope

This standard provides basic design requirements and sets inspection and testing requirements for gas pressure relief devices used for natural gas service at compressor, pressure limiting and regulator stations. This standard does not cover rupture disks.

Acronyms

CFR:	Code of Federal Regulations
CGT:	California Gas Transmission (organization within PG&E)
DCS:	Distribution and Customer Services
DOT:	Department of Transportation
GSM&TS:	Gas System Maintenance and Technical Support
MAOP:	maximum allowable operating pressure
MOP:	maximum operating pressure
psig:	pounds per square inch gauge
SMYS:	specified minimum yield strength
WC:	water column

References

	Document
49 CFR Part 192, "Pipeline Safety Regulations, Natural Gas"	Section 192.199
49 CFR Part 192, "Pipeline Safety Regulations, Natural Gas"	Section 192.201
49 CFR Part 192, "Pipeline Safety Regulations, Natural Gas"	Section 192.731
49 CFR Part 192, "Pipeline Safety Regulations, Natural Gas"	Section 192.739
49 CFR Part 192, "Pipeline Safety Regulations, Natural Gas"	Section 192.743
CGT Standard "Gas Pressure Relief Devices – Responsibility for Capacity Verification"	S-4433
DCS Standard "District Regulator Station Maintenance"	D-S031
DCS/CGT Standard "Standard, Maximum Allowable Operating Pressures, Requirements for Transmission Lines and Distribution Mains & Services"	D-S0430/S-4125

Design Requirements

1. Do not use relief valves unless it has been determined that monitor valves are impractical.
2. A pressure relief device shall have the capacity, and shall be set, to limit the pressure in a system to the appropriate maximum pressure shown below, under any possible operating conditions.
   A. In a low-pressure distribution system, the pressure may not exceed 14" WC.
   B. In pipelines other than a low pressure distribution system:
      (1) If the MAOP is 60 psig or more, the pressure may not exceed the MAOP plus 10%, or the pressure that produces a hoop stress of 75% of SMYS, whichever is lower;
      (2) If the MAOP is 12 psig or more, but less than 60 psig, the pressure may not exceed the MAOP plus 6 psig; or
      (3) If the MAOP is less than 12 psig, the pressure may not exceed the MAOP plus 50%.

3. The pressure at which the relief valve is set to open will depend on its operating characteristics. This includes the pressure buildup above the set pressure necessary to achieve full capacity, and the pressure at which the system is to be operated under normal conditions. However, the setting shall **not** be higher than a level which would permit the pressure to reach or exceed the pressures specified in Paragraph 2, taking into account the pressure buildup required for the valve to reach full capacity.
4. Set the relief valve or other overpressure protection just sufficiently above the MOP of the system being protected to permit the system to be operated at the MOP without causing the relief valve to leak or vent gas. This pressure shall be determined by considering the operating characteristics and operating tolerances of the valve being used. The pressure shall **not** be any higher than necessary to accomplish this, and **under no condition** shall it be set so high that it will permit the pressure in the piping to exceed that specified in Paragraph 2.
5. When more than one pressure regulating or compressor station feeds into a pipeline, relief valves or other protective devices shall be installed at each station to ensure that a failure of the supply devices will not impose pressure on any part of the downstream pipeline system in excess of the pressure permitted by Paragraph 2. The relief devices shall have sufficient capacity to relieve a failure of the supply device with the largest capacity.
6. The discharge piping of pressure relief valves shall be designed to prevent an accumulation of water, ice or snow and to discharge gas to nonhazardous locations. To prevent injury to personnel, the vent exhaust shall be located at or above 8' from ground level.

Sizing Relief Valves

7. Ensure the relief valve has adequate capacity and operating characteristics to prevent the pressure from exceeding the limits specified in Paragraph 2. Take into account the set pressure, the operating tolerance of the valve and the pressure buildup required to achieve full capacity.
8. Base the capacity of the relief valve on the highest anticipated supply pressure in the line feeding the regulator. This may be the MOP rather than the MAOP of the line. However, there must be adequate assurance that the supply pressure will not increase above that for which the relief valve is sized. If it is necessary to increase the MOP of the system supplying the regulator(s), the capacity of all relief valves protecting it must first be checked to verify that there is adequate relief capacity for the new conditions. Where the relief capacity is not adequate, provide additional capacity before increasing the MOP.
9. Consider the minimum demand on a system when sizing the relief valve, provided there is assurance that this minimum demand will always be present.
10. Use the manufacturer's capacity rating to determine the adequacy of the relief valve (subject to the precautions outlined in Paragraph 12). Before using the manufacturer's capacity rating, verify with GSM&TS System Integrity or Utility Operations Engineering & Planning that the latest available information is being used.
11. When selecting and sizing a relief valve, consider the following characteristics:
    A. The pressure buildup above the point where the valve first opens, which is necessary to obtain full capacity. This must be compared to the maximum pressure permitted by Paragraph 2.
    B. The repeatability of operation. How close can the relief valve be set to the MOP of the downstream piping system without operating or leaking gas unintentionally?
    C. The pressure to which the system must drop before the relief valve will close after it operates.
    D. The potential hammering or excessive vibration effects. The relief valve should be sized small enough to prevent hammering or excessive vibration.
12. The regulator capacity against which the relief valve must protect is the **failed wide open** capacity. This can be calculated using the valve coefficient (Cv) for a wide-open valve. Do not use the tabulated capacity for the regulator shown in the *Gas Standards and Specifications* or the manufacturer's literature unless it is known to be the **wide open** capacity.
13. Piping between the system being protected and the relief valve must be sized so that it will not restrict the capacity of the relief valve.
14. Any valve between the system being protected and the relief valve must be locked open to prevent unauthorized operation that would isolate the relief valve from the piping being protected.
15. The vent stack represents a restriction against which the relief valve must discharge. Consider the pressure drop in the vent stack when sizing the relief valve and the vent stack piping.

Inspecting and Testing Pressure Relief Devices

16. All pressure relief devices shall be inspected, tested and the capacity reviewed at intervals not exceeding 15 months, but at least once each calendar year as required by DOT 49 CFR, Part 192, Paragraphs 192.739 and 192.743.
17. The relief valves that were purchased as an integral part of a piece of equipment do not require capacity calculations, but still must be inspected and tested annually.
18. The relief devices shall be **inspected** and **tested** to determine that they are:
    A. In good operating condition;
    B. Set to function at the correct pressure (Note: the setpoint must be verified by physically testing that the relief valve begins to operate at the proper pressure setting); and
    C. Properly installed and protected from dirt, liquids and other conditions that might prevent proper operations.
19. Verify that the relief valve has sufficient **capacity** to limit pressure to the level required in Paragraph 2 by performing the following actions.
    A. Make an office review and calculation to verify that under operating conditions the relief valve has the proper setting and capacity to limit pressure to the required level; or
    B. Physically test the relief valve(s) in place to verify that the relief valve(s) has sufficient capacity to limit pressure to the required level.
20. The capacity shall be considered satisfactory if the maximum downstream system pressure will not exceed the maximum pressure specified in Paragraph 2. If the capacity at the maximum system pressure is not adequate, immediate steps shall be taken to provide adequate capacity.
21. The capacity of the relief devices at **pressure limiting and regulating stations** shall be recorded using the form "Capacity Review of Relief Devices at Pressure Limiting & Regulator Stations," Exhibit 1. The capacity of the relief devices protecting against overpressure due to **gas compression** shall be recorded using the form "Capacity Review of Relief Devices at Compressor Stations," Exhibit 2. Both forms are available from System Integrity.
22. In addition to annual capacity testing, the capacity of relief devices shall be verified immediately when changes are made which could affect the ability of the relief valve to protect the system.

Responsibility

23. The Utility Operations area managers, the GSM&TS manager, or their designated representatives, are responsible for performing inspections, testing, operation and maintenance of the subject facilities, within their assigned areas of responsibility.

Revision Notes

Revision 01 has the following changes.

1. Revised the capacity requirements when multiple pressure regulators or multiple compressors feed into a pipeline.
2. Updated the names of the GSM&TS and its section.
3. Made minor grammatical changes throughout the document.
4. This document is part of Change 47.

CAPACITY REVIEW OF RELIEF DEVICES AT PRESSURE LIMITING AND REGULATING STATIONS AS REQUIRED BY PARAGRAPHS 192.739 (B) AND 192.743 OF 49 CFR 192 (REFER TO GAS STANDARD H–70)

Station name:	Area:	District:
Line or system supplied by facility (see Note 1 below)		Anniversary month (see Note 2 below)

PART I — To Be Completed Annually

This capacity check is for the Year											
1 Was capacity reviewed for previous year?	**YES**										
If NO, complete Part II of Annual Capacity Review for PLS & Reg stations.	**NO**										
2 Did previous review show that relief valve(s) had adequate capacity?	**YES**										
If NO, complete Part II of Annual Capacity Review for PLS & Reg stations.	**NO**										
3 Have there been any changes to the equipment at this station, to pressure conditions (either inlet or outlet), to load conditions, or to supply conditions which could affect the ability of the relief valve(s) to limit the pressure to the maximum permitted by paragraphs 192.169 and 192.201 of 49 CFR 192?	**YES**										
	NO										
*If the answer is YES, complete Part II of Annual Capacity Review for PLS & Reg Stns. **If answers to Items 1 and 2 were YES and Item 3 was NO, check YES on Item 4.											
4 Relief valve(s) at this station have adequate capacity. If NO, complete Part III of Annual Capacity Review for PLS & Reg stations.	**YES**										
	NO										
VERIFIED BY (Place initials in the appropriate box)											
DATE (Put date verified in the appropriate box)											
APPROVED BY (Place initials in the appropriate box)											
DATE (Put date approved in the appropriate box)											

NOTES:

1. If there are regulating and overpressure facilities at the station supplying more than one line or system, perform a separate review for the overpressure protection devices for each line or system.
2. All pressure relief devices shall be inspected, tested, and the capacity reviewed at intervals not exceeding 15 months, but at least once each calendar year. Furthermore, in addition to the annual capacity testing, the capacity of the relief devices shall be verified immediately when changes are made which could affect the ability of the relief device to protect the connected systems.
3. The **Verified By** box is usually initialed by a technician or an M&C mechanic. The **Approved By** box is usually initialed by an engineer or operating supervisor/superintendent.

RETAIN THIS DOCUMENT AS A PERMANENT RECORD FOR THE LIFE OF THE FACILITY.

CAPACITY REVIEW OF RELIEF DEVICES AT **PRESSURE LIMITING AND REGULATING STATIONS** AS REQUIRED BY PARAGRAPHS 192.739 (B) AND 192.743 OF 49 CFR 192 (REFER TO GAS STANDARD H–70)

PART II — To be completed only if Part I indicates that a complete review is required.

Station Name _____ Date _____

Division _____ District _____

Line or System Supplied by Facility (see Note 1 below) _____

This Capacity Review is for the Year _____

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1. **A complete capacity review was required because:**
   - a. _____ A capacity review was not performed in the previous year.
   - b. _____ The previous capacity review showed that the relief device capacity was inadequate.
   - c. _____ Changes have been made to the equipment at the station, to pressure conditions, to load conditions, or to supply conditions which could affect the ability of the relief valves to limit the pressure to the maximum permitted by 49 CFR 192.

2. **Station Pressure Conditions**

   P1 – Maximum upstream pressure (MAOP or MOP, if lower) _____ psig

   P2 – MAOP or MOP downstream of station _____ psig

   P3 – Maximum permissible downstream pressure (see Par. 192.201) _____ psig

3. **Regulator(s) Supplying Line or System Described Above**

Regulating Valve					Wide Open Capacity (@ P1 in, P2 out)	Indicate Catalog Reference or Gas Standard for Capacity ***(Attach calculation sheet)***
No.	Size	Model	Inner Valve Size	Field Verified		

If more than one regulator, note if regulators are installed in series [ ] or in parallel [ ].

4. **Maximum Supply Capability**
   - a. Capacity of single regulator, if only one regulator, _____ scfh

     Largest capacity of any regulator, if installed in parallel, or _____ scfh

     Total capacity of series regulator installation with pressure drops adjusted to give maximum flow. _____ scfh
   - b. Maximum capacity through station if limited by conditions other than regulators. _____ scfh

     State limiting conditions: _____

     _____

     _____

Note 1 If there are regulating and overpressure protection facilities at the station supplying more than one line or system, perform a separate review for the overpressure protection device for each line or system.

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CAPACITY REVIEW OF RELIEF DEVICES AT **PRESSURE LIMITING AND REGULATING STATIONS** AS REQUIRED BY PARAGRAPHS 192.739 (B) AND 192.743 OF 49 CFR 192 (REFER TO GAS STANDARD H–70)

PART II, (continued)

Station Name _____ Date _____

5. **Minimum Downstream Load**

The minimum load supplied from the line or system being reviewed **under any operating condition or situation**. _____ scfh

Note: Unless it can be established that this minimum load will be present under any operating condition, this load should be considered as zero.

Describe load, if present _____

6. **Relief Capacity Required**

Enter either Item 4a or Item 4b, whichever is lower _____ scfh

Less Item 5 (if any) _____ scfh

Minimum Relief Capacity Required _____ scfh

7. **Relief Device(s) Protecting Line or System Described Above**

a.

Relief Valve						Maximum Capacity @ P3 (See Note 2)	Capacity Reference
No.	Size	Model	Inner Valve Size	Field Verified	Pressure Setting		

b. Total capacity restrictions from valves, piping, silencers, etc. _____ scfh

Describe _____

_____

c. Relief capacity available. Total of 7(a), less total of 7(b) _____ scfh

8. **Adequacy of Relief Capacity**

a. Capacity shown in 7(c) is equal to or greater than relief capacity required (Item 6). Capacity Adequate. See Item 9. _____

b. Capacity shown in 7(c) is less than the relief capacity required (Item 6). Capacity not adequate. See Part III. _____

9. **The relief device(s) described above have adequate capacity** (see Note 3).

Verified by: _____	Approved by: _____
Date:	Date:

Note 2 Refer to Section 3.0 of Gas Standard H–70.

Note 3 The **Verified By** box is usually initialed by a GSM&TS or Utility Operations area engineer. The **Approved By** box is usually approved by the engineering supervisor.

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CAPACITY REVIEW OF RELIEF DEVICES AT **PRESSURE LIMITING AND REGULATING STATIONS** AS REQUIRED BY PARAGRAPHS 192.739 (B) AND 192.743 OF 49 CFR 192 (REFER TO GAS STANDARD H–70)

PART III — To be completed only if Part II indicates that relief capacity is inadequate.

Station Name _____ Date _____

Division _____ District _____

Line or System Supplied by Facility _____

1. Additional relief capacity required (from Part II, Item 6, less Item 7(c)). _____ scfh
2. Corrective action to be taken:
   a. Increase relief capacity (see Item 3, this sheet). _____ scfh
   b. Replace relief equipment with a monitor.
   c. Other. Describe _____
3. If relief capacity is increased by adding an additional relief device or replacing the existing relief equipment with a relief device of larger capacity, a copy of the design calculations must be attached to this form.
4. Date capacity was found to be inadequate: _____
5. Work to provide adequate overpressure protection completed.
   Job No. _____ Completed on _____

Verified by: _____	Approved by: _____
Date:	Date:

Note 1 The **Verified By** box is usually initialed by a GSM&TS or Utility Operations area engineer. The **Approved By** box is usually approved by the engineering supervisor.

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CAPACITY REVIEW OF RELIEF DEVICES AT **COMPRESSOR STATIONS**
AS REQUIRED BY PARAGRAPH 192.731 OF 49 CFR 192 (REFER TO GAS STANDARD H–70)

Station name:	Area:	District:
Line or system supplied by facility (see Note 1 below)		Anniversary month (see Note 2 below)

PART I — To Be Completed Annually

This capacity check is for the Year											
1 Was capacity reviewed for previous year?	**YES**										
If NO, complete Part II of Annual Capacity Review for Compressor Stations.	**NO**										
2 Did previous review show that relief valve(s) had adequate capacity?	**YES**										
If NO, complete Part II of Annual Capacity Review for Compressor Stations.	**NO**										
3 Have there been any changes to the compressor(s) at this station, to pressure conditions (either inlet or outlet), to load conditions, or to supply conditions which could affect the ability of the relief valve(s) to limit the pressure to the maximum permitted by paragraphs 192.169 and 192.201 of 49 CFR 192?	**YES**										
	NO										
*If the answer is YES, complete Part II of Annual Capacity Review for Compressor Stns. **If answers to Items 1 and 2 were YES and Item 3 was NO, check YES on Item 4.											
4 Relief valve(s) at this station have adequate capacity. If NO, complete	**YES**										
Part III of Annual Capacity Review for Compressor stations.	**NO**										
VERIFIED BY (Place initials in the appropriate box)											
DATE (Put date verified in the appropriate box)											
APPROVED BY (Place initials in the appropriate box)											
DATE (Put date approved in the appropriate box)											

NOTES:

1. If there are compression facilities at the station supplying more than one line or system, perform a separate review for the overpressure protection devices for each line or system.
2. All pressure relief devices shall be inspected, tested, and the capacity reviewed at intervals not exceeding 15 months, but at least once each calendar year. Furthermore, in addition to the annual capacity testing, the capacity of the relief devices shall be verified immediately when changes are made which could affect the ability of the relief device to protect the connected systems.
3. The **Verified By** box is usually initialed by a technician or an M&C mechanic. The **Approved By** box is usually initialed by an engineer or operating supervisor/superintendent.

RETAIN THIS DOCUMENT AS A PERMANENT RECORD FOR THE LIFE OF THE FACILITY.

CAPACITY REVIEW OF RELIEF DEVICES AT **COMPRESSOR STATIONS** AS REQUIRED BY PARAGRAPHS 192.731 OF 49 CFR 192 (REFER TO GAS STANDARD H–70)

PART II — To be completed only if Part I indicates that a complete review is required.

Station Name _____ Date _____

Division _____ District _____

Line or System Supplied by Facility (see Note 1 below) _____

_____

This Capacity Review is for the Year _____

1. **A complete capacity review was required because:**
   - a. _____ Capacity review was not performed in the previous year.
   - b. _____ The previous capacity review showed that the relief device capacity was inadequate.
   - c. _____ Changes have been made to the equipment at the station, to pressure conditions, to load conditions, or to supply conditions which could affect the ability of the relief valves to limit the pressure to the maximum permitted by 49 CFR 192.

2. **Station Pressure Conditions**
   - P1 – Maximum suction pressure (MAOP or MOP, if lower) _____ psig
   - P2 – Maximum normal suction pressure _____ psig
   - P3 – MAOP or MOP downstream of station _____ psig
   - P4 – Maximum permissible downstream pressure (see Par. 192.169 and Par. 192.201) _____ psig

3. **Compressor(s) Supplying Line or System Described Above**

Compressor		Max Capacity	Indicate Reference Source for Capacity *(Attach calculation sheet)*
Operating Diagram Designation	Model	(P1 or P2 in, P4 out)	

4. **Maximum Supply Capability**
   - a. Total capacity of all compressors if installed in parallel. _____ scfh
     Total capacity of series compressor installation with pressure drops adjusted to give maximum flow. _____ scfh
   - b. Maximum capacity through station if limited by conditions other than compressor(s). _____ scfh
     State limiting conditions: _____
     _____
     _____

Note 1 If there are compressor facilities at the station supplying more than one line or system, perform a separate review for the overpressure protection device for each line or system.

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CAPACITY REVIEW OF RELIEF DEVICES AT **COMPRESSOR STATIONS** AS REQUIRED BY PARAGRAPHS 192.731) OF 49CFR192 (REFER TO GAS STANDARD H–70)

PART II, (continued)

Station Name _____ Date _____

5. **Relief Capacity Required**

   Enter either Item 4a or Item 4b, whichever is lower. _____ scfh

6. **Relief Device(s) Protecting Line or System Described Above**

   a.

Relief Valve						Maximum Capacity @ P4 (See Note 2)	Capacity Reference
No.	Size	Model	Serial No.	Orifice (Sq. In.)	Set Pressure (psig)		

   b. Total capacity restrictions from valves, piping, silencers, etc. _____ scfh

   Describe _____

   _____

   _____

   c. Relief capacity available. Total of 6(a), less total of 6(b) _____ scfh

7. **Adequacy of Relief Capacity**

   a. Capacity shown in 6(c) is equal to or greater than relief capacity required (Item 5). Capacity adequate. Complete Item 8 below and answer question 4 in Part I. _____

   b. Capacity shown in 6(c) is less than the relief capacity required (Item 5). Capacity not adequate. See Part III. _____

8. **The relief device(s) described above have adequate capacity** (see Note 3).

Verified by: _____	Approved by: _____
Date:	Date:

Note 2 Refer to Section 3.0 of Gas Standard H–70.

Note 3 The **Verified By** box is usually initialed by a GSM&TS or Utility Operations area engineer. The **Approved By** box is usually approved by the engineering supervisor.

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CAPACITY REVIEW OF RELIEF DEVICES AT **COMPRESSOR STATIONS** AS REQUIRED BY PARAGRAPHS 192.731 OF 49 CFR 192 (REFER TO GAS STANDARD H–70)

PART III — To be completed only if Part II indicates that relief capacity is inadequate.

Station Name _____ Date _____

Area _____ District _____

Line or System Supplied by Facility (see Note 1 below) _____

1. Additional relief capacity required (from Part II, Item 5, less Item 6(c)). _____ Scfh

2. Corrective action to be taken:

   a. Increase relief capacity (see Item 3, this sheet). _____

   b. Other. Describe _____

3. If relief capacity is increased by adding an additional relief device or replacing the existing relief equipment with a relief device of larger capacity, a copy of the design calculations must be attached to this form.

4. Date capacity was found to be inadequate _____

5. Work to provide adequate overpressure protection completed.
   Job No. _____ Completed on _____

Verified by: _____	Approved by: _____
Date:	Date:

Note 1 The **Verified By** box is usually initialed by a GSM&TS or Utility Operations area engineer. The **Approved By** box is usually approved by the engineering supervisor.

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