Relief Device Selection Process for Gas Bottle Systems (Guidance)

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Was Appendix D of Section I, rev. 3	Ari Ben Swartz, *ES-EPD*	Larry Goen, *ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	Pressure Safety POC and Committee

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This document provides a sample calculation to illustrate the methodology to be used to size a relief device for a gas bottle system.[1]

This sample calculation evaluates two cases: (1) without a restriction orifice and (2) with a restriction orifice.

> Note: Both cases involve the placement of the orifice upstream of the regulator. The orifice may be placed downstream of the regulator, but different calculations must be performed.

The following design parameters are assumed for this pressure system:

Gas Bottle: Nitrogen at 2265 psig

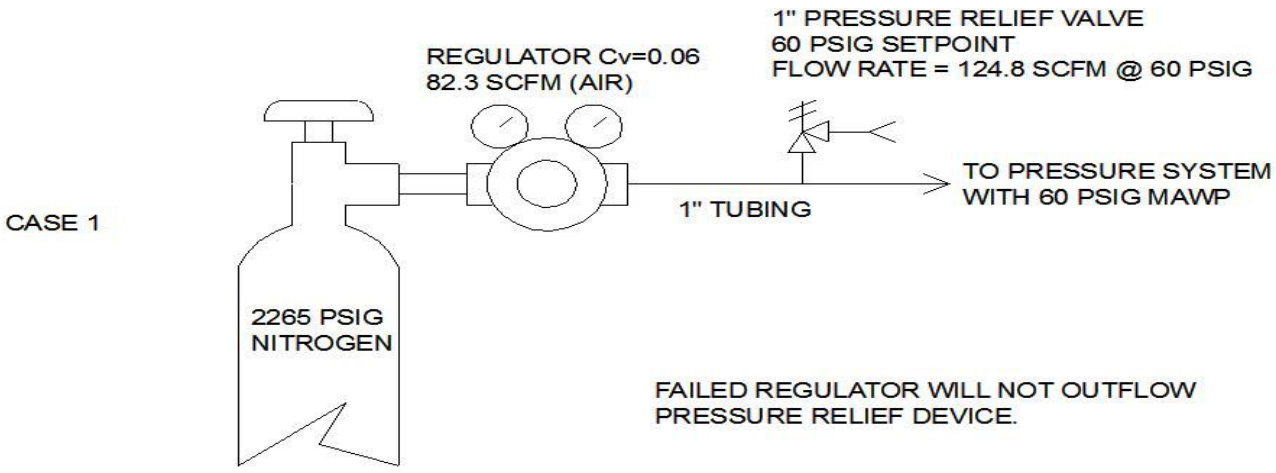
Regulator: Scott model 51-3300E-CGA, with a $C_v = 0.06$

Regulator downstream MAWP = 60 psig

Relief valve set pressure = 60 psig

[1] This sample calculation uses information contained in ARES calculation 0633301.52-M-062 (LANL CALC-10-00-786-PSS-GEN-00001r0), which is available as "Compressed Gas System Flow Calculation (pdf)" via the Pressure Protection Program Website: http://int.lanl.gov/org/padops/adnhho/engineering-services/pressure-protection-program/index.shtml

CASE 1



Case 1

From the ARES calculation (page 9), the flow, $Q_{air\_nitrogen}$ = 82.3 scfm for a C_v = 0.06

Regulator downstream pipe size: 1 inch

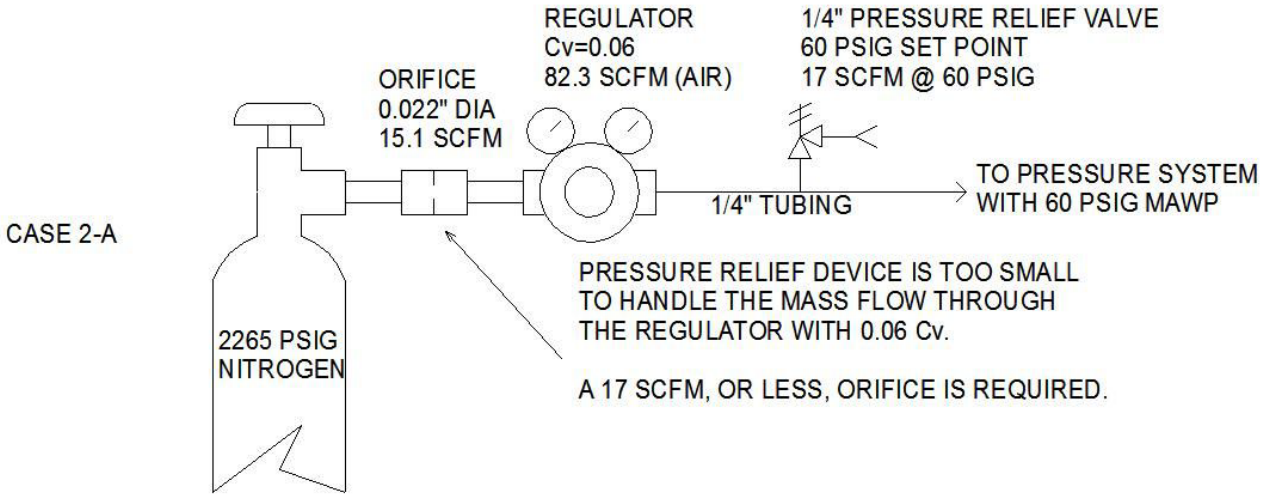
For valve selection, refer to the capacity data for Kunkle Relief Models 264 through 267 (ASME Section VIII, Air/Gas and Steam, National Board Certified). Valve inlet sizes: ½", ¾", 1". Refer to Kunkle catalog at: http://www.kunklevalve.com/catalog/_264.pdf

The capacity data sheet provides the following flows as a function of the setpoints:

Set Pressure (psig)	Flow (Air) (scfm)
50	108
75	150

Interpolating for a set pressure of 60 psig yields a flow of 124.8 scfm -- which is greater than the required flow of 82.3 scfm.

CASE 2-A



Case 2-A

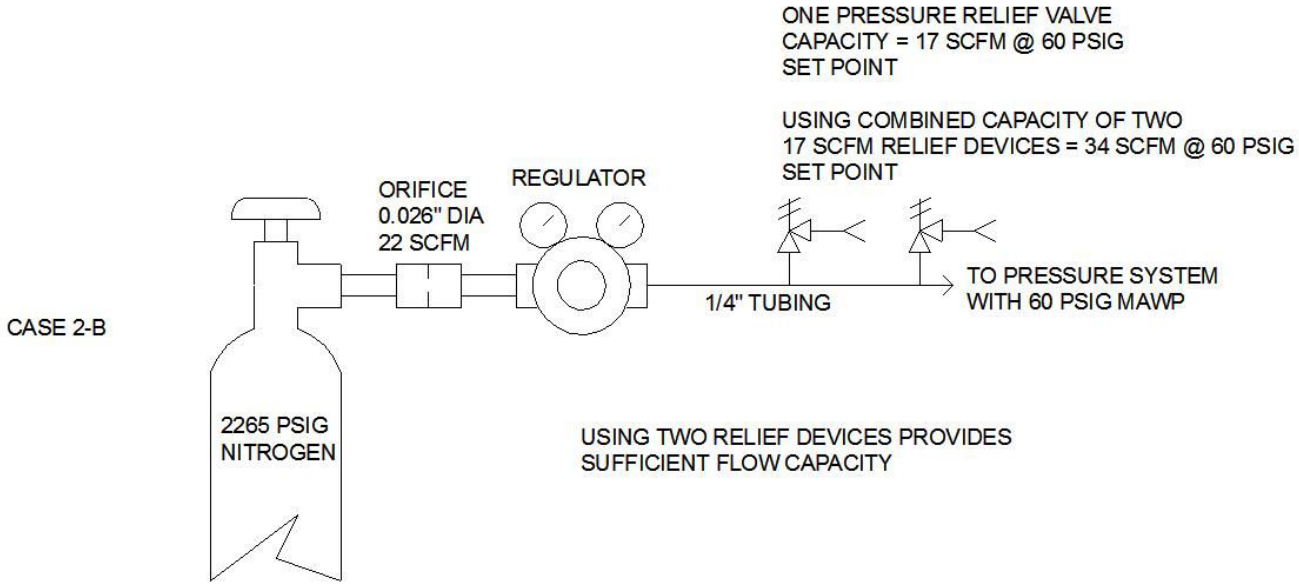
Regulator downstream pipe size: ¼ inch

82.3 scfm is too much for a ¼ inch relief valve; consequently, a restriction orifice will be added upstream of the regulator.

Assume that a ¼ inch Circle Seal model D500-M relief valve is available. The capacity data sheet for that valve indicates a flow of 17 scfm (air) at a setpoint of 60 psig (size 2M at 10% accumulation). Refer to Circle Seal catalog at:
http://www.circlesealcontrols.com/products/relief_valves/500/500-series_2007-10_lo.pdf

From the ARES calculation (page 12), the flow, $Q_{air\_nitrogen}$ = 15.1 scfm for an orifice diameter of 0.022 inch, the orifice flow of 15.1 scfm is within the relief valve capacity of 17 scfm.

CASE 2-B



Case 2-B

Regulator downstream pipe size: ¼ inch

Assume that a flow of 18 scfm (air) is required to meet the demands of the downstream system.

From the ARES calculation (page 12), the flow, an orifice diameter of 0.026 allows a flow, $Q_{air\_nitrogen}$ = 22.0 scfm.

ASME B31.3, Section 322.6.3, references ASME Section VIII, UG-134, which allows multiple pressure relief valves.

Using two Circle Seal model D500-M (1/4" inlet at 10% accumulation) provides a total flow of 34 scfm (air) at a setpoint of 60 psig, which exceeds the orifice flow of 22.0 scfm.