

# Calculating Relief Valves Under The New ASHRAE 15 Rules

Daniel R. Kuespert  
Snowy Owl LLC  
Member IIAR

---

Between the 1994 and 2001 editions of the ASHRAE 15 standard, there were substantial changes in the method for calculating allowable length for relief discharge piping. These have confused and upset many people in the industry, including my fellow IIAR members. This short note is a simple example of how to perform calculations under the new rules.

Note that these calculations are sensitive to roundoff errors due to the high exponents and divisions involved. You may get answers that vary by 20% or so.

Requirements for determining the required relief capacity do not change between ASHRAE 15-1994 and -2001, so I will start at the relief valve. For those interested in how to calculate relief manifolds and apply concepts like equivalent length, please refer to the *IIAR Piping Handbook* and the *ASHRAE Handbooks*.

## ASHRAE 15-1994

Assume we have a vessel with a relief valve with a 1/2" inlet and 3/4" outlet, a set pressure of 150 psi (gauge) and a rated capacity of 27.16 lb air/min.

This example is an actual commercially-available relief valve.

ASHRAE 15-1994 specifies that the allowable (equivalent) length of

discharge piping be limited to  $\frac{9P^2 d^5}{16C_r^2}$ .

In this case,

- $P = 1.10 \times 150 \text{ psig} + 14.7 \text{ psi} = 179.7 \text{ psia}$  (you're allowed 10% overpressure, and we convert to absolute pressure from gauge);
- $C_r = 27.16 \text{ lb air/min}$ ;
- $d = 0.824 \text{ in}^2$  (typical cross-section for 1" pipe).

This gives an allowable pipe length of **9.35 ft**, which should be enough to get the relief through the roof. In practice, a contractor would "step up" to a larger pipe size in order to get more allowable length.

## ASHRAE 15-2001

Under ASHRAE 15-2001, Appendix H gives an entirely new, more complex method of calculating allowable length – usually shorter. The reason is that it employs better physics, which is supposedly safer for the relief valve (preventing it slamming shut during a release, for example).

The specified equation for determining allowable length in the 2001 edition is

$$L = \frac{0.2146d^5(P_0^2 - P_2^2)}{fC_r^2} - \frac{d \ln\left(\frac{P_0}{P_2}\right)}{6f}$$

In our case,

- $P_0 = 0.15P + 14.7 \text{ psia} = 37.2 \text{ psia}$  (this allows 15% backpressure on the relief valve);

- $P_2 = 14.7$  psia (discharge to atmosphere);
- $d = 0.824$  in<sup>2</sup> for 3/4" pipe (ID);
- $f = 0.0225$  (Moody friction factor – typical value for 1" pipe).

Calculating the allowable length for our case gives a result of **0.068 ft!**

### Help me!

We have an apparent problem. We obviously need to upgrade to a larger pipe size. Let's try "stepping up" to a 1" relief pipe size. Running the same calculation gives us  $L=12$  ft. ( $d=1.049$ ;  $f=0.0225$ ) This is adequate. Stepping up further to 1 1/4" gives **71.1 ft.** This is plenty for a complex piping system.

But there's a catch – we had to get up to the larger piping system somehow. Most mechanical contractors would do so by inserting a bushing into the relief valve outlet (3/4" MNPT:1" FNPT) This will actually constrict the outlet even further, since most fittings are more thickly built than pipe.

If we use a "literalist" interpretation of ASHRAE 15-2001, we're not allowed to put anything in with a diameter of 3/4" NPT – there's essentially no allowable length whatsoever. This would apply even to make it bigger so we could run bigger pipe. This would actually outlaw certain (in some applications, most) models of relief valve.

This was not the intent of the standard. (I was on the committee at the time, and I certainly didn't think so from a personal standpoint!) The ensuing misconceptions caused an uproar, and an interpretation was issued to clarify the issue. (See [www.ashrae.org](http://www.ashrae.org) and choose "Technology," then "Standards

Interpretations" to see the gory details.)

### Rescued

Basically, what to do to solve the problem is to use a bushing or reducer to expand the relief piping at or near the valve, and then calculate the equivalent length of the bushing – as feet of the larger pipe. After all, a reducer has two sizes, and you can pick whichever you like.

In our case, a typical bushing introduces 0.25-0.50 ft-equiv pressure drop of 1 1/4" pipe, disregarding its effect as 3/4" pipe. To calculate the pressure drop, you can use a table, you can calculate it, you can call your friendly neighborhood professional engineer – highly recommended for this sort of work. Overall, we have about 70 ft-equiv remaining to use in our 1 1/4" relief system.

---

NOTE: The above is only a simplified example for educational use. Do not rely on it for complete design information, as there are many other considerations in a total relief discharge system. Obtaining assistance from a qualified party is recommended.

This article is adapted from *coldcodes*, a newsletter covering codes and standards for the refrigeration industry (ISSN 1537-3029). Copyright © 2004 Snowy Owl LLC. All Rights Reserved. Permission is granted to reproduce and distribute this document provided no changes or derivatives are made and no charge is made to the recipient.

Dan Kuespert, is a consultant working in Columbia, MD. He is a former Technical Director of the IIAR. He can be contacted at [dkuespert@snowy-owl.net](mailto:dkuespert@snowy-owl.net) or (410) 964-8433.