# Safety Considerations in Canning of Valves

Here's a technique that stops minor leaks in ammonia plants and thus prevents major shutdowns, an important contribution to operating efficiency.

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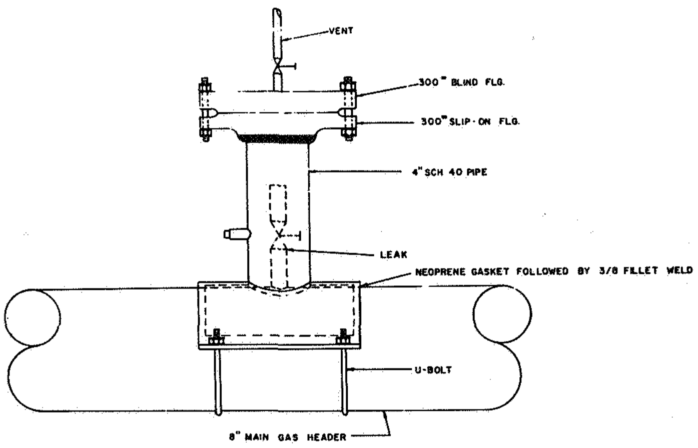


**Figure 1. Sectional design of a boot used to seal a leak from a cracked nipple on an appurtenance valve on an incoming gas header.**

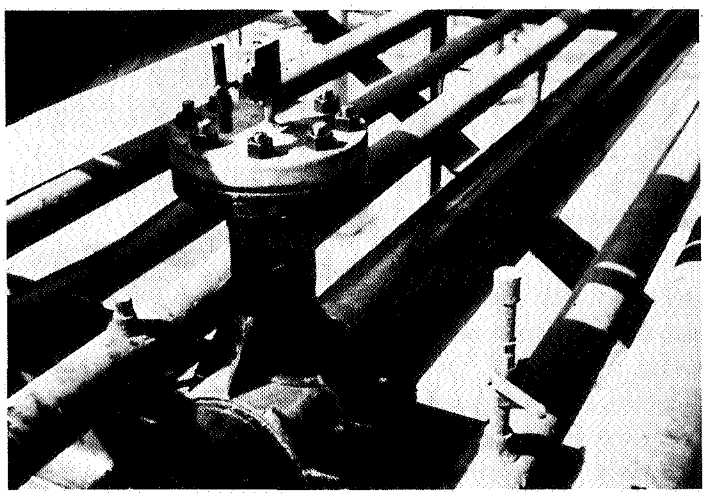

**Figure 2. The boot in Figure 1 as actually installed at Agrico's Donaldsonville, La., 1,000-ton/day ammonia plant.**

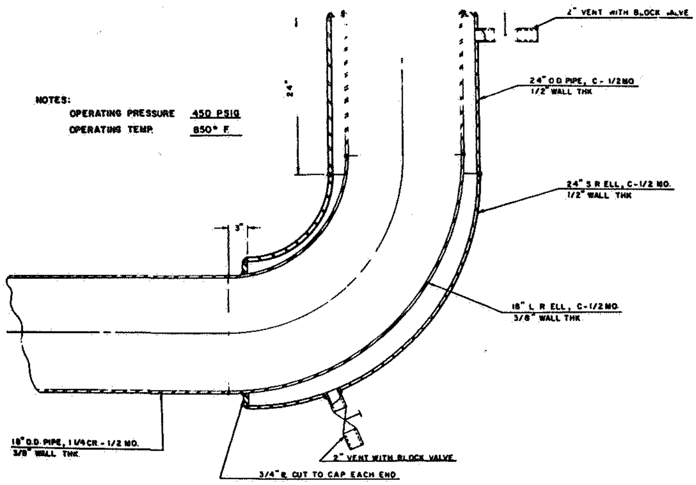


**Figure 3. Design of a boot around an eroded elbow in a waste heat boiler line in an ammonia plant at Blytheville, Ark.**

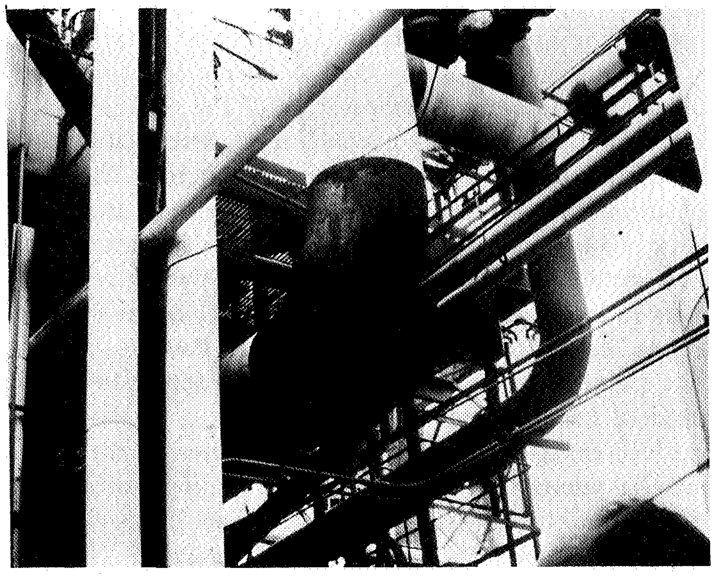

**Figure 4. Photograph shows the boot of Figure 3 as actually installed on the 18-in. 90° elbow.**

Canning of valves in process or steam or air lines to stop minor leaks and maintain units onstream has gained favorable acceptance in ammonia plants today. It is important, however, to make sure that all proper safety precautions are taken when this is done, particularly when dealing with natural gas and hydrogen process gas.

Canning, also known in the trade as booting, is the technique whereby a leak is bottled up by means of putting another pressure shell around its source, namely, the valve or line. Process leaks that are successfully canned will permit operation to continue until some future time when a turn-around can be properly planned and executed. At that time, the boot can be removed and the valve replaced or the line repaired if it is necessary for operation to do so. Occasionally it can be determined that a boot may be left "in use" since it is now a properly designed pressure container.

The accompanying illustrations show cross sectional designs of typical applications of cans or boots and photographs of the actual application of these designs.

Figures 1 and 2 are of a boot used to seal a leak resulting from a cracked nipple on an appurtenance valve on the incoming gas header to Agrico's 1000-ton/day Kellogg $NH_3$ plant at Donaldsonville, La. Failure to can this leak would have resulted in a plant shutdown.

Figures 3 and 4 show the canning of a process line at Agrico's Blytheville, Ark. 1000-ton/day Bechtel $NH_3$ plant. In this case, wetted process gas had eroded the 90° elbow in a waste heat boiler exit line. A boot of oversize pipe and elbow was designed and fabricated. The application was successful and a costly shutdown was prevented.

Figures 5 and 6 show the typical valve boot. It is an assembly of weld caps and pipe. This idea has probably saved more shutdowns in our company than any other single item.

One of the first considerations is the selection of material that will be compatible with the process stream and certain operating conditions of that stream. In $NH_3$ plants the prime consideration is hydrogen. Its partial pressure must be plotted on the Nelson curve, as found in API Publication 941, and shown in Figure 7, to determine alloy content of carbon steel used. In some cases where corrosion warrants, ASTM A312 series stainless steels may be used.

Consideration must be given to welding rod composition, especially when the boot may be of upgraded material from the original failed material. Since such a wide variety exists, reference should be made to a welding manual for selection, such as "The Welding Data Book."

Where there is a borderline or grey area of material selection, one must always go to the higher alloy, because the cost will be so small in relation to the safety factor gained.

Of equal importance to the safe design of boots is the operating pressure and temperature of the process at the point of the failure. The maximums of these factors must be known so as to properly design the container. The body of the boot must have the proper hoop stress design to allow a 4-to-1 safety factor. After the outside diameter has been determined, the thickness of the body can be calculated in accordance with the ASA B31.3 Code on Pressure Piping, or ASME Section VIII, Unfired Pressure Vessels. The temperature directly affects the allowable stress of the material being considered. Consequently, if temperatures are high enough, it may be necessary to override the initial material selection which was based on hydrogen attack. In $NH_3$ plants there are borderline cases where this could happen, and it is always wiser to use the higher alloy.

Once the boot has been properly designed and built, it is time for the installation. It is very important to know if the line on which the attachment is to be made is structurally sound. This can be learned through mechanical inspection. An ultrasonic thickness tester will provide the necessary information. If the results are sound, then welding may proceed.

When the boot was fabricated in the shop, connections were installed to permit the injection of nitrogen and/or

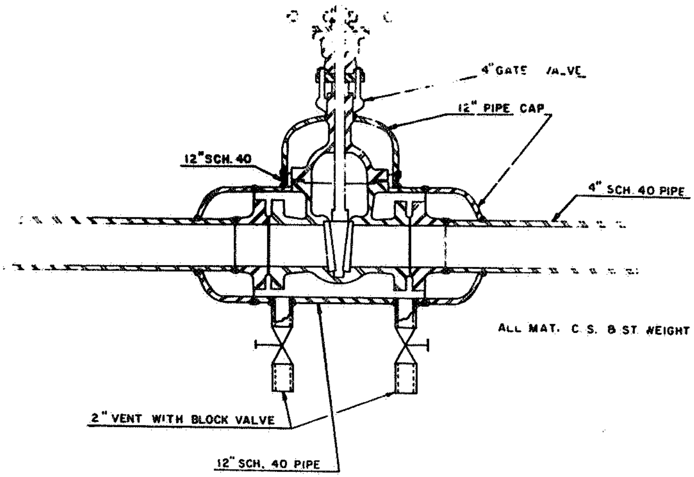


Figure 5. A typical valve can, in this case, around a 4-in. gate valve in a 4-in. line, in section design.

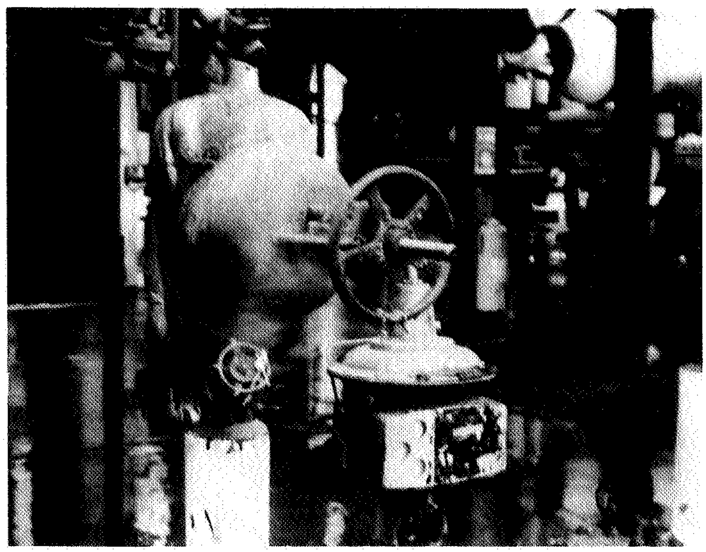

Figure 6. A valve canned in a vertical installation, using design shown in Figure 5.

steam into the chamber. Connections of sufficient size were also installed to permit the exhaust of this same nitrogen or steam along with the hydrogen and/or methane that is escaping into the chamber. In the case of steam or air leaks, this purge is not necessary.

Valves of proper material selection and capacity are attached to the exhaust nozzle. Nitrogen is connected to the inlet nozzle to purge the chamber and, if the gas is dry, steam may be added. When flow is established, a "sniff check" should be made of the area to be welded. When this indicates "safe," welding may commence.

In the set up of the job, all possible safety precautions should be taken. A "fire watch" should be provided, with a fire hose ready for use. The area should be checked out for other leaks, flanges, etc. Problem areas should be protected with asbestos blankets and wetted down thoroughly. Welding sparks should be contained by means of wetted asbestos blankets.

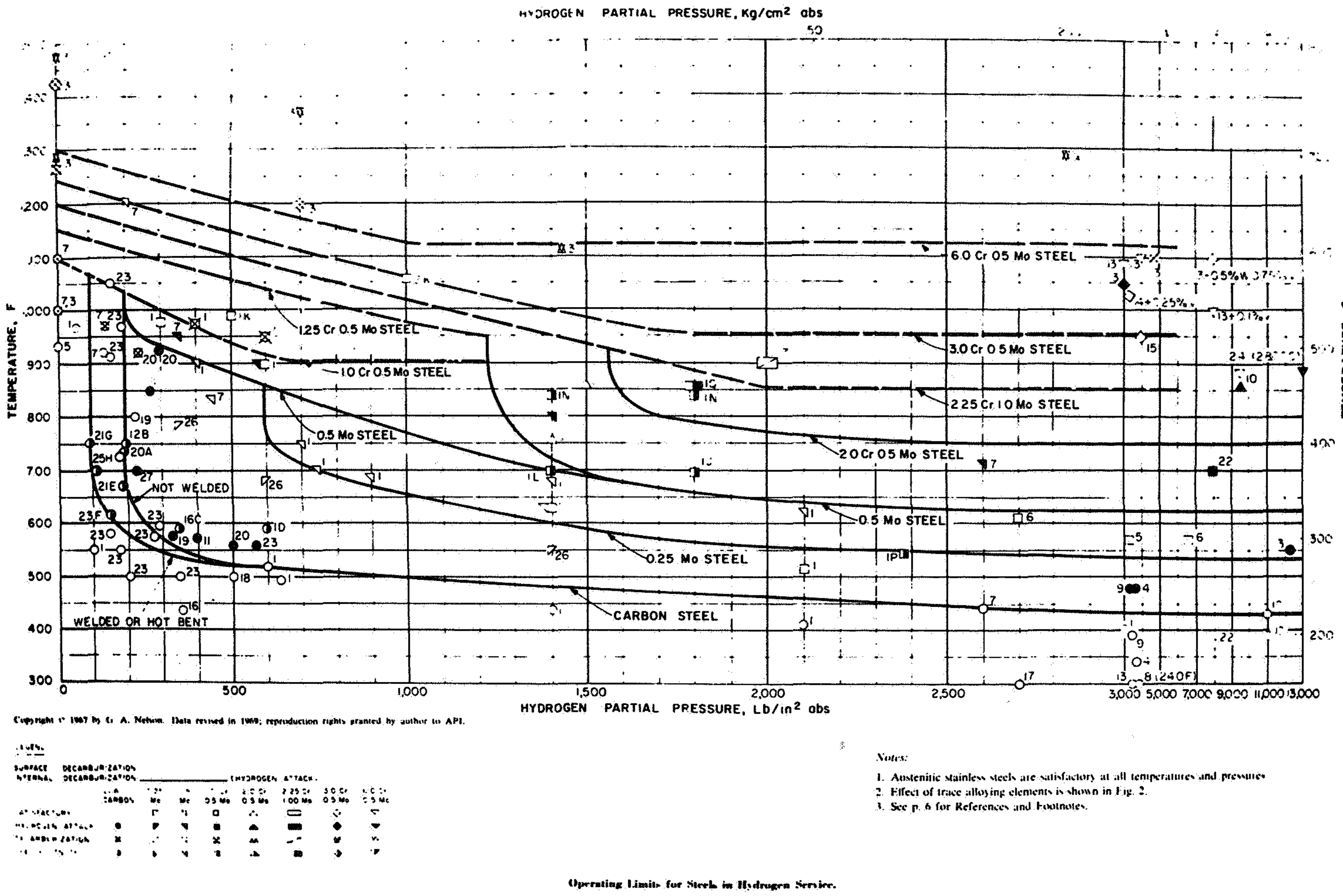


**Figure 7. Operating limits for steels in hydrogen service.**

When a job is approached in the manner of doing all possible to make it safe and successful, it is very likely to succeed. When the operating, maintenance, engineering, and managing employes act as a team and face the problem with a unified front, success is inevitable. Success in these cases can mean millions of dollars saved to companies by avoiding lost production. #

**WICHER, M.E.**

# DISCUSSION

Q. I would like to ask if in making these sort of boxed valve repairs that you've had any encounters with government bodies of one sort or another.

**WICHER:** With what bodies?

Q. With government regulatory bodies of one sort or another.

**WICHER:** No, we have not. We have always kept our insurance people involved with us in making these type of applications. We have not had any conflicts with government regulations, at all.

**WILLIE CLARK,** ICI, Billighame: Two points. One, an additional method. We've been involved a little bit with a thousand pound per square inch ethylene pipeline which has sprung one or two leaks at small tapping points and so forth in the middle of nowhere and we had to do something about them. You can't weld on ethylene lines because ethylene is liable to go pop if you heat it suddenly. But we have been successful—and we've got a patented method for putting on a can very similar to the sort of thing that you're speaking of except that it has a much longer interface between the pipe and the can, injecting epoxy, curing it. The can is vented while you're doing this so that there's no pressure blowing the epoxy out before it's set. With suitable design a can attached by epoxy resin instead of weld metal can hold 1000 lb./sq.in. or more. This has saved us a lot of money.

Now the other question. I wonder if you have one of the troubles that we get. This is particularly on steam valves where after a year or two in service you find because of porosity in the casting that you've got a steam leak, and this is a pain in the neck. We have found slightly surprisingly that you can peen the surface and stop the leak and it'll stay stopped for a short time and during that time you can weld over it and then you've got something that's going to last perfectly well for a long time.

Do you get trouble with leaks through valve castings or are all your castings good sound metal?

**WICHER:** Primarily the experience has been not in the casting itself but we've been finding these flange leak type problems. And some of the applications of the last five or six slides have been in service for almost seven years now.