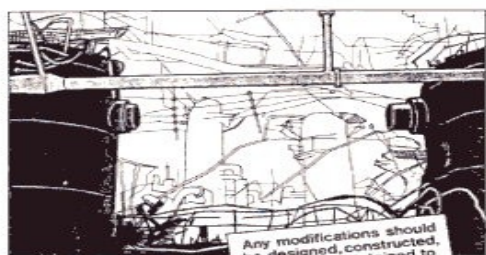




SAFE INDUSTRIAL PRACTICES

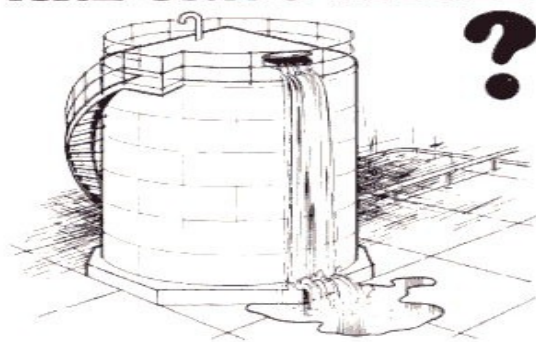
No. 127

MORE ABOUT MODIFICATIONS AND INSTRUMENTS



Any modifications should be designed, constructed, tested and maintained to the same standards as the original plant.
FROM THE OFFICIAL REPORT ON THE EXPLOSION AT FLOUOROCHEM ON JUNE 1st 1974

ARE TRIPS TESTED



- 127/1 Another instrument gives an impossible reading — and is right.
- 127/2 Some protective systems which might not be tested.
- 127/3 Another hazard introduced by a modification.
- 127/4 Modifications — a success story.
- 127/5 A new sort of gasket is a modification.
- 127/6 Test just before welding, not five hours before.
- 127/7 A chemical valve to prevent oil spillages going to drain.
- 127/8 If you can't see that it is clean, assume that it is dirty.
- 127/9 If the HSE and the Planning Authorities don't agree...
- 127/10 Fires in the home.

An Engineer's Casebook — Duration of Hydrostatic Tests on Piping.



IMPERIAL CHEMICAL INDUSTRIES LIMITED
PETROCHEMICALS DIVISION

127/1 ANOTHER INSTRUMENT GIVES AN IMPOSSIBLE READING — AND IS RIGHT

Newsletters 124/3, 108/2, 97/9, 65/9, 50/1 8/2 and 5/1 described how instrument readings or alarms were ignored because they were thought to be incorrect. Unfortunately they were correct and a tank overflowed, a pump overheated or a vessel burst.

Now another incident has occurred.

A reactor was swept out with nitrogen during the night and left to cool, ready for a catalyst change. Temperatures were read every two or three hours.

The temperatures fell more slowly than usual so the nitrogen flow was increased.

When the manager came into the control room in the morning he was told that the temperature indicator was out of order — **it was reading about 930°C, though it was expected to read less than 300°C.**

The manager went round the plant and found that the valve on an air line, still connected up after the catalyst regeneration, had been opened. The air was reacting with the catalyst and raising its temperature.

The air line should be connected up only while the catalyst regeneration is in progress.

Never ignore instruments that give unusual readings — they might be right. Check the job.

127/2 TEST ALL PROTECTIVE SYSTEMS

By accident a compressor was started up before the barring gear was disengaged.

Result: The barring gear was damaged.

The compressor was fitted with a protective system which should make it impossible to start up the compressor with the barring gear engaged but the protective system was out of order. It **was not tested regularly** and may have been out of order for some time.

For many years now it has been our normal practice to test all protective systems regularly, but every now and then we find that a protective system of an unusual type has slipped through the net.

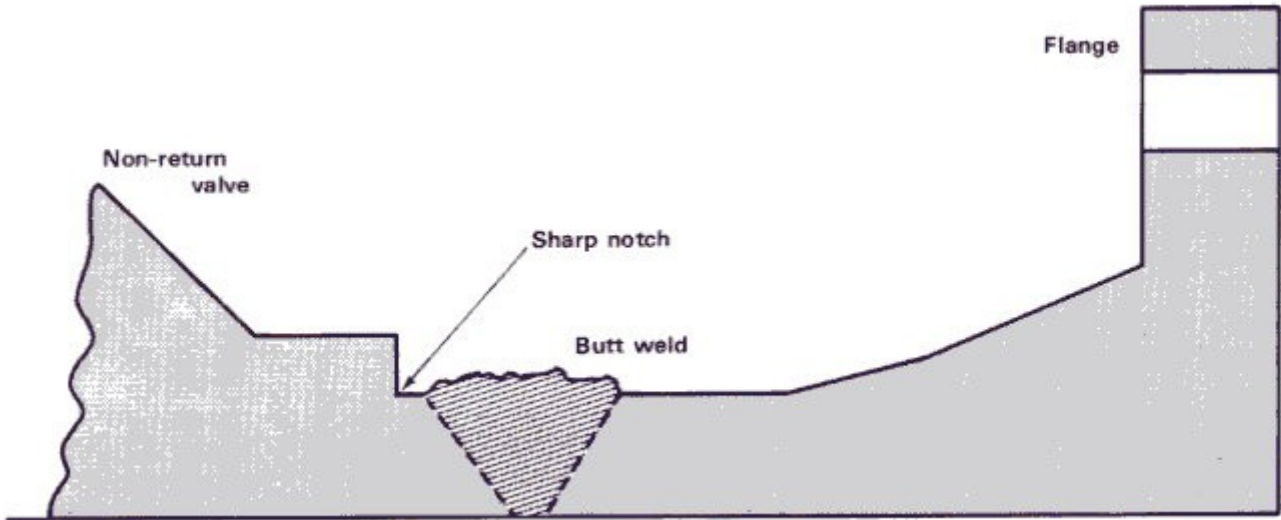
Another example is provided by an automatic BCF fire-fighting system which was installed in a building. A small explosive charge is supposed to cut a bursting disc and release the BCF. When the equipment was tested the smoke detectors worked and the explosive charge operated, but the cutter did not cut the bursting disc. The explosive charge could not develop enough pressure as the volume between it and the bursting disc — including the volume of the pipeline used for manual operation — was too great.

The manufacturers had suggested that it was not necessary to do a full test as BCF is expensive. Fortunately we carried out a full test. How many similar installations have not been fully tested and will not work when required?

Do you know of any other protective systems which are never tested?

127/3 ANOTHER HAZARD INTRODUCED BY A MODIFICATION

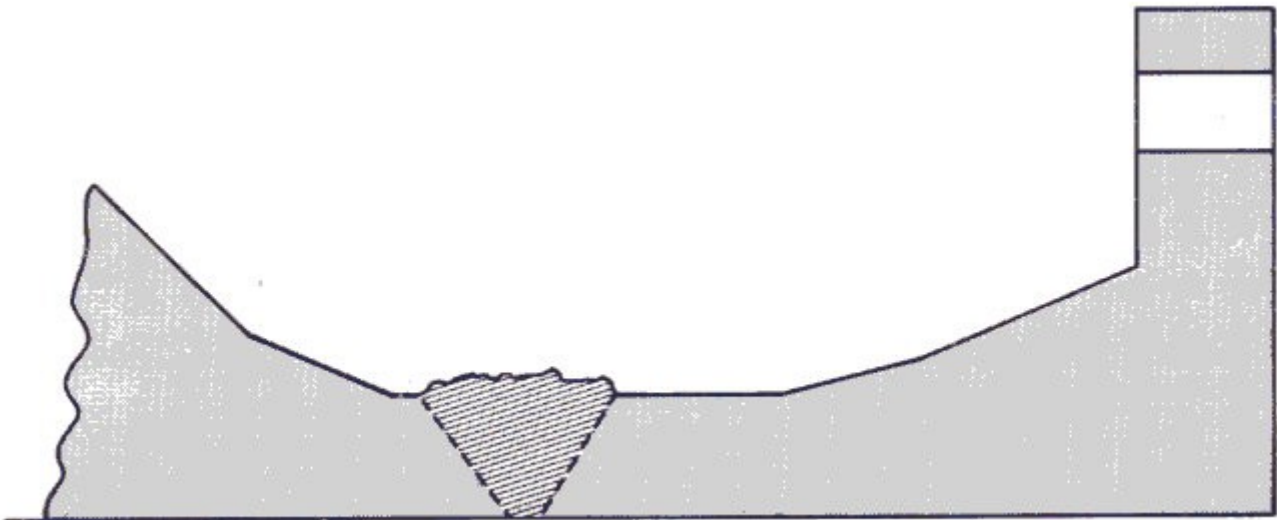
A non-return valve on the delivery line from an injector cracked and leaked. It was then found that there was a sharp notch on the body, close to a weld. This caused a fatigue failure.



How did such a design come to be adopted?

The non-return valve was originally designed to take screw-on flanges but the design was modified so that weld-neck flanges could be used. The hub diameter of a weld-neck flange is less than that of a screw-on flange. The stub of the non-return valve forging was therefore turned down to match, leaving a sharp discontinuity.

The non-return valve should have been tapered, at a gradient of 1 in 4, as shown below.



Another example of cracking caused by stress concentration at sharp edges is described in "Endeavour", 1979, Vol 3, No 1, p 19. Church bells used to be tuned by chipping bits off the lip. The ragged edge produced served as a stress raiser and this often led to cracks and eventual failure.

Nevertheless, church bells last a long time by our standards. The average life is 250 years. After 500 years the tone deadens due, it is believed, to numerous small cracks.

127/4 THE CONTROL OF PLANT MODIFICATIONS — A SUCCESS STORY

Earlier Newsletters (126/12, 118/2, 111, 103/5a, 100/2, 99/1, 97/6, 83, 71/7, 67/7d and 63/7) have described many incidents that occurred because plant modifications had unforeseen and unexpected side effects. One of our associate companies has described how the systematic examination of proposed modifications — using a system similar to that described in Newsletter 83 — picked up unforeseen effects before the modification was made.

A proposal was made to fix acoustic insulation on to pipework. During a review of the modification the review team realised that the acoustic insulation would also act as thermal insulation and would prevent the process stream, which was cold, taking up heat from the atmosphere. This could result in freezing of the process stream and the formation of a plug in the pipeline. The acoustic insulation was still fitted but a relief valve was re-located so that freezing could not result in over-pressuring of the equipment.

127/5 A NEW SORT OF GASKET IS A MODIFICATION

A leak of hot oil occurred from a filter while it was being brought on line. A remotely operated emergency isolation valve stopped the leak. The leak occurred because the 'O' rings used to seal the filter cover were out-of-stock and a flat gasket had been cut out of sheet rubber. It squeezed into the 'O' ring groove and leaked.

Changing the type of gasket is a modification and should go through the normal modification procedure.

127/6 TEST JUST BEFORE WELDING, NOT 5 HOURS BEFORE

A nitrogen line had to be modified. It was isolated and de-pressured and the atmosphere inside the pipe was tested with a combustible gas detector and found to be safe.

5½ hours later welding started and a small fire occurred at the open end of the nitrogen line.

The cause of the contamination was not established with certainty but earlier Newsletters (121/5, 98/2 and 3, 79/2b and 51/7) have described many other occasions on which process materials got into service lines. Newsletter 21/6 described the precautions necessary to prevent this happening.

The point which the recent fire does bring out is that a test in the middle of the morning does not tell us what will be present in a pipeline or in the atmosphere during the afternoon.

Test just before welding starts.

If leaks may develop outside the equipment while welding is in progress then a portable combustible gas alarm or Dalek should be used (See Newsletters 51/1 and 36/1).

127/7 A 'CHEMICAL VALVE' TO PREVENT OIL SPILLAGES GOING TO DRAIN

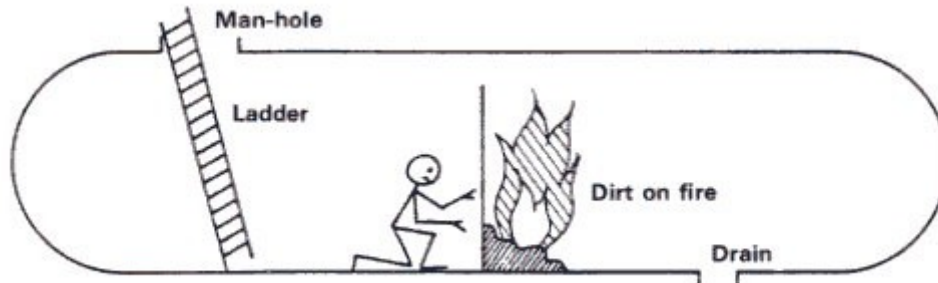
The drain valves on tank bunds should always be kept shut, except when rainwater is being drained, so that any spillage is collected in the bund and recovered. However, on many occasions the valves have been left open and spillages have got into the drain system, causing loss and contamination.

Dow are now marketing a simple automatic device to prevent this happening. A special cartridge, packed with "Imbiber Beads", is installed in the drain line. The cartridge allows water to pass but if any oil comes along the beads absorb it and swell, blocking the drain line.

127/8 A LOOK BACK AT NEWSLETTER 27 (March 1971)

If you can't see it is clean, assume it is dirty

A vessel was divided into two halves by a baffle which it was decided to remove. The vessel was cleaned out, inspected and a permit issued for a man to enter the left-hand side of the vessel to burn out the baffle. It was impossible to see into the right-hand half but as the left-hand half was clean and as no combustible gas could be detected it was assumed that the other half was also clean.



While the welder was in the vessel some deposit in the right-hand half caught fire. The welder got out without serious injury but bruised himself in his haste.

If a part of the vessel cannot be inspected and seen to be safe, then we must assume the vessel contains hazardous materials.

If the previous contents were flammable, we must assume there is some flammable material out-of-sight.

If the previous contents were poisonous, we must assume there is some poisonous material out-of-sight and breathing apparatus must be worn for entry.

Gas tests alone are not conclusive. There may be some sludge present which gives off gas when heated or disturbed.

127/9 WHAT THE LAW SAYS No 20

Developers have two distinct hurdles to cross in connection with new building projects. The first is planning permission. The second and separate issue is that the developer has to meet the requirements of the Health and Safety at Work Act. It is possible to have planning permission and still not be able to proceed because of the requirements of the Health and Safety at Work Act. The Executive will not hesitate to use Prohibition Notices in appropriate cases even where planning permission has been given.

S Grant, Scottish Director, Health and Safety Executive, Occupational Safety and Health, June 1979, p 22.

127/10 FIRES IN THE HOME

Fires in the home produce poisonous fumes, particularly if the furniture is modern and made from foam plastic.

The most dangerous fires are those that occur downstairs at night while everyone is asleep upstairs.

Very few people are killed in their beds but by the time the smoke has woken them up, people may have less than two minutes to escape downstairs and out of the front door. Many people have been killed by going downstairs into the fumes.

Other people have been killed, within 2-5 minutes, by fumes rising into the bedrooms, and killing them before they realised what was happening. The fumes contain carbon monoxide, which does not cause irritation and kills without warning.

What should we do?

1 Close all downstairs doors before going to bed.

2 If there is a fire, do not go downstairs, leave through a bedroom window. Better a broken bone, than dead.

3 Consider buying a smoke detector. Several models are now available for about £15 — £20.

4 Live in a bungalow. You can escape safely through doors or windows.

For more details see "Care in the Home", July 1979, pp 6 and 16 and BRE News, No 47, Spring 1979, p 2.

127/11 UNUSUAL ACCIDENTS No 89

A Spaniard hitched a lift on a lorry which was carrying an empty coffin. He got into the coffin to shelter from the rain.

The driver then gave a lift to some Arabs. When the Spaniard lifted the lid of the coffin the terrified Arabs jumped off the moving lorry and were injured. The driver stopped the lorry and with the Spaniard went back to explain, but the Arabs threw stones at the "dead man" and he ended up in hospital.

From Mond Division Safety Report, May 1979

127/12 RECENT PUBLICATIONS

(a) Safety Note 79/4, "The application of hazard analysis to chronic hazards

(b) Safety Note 79/5, "Why do pipes fail?" Most Flixborough type explosions are due to pipe failures. This Note examines the reasons and suggests some actions.

For copies of these publications or for more information on any item in this Newsletter please 'phone ET (Ext. P.2845) or write to her at Wilton. If you do not see this Newsletter regularly and would like your own copy, please ask her to add your name to the circulation list.

September 1979

An Engineer's Casebook No 27

DURATION OF HYDROSTATIC TESTS ON PIPING

Recent work on re-testing some of the older Billingham/Wilton link lines has raised the question as to the duration of a hydrostatic test on such lines.

Petrochemicals Division use ANSI B31.3 Chemical Plant and Petroleum Refinery Piping together with Piping Specification PI 0101 for piping design. They refer to piping inside battery limits or on-plot though they are often used for inter-plant, inter-Works and external pipelines such as in the Billingham/Wilton link.

B31.3 requires the pressure test to be maintained for a sufficient time to determine if there are any leaks, but for not less than 10 minutes.

PI 0101 differentiates between shop fabricated piping, to which ICI Spec. B125D applies, and erected pipework covered by B80 (hyd.). Shop fabricated items shall be held at the test pressure for a minimum period of 10 minutes or, where necessary, for sufficient time to allow complete inspection. For erected pipework, which is a mixture of shop and field fabricated items, B80 requires that the test pressure shall be maintained for a minimum period of 30 minutes or, where necessary, for sufficient time to allow complete inspection.

The above quoted specifications apply to piping inside battery or plant limits. Though piping outside these limits is frequently treated as though it were inside, transmission and distribution piping is recognised as a different duty. Appropriate codes are ANSI B31.8 Gas Transmission and Distribution Systems, IGE/TD/1 Edn. 2 1977 Steel Pipelines for High Pressure Gas Transmission, CP 2010 the British Standard Code of Practice for the Design and Construction of Steel Pipelines In Land. In this latter Code 'In Land' covers lines above and below ground which have appreciable length, certainly lines to which the Pipelines Act 1962 would apply.

CP 2010 requires that the test pressure be held for 24 hrs or alternatively a cyclic testing procedure be used. In this pressure is raised to the test level and held for a short time, say 1 hr. The pressure is then reduced to about half the test pressure and the test pressure re-imposed and held for 3 to 4 hours. The pressure is again reduced and the test pressure re-imposed and held for a period of from 6 to 24 hours. The 'ratcheting' effect of a cyclic test is more likely to cause defects to propagate to failure under the test stress than the application of a single pressure cycle.

Pipelines which are miles long should be tested this way, i.e. to CP 2010. For lines of length between miles and the much shorter lengths typical within battery limits, for example, inter-plant or inter-Works lines, the test duration should be long enough to allow complete inspection of the line under pressure with a minimum time of 6 hours.

E H Frank

Photographs from Our Archives No.4



In June 1965 this 4½ inch diameter high pressure pipe burst, producing a jet of flame over 100 feet long. Fortunately the pipe was high up and no-one was injured.

The pipe was carrying a mixture of hydrogen and hydrocarbons at 250 bar and 350-400°C, conditions under which the grade of steel used should be perfectly satisfactory.

Investigation showed that the pipe had previously been used on another plant for 12 years at 500°C. At this temperature it will last for anything between 5 and 500 years before failing by creep.

Do not re-use old pipes unless their history is known in detail and tests show that they are suitable for re-use.