SAFETY NEWSLETTER

No. 131
SOME OPERATING ERRORS
(Plus a design error or two to show we're not prejudiced)

131/1 A simple, unauthorised modification to a valve caused an explosion.

131/2 If equipment has been taken above its design temperature or pressure, do not use it again without an engineer's permission.

131/3 How not to treat your trips.

131/4 Do not carry chemicals in open containers.

131/5 Water froze in a dead-end pipe and caused a leak.

131/6 Two accidents to tilting platforms.

131/7 Can we prevent people wiring plugs wrongly?

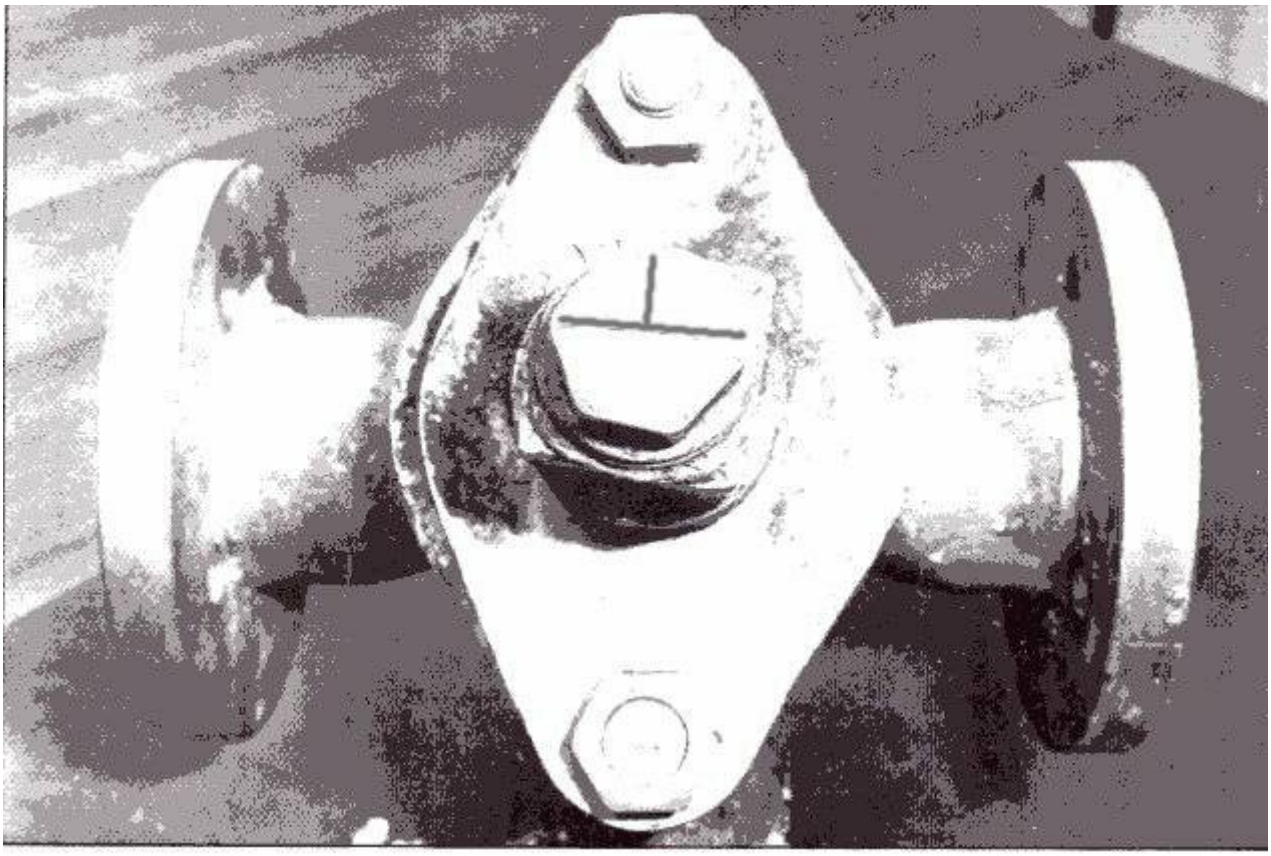
131/8 Those who asked school children to sample rivers, forgot about the risk of drowning.

An Engineer's Casebook — Welded pads and compensation plates.

Pictures from our Archives — Overheating caused a failure of a furnace tube.

ICI
IMPERIAL CHEMICAL INDUSTRIES LIMITED
PETROCHEMICALS DIVISION

131/1 A SIMPLE, UNAUTHORISED MODIFICATION TO A VALVE CAUSED AN EXPLOSION.



The photograph shows a 3-way cock on which the centre bolt has been marked in order to show the cock position, presumably because the marks on the plug are hard to see.

Originally the marks on the bolt corresponded with those on the plug, but at some time two washers were inserted underneath the bolt, it could not be screwed in as far as before and the marks no longer corresponded.

Nearly all the operators on the plant set the cock according to the markings on the centre bolt. It was thus set wrongly, a process stream was directed to the wrong vessel and ultimately this caused formation of an explosive by-product — and an explosion.

Beware of do-it-yourself modifications

Newsletter 122 described some other accidents which occurred because those concerned did not understand how their equipment worked.

131/2 IF EQUIPMENT GETS TOO HOT, DO NOT USE IT AGAIN WITHOUT AN ENGINEER'S PERMISSION

As a result of a control system failure the temperature in a reactor started to rise. The operators tried to control it, but without success. When the recorded temperature reached 465°C, feed was tripped automatically. The highest temperature recorded was 500°C but it was estimated that part of the reactor may have reached 600°C. The design temperature was 500°C.

After the reactor had cooled, the operators restarted the feed. They should not have done so.

If any equipment has been taken above its design temperature or pressure (or, in some cases, if the composition of the process stream goes outside certain limits) **the plant should not be brought**

back on line or left on line without the permission of the plant manager and engineer. Do the operators on your plant know the design temperature and pressure (or the critical composition limits)? Are they included in the operating instructions or in some other readily accessible document?

The temperature rise occurred because an instrument air line broke and the motor valve in a diluent feed line closed. The loss of diluent should have sounded an alarm but it did not do so as the alarm signal was activated by the electrical signal which controls the air pressure to the valve. The diluent flow should have been measured directly.

Measure directly what we want to know — not some other signal from which it can be inferred (See Newsletter 119/1).

131/3 HOW NOT TO TREAT YOUR TRIPS

A furnace is used to bring a plant up to operating temperature. It is then by-passed and shut-down.

Recently, after by-passing the furnace, the process operator did not shut it down manually but waited for the low flow trip to do so. The low flow trip failed to operate and the furnace coils were overheated; fortunately they were not seriously damaged.

All trips fail occasionally so *do not wait for a trip to operate unless you can watch the readings and have time to intervene if the trip fails.*

The trip failed to operate because it had been disarmed during the shut-down. Normally on the plant concerned, all trip disarming is entered in a 'Trip defeat' book, but this book was not used during shut-downs!

All trip disarming should be authorised in writing — on both running *and* shut-down plants.

The low flow trip defeat has now been removed; it was not necessary!

As pointed out in Newsletter 119/2:

All trips which have been worked on during a shut-down should be tested before start-up.

Trips on furnaces and compressors should be tested after all major shut-downs.

131/4 DO NOT CARRY CHEMICALS IN OPEN CONTAINERS

Many men have been injured because they carried chemicals in open buckets or trays. See Newsletter 90, page 8.

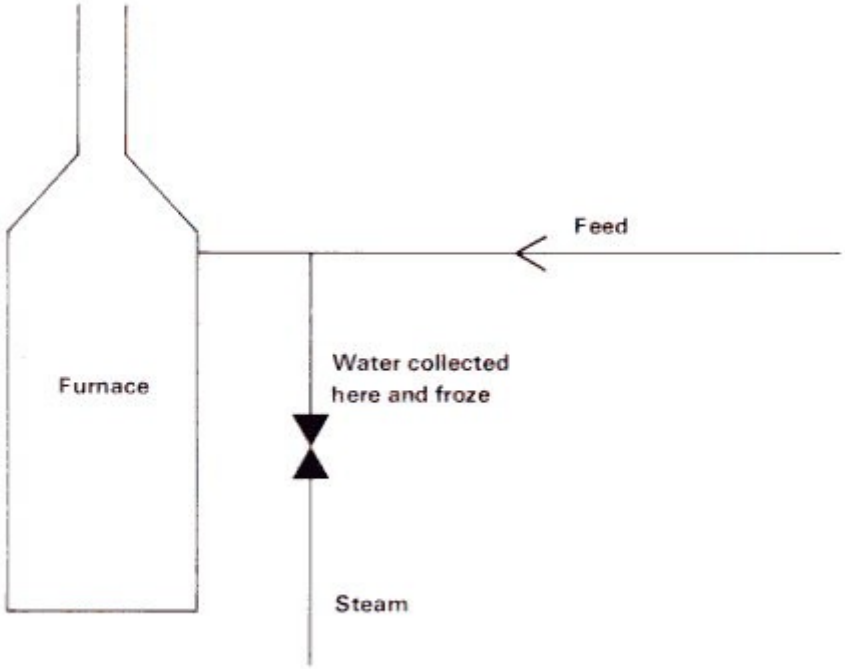
Now another incident has occurred in the Division. A pump was drained into a drip tray. The operator then picked up the full tray to carry it away for disposal. He stumbled on a step and some of the liquid splashed him on the face. He was absent for two weeks.

131/5 ANOTHER FAILURE OF A DEAD-END

Newsletters 99/5 and 84/2 described how water or corrosion products collected in a dead-end pipes and then froze or caused corrosion.

Another company have described another incident. The feedline to a furnace was provided with a permanent steam connection for use during de-coking. The connection was on the bottom of the feedline and the steam valve was not close to the feedline. Water collected in the vertical section of the steam line above the valve, froze during cold weather and ruptured the line, allowing oil at a

pressure of 30 bar to escape. Fortunately it did not ignite.



131/6 TILTING PLATFORMS

To empty tote bins — portable containers holding about 1½ tonnes of plastic — they are placed on a ‘tilt’, a hydraulically operated-tilting platform.

These tilts have recently been involved in two accidents, one due to fatigue failure and the other to incorrect assembly. Details can be given to other users of this equipment.

131/7 CAN WE PREVENT PEOPLE WIRING PLUGS WRONGLY?

A recent survey showed than many 3-pin electric plugs in the home are incorrectly wired.

A reader suggests that mistakes would be fewer if the terminals were coloured in the same way as the wires:

Live	—	brown
Neutral	—	blue
Earth	—	yellow and green

Terms like ‘live’ and ‘neutral’ mean nothing to most people but it would be obvious to almost everyone that the brown wire has to be joined to the brown terminal and so on.

When plugs are wired up wrongly it is easy to say that people should be more careful, or better trained and that the wrong wiring is due to human error. However, this sort of approach will not prevent accidents. It is better to remove the opportunities for error, to redesign the work situation so that mistakes are less likely to occur. We cannot always do so, but sometimes we can do so without difficulty.

131/8 OTHER MEN'S VIEWS No. 16

In retrospect, the hysteria which accompanied the early days of the anti-growth movement probably did some harm. For example, associated with it were some excessive conservationist reactions which had most unfortunate results. In Ceylon, for example, where malaria had been almost eradicated, the banning of DDT led to a rapid rise in the malaria death rate. In Sweden, DDT had to be quickly reintroduced when insects started to destroy forests.

One typical unpleasant effect was the movement, in Britain, to encourage school children to monitor pollution levels in their local rivers and lakes, for although there have been no cases of fatal illness from water pollution in Britain for more than 50 years, every year more than 100 children are drowned playing in or near water. Unfortunately a campaign to teach all children to swim did not appear sufficiently novel and exciting to the pressure groups whose acute sense of social responsibility inspired them with tender concern to provide all fish with beautifully clean water to swim in.

W. Beckerman, The Times Higher Education Supplement, No. 370, 23 Nov. 1979, p. 14.

131/9 UNUSUAL ACCIDENTS No.92

The following was reported by one of our overseas companies.

Employee was struck in the knee by another employee who was running to get away from wasps which had just been sprayed.

Key Prevention Recommendation: Call a professional exterminator.

131/10 COMMENTS FROM READERS

(a) In Newsletter 128/1 I suggested that we should remember the reasons for our various rules and guidelines and not apply them unthinkingly in circumstances which were not thought of by those who wrote them.

A reader points out that in some countries rules have to be followed to the letter. Remember this when designing plants for operation in these countries.

An article in 'Works Management" for July 1979 (copy on request) compares the UK approach with that of other countries and explains why codes are better than regulations.

(b) My advice "What you don't have, can't leak", can be carried too far. An insurance company reports that a client wanted to extend his sprinkler system and asked a contractor for a price. When the contractor inspected the existing system he found there was no piping anywhere, just sprinkler heads glued to the ceiling!

131/2 RECENT PUBLICATIONS

(a) The Second Report of the Advisory Committee on Major Hazards (HMSO, £2) expands the arguments of the earlier report and includes a lot of information on past explosions and releases of toxic gas. The flavour of the Report is given by the following extracts from the Conclusions:

> *"In areas of high risk it is not sufficient for employers merely to demonstrate to themselves that all is well. They should be required to demonstrate to the community that their plants are properly designed, well constructed, and safely operated.*
>
> *The committee has reservations about the effectiveness of a system of detailed regulations ... and*

feel that strongly interventionist licensing schemes have inbuilt drawbacks.

The concept of the employer having to demonstrate to the enforcing authority the steps taken to ensure the safety of the operation would keep responsibility within industry."

(b) The Second Report recommends that control buildings should be strengthened. The Chemical Industries Association have issued a report, "Process Plant Hazard and Control Building Design", which describes in detail a method for the design of such buildings (Price £12 to member companies, £20 to non-members but free to ICI and other author Companies).

(c) As in previous years, the 1979 Newsletters have been re-issued as a bound volume (Report No. PC.200, 903/A).

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 Mrs. T to add your name to the circulation list.

January 1980

An Engineer's Casebook No. 31
WELDED PADS AND COMPENSATION PLATES

From time to time it is necessary to locally reinforce the wall of a pipe or vessel where there is additional local loading, such as a pipe support or anchor, or where membrane stresses are increased as a result of providing an opening in the vessel wall to accept a branch connection.

In such cases a pad or compensation plate is welded to the pipe or vessel to give local reinforcement and, since the objective is to effectively increase the wall thickness at that point to reduce the applied stress, full strength fillet welds are used.

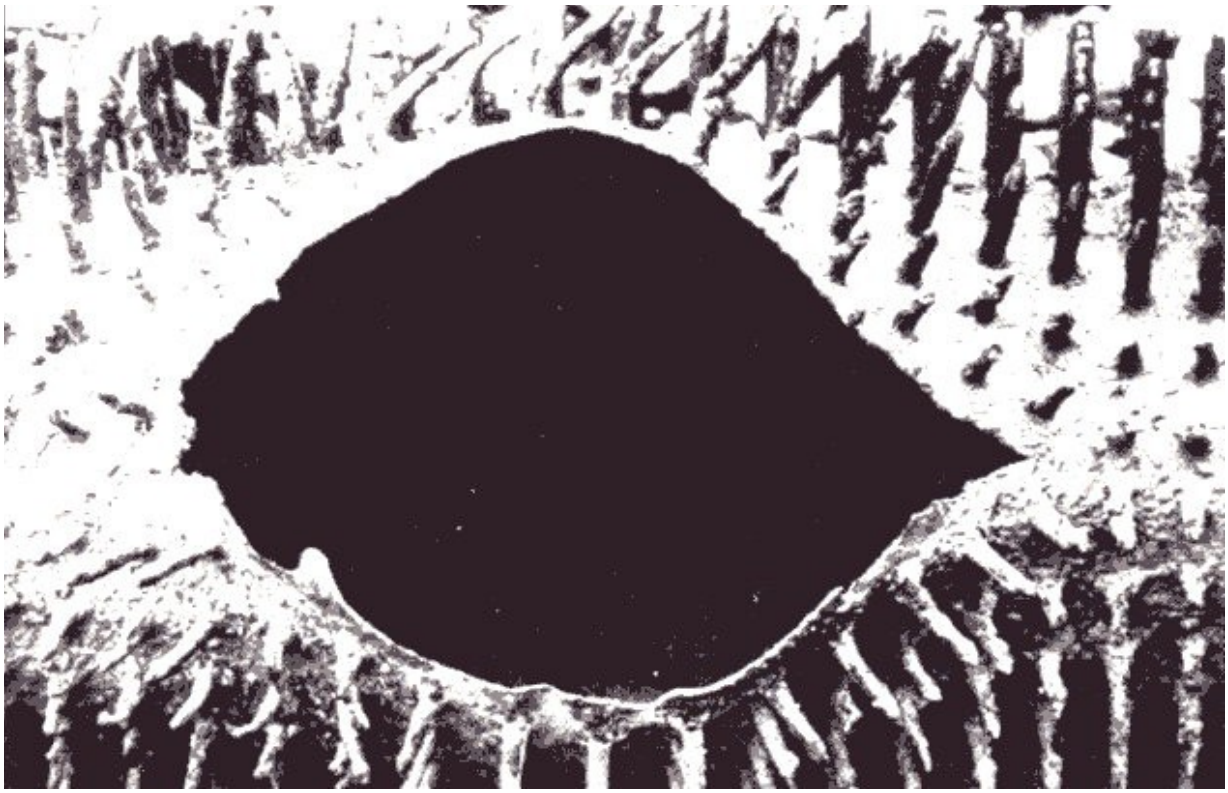
For both pipe and vessel reinforcement the pad has to be shaped to the local contour and a nominal, rather than perfect, fit will result leaving a space between the pad and the parent structure which may vary from nothing to perhaps $^{1}/_{16}$th inch. When the attachment weld is completed this space will be totally enclosed and, unless steps are taken to vent it, a pressure will be created within it when the pipe or vessel temperature is raised. The rise in pressure will be enhanced if water is trapped in the space and the temperature rise is sufficient to convert the water into steam.

Failures due to this cause have been reported on a pipe support reinforcing pad on a 200 psig steam main. Another failure occurred on a cold flare main when an unvented pad caused collapse of the parent pipe during a stress relief operation.

With pipe support pads it is rarely necessary to have a continuous full strength weld all the way round the pad, in which case the use of an intermittent or stitch weld will allow the necessary venting. In the case of compensation pads fitted to vessel branches, full strength welds are required and venting should be achieved by means of a hole drilled through the pad. A small hole is all that is necessary, ¼ inch diameter or $^{1}/_{8}$ inch BSP. The hole may be tapped so that a low pressure leak test may be applied to prove the tightness of the compensation pad welds. Screwed plugs should not be inserted as a permanent feature if the holes are tapped; holes should be left unfilled to allow the pad/vessel inter-space to breathe.

E H Frank

Photographs from Our Archives No.5



This is not a monster from Dr. Who but a convection bank tube on a furnace after a failure which occurred in July 1969. The furnace was destroyed and neighbouring equipment was damaged.

The failure was not due to gross overheating but to prolonged slight overheating during periods when maximum output was required. This led to a creep failure.

The tubes were overheated because there were not enough instruments on the furnace for its condition to be monitored and because the operators did not fully understand the way furnace tubes behave if they are overheated.

Furnace tubes are usually designed to last for about ten years. If they are kept at or below design temperature they will last ten years but if they are allowed to get too hot they will not last as long and will burst before ten years have passed.

Suppose a furnace tube is designed to operate at 500°C:

If it is operated at 550°C it may last only 3 months.

If it is operated at 635°C it may last only 20 hours.

Suppose we have allowed a tube to get too hot. Then, however carefully we treat it afterwards, it will never be the same again. It will never forget that we have ill-treated it and in the end it will let us down.

Suppose a furnace tube has been designed to operate at 500°C but has been heated to 550°C for six weeks: then we have used up half its life, and though we keep it at 500°C thereafter, it may burst after a total life of five years.

For more details see Newsletter 55/3, Accidents Illustrated No. 7 or report No. EDN 1328, “Effect of Overheating on Furnace Tube Lives”.

A furnace tube has a better memory than an elephant.