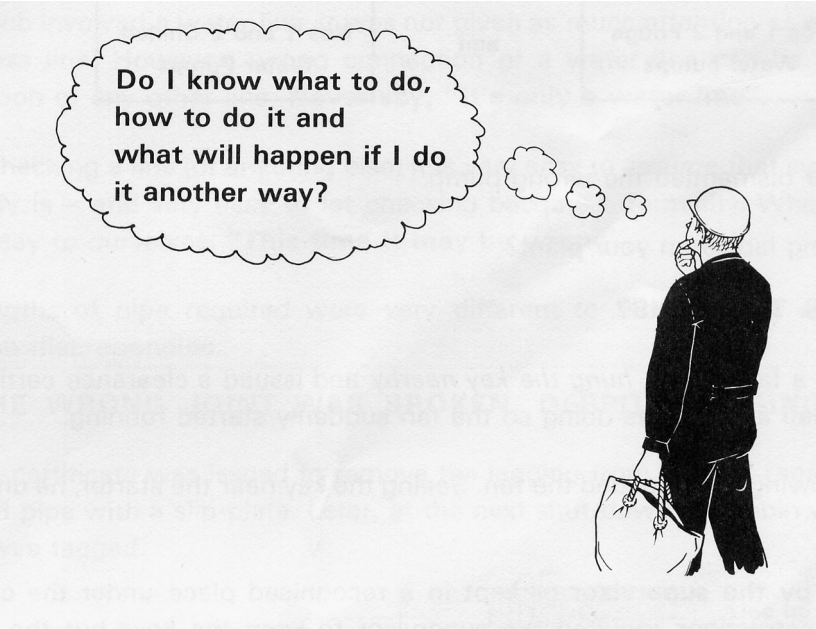
SAFETY NEWSLETTER

No. 151
PREPARATION FOR MAINTENANCE



In recent years one Newsletter per year has been devoted to this subject (108 Feb 1978, 125 July 1979, 137 July 1980, 146 April 1981). This year so many incidents have been reported that we need a second.

Are we getting slack? Are these incidents a warning? None of those occurring in ICI caused serious injury or damage but they could have done, as shown by the incident from another Company (151/6).

Also in this issue —

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

157/1 POOR LABELLING AGAIN

Newsletter 146/4 described an incident which occurred because two pumps, side-by-side, were both labelled No 16; one was called

No 16 Purge Pump	and the other	No 16 TC Fan

Now a similar accident has occurred. Two pairs of pumps, near each other, were called

Nos 1 and 2 Fridge Water pumps	and	Nos 1 and 2 Chilled Water pumps

Not surprisingly, a fitter dismantled the wrong pump.

Are there any misleading lebals on your plant?

151/2 WHO KEEPS THE KEYS?

A supervisor locked off a fan starter, *hung the key nearby* and issued a clearance certificate for the fan to be adjusted. When a fitter was doing so the fan suddenly started running.

An operator on the following shift, needed the fan. Seeing the key near the starter, he unlocked it and started the fan.

Keys should be kept by the supervisor or kept in a recognised place under the control of the supervisor. The plant instructions required the supervisor to keep the keys but the practice had developed of hanging them on the job.

Who keeps the keys on your plant?

151/3 THE WRONG EQUIPMENT WAS OPENED UP

Two fitters were given a clearance certificate to open up a filter of a particular type. The clearance certificate **described** the location of the filter but the fitters did not read it carefully as they had worked on these filters before and knew where they were.

However, unknown to them, some new filters of the same type had been installed in a different part of the plant. The fitters should have opened up one of these. Instead they opened up one of the old ones.

It was not isolated and a leak occurred. About 100 kg of liquefied gas escaped but fortunately it did not ignite.

Two things were wrong:

— **The job should have been discussed with the fitters**. (Newsletter 140/1 described a similar incident).

— **A numbered tag should have been fixed to the filter to identify it more clearly**. (See Newsletter 137/4).

See back page.

151/4 “IT’S ONLY A WATER LINE”

The water line to a new cooler had to be connected to a cooling water line on a pipebridge, using an existing branch. The plumber supervisor pointed out the branch to the plumber and had scaffolding erected. Unfortunately he pointed out a branch on a methanol line and the connection was made to this branch. The plant manager inspected the job but did not spot the mistake. Fortunately the process supervisor spotted it when he was bringing the line into use.

How can we prevent such mistakes?

1 **All connections to existing plants should be identified and tagged by Process**. This is a process responsibility and cannot be left to others.

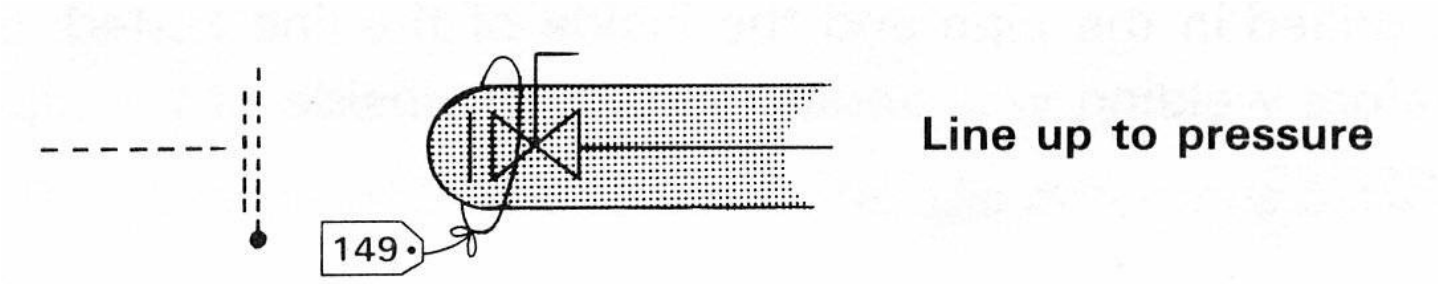
2 As the job involved a water line, it was not given as much attention as would have been given to a process line. However, wrong connection of a water line can be as dangerous as wrong connection of any other line. **Never say, “It’s only a water line”.**

3 When checking a line (or anything else) it is very easy to assume that everything will be correct — it usually is — and very easy to let checking become a formality. When checking anything we should say to ourselves, **“This time it may be wrong”.**

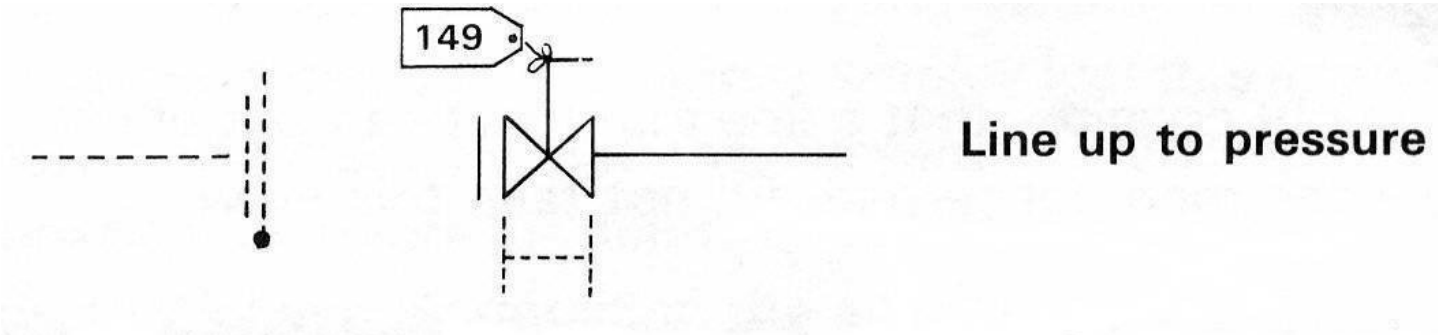
4 The lengths of pipe required were very different to those shown on the drawing. **Always question discrepancies.**

151/5 THE WRONG JOINT WAS BROKEN, DESPITE TAGGING

A clearance certificate was issued to remove the lagging from a valve, remove a blank and connect up a flanged pipe with a slip-plate. Later, at the next shut-down, a bobbin was to replace the valve. The blank was tagged.



To remove the lagging, the laggers had to move the tag. They fixed it to the valve handle. The bobbin piece was left near the valve.



When the fitter, who had seen the clearance certificate, came to do the job several days after the issue of the clearance, he assumed that the valve had to be replaced by the bobbin piece. He broke

the joint on the right of the valve and flammable gas under pressure came out. Fortunately it did not ignite and fortunately he broke the joint carefully.

What can we do to prevent incidents like this?

1 **Do not fit tags too early**. Wait until lagging has been removed if this cannot be done with a tag in position.

2 **Do not put a collection of short-term and long-term jobs on one clearance certificate**. The clearance had been issued a week before the incident and covered erection of some new pipework as well as connection to existing equipment. **Connection of new equipment to old should be done under a separate clearances**.

3 If the clearance had been exhibited on the job, as it is done in some parts of the Division, then the fitter might have checked it immediately before doing the job, instead of relying on his memory. However this would not help if he did not understand what was required.

151/6 A MAN DID A JOB THE WRONG WAY AND WAS KILLED

Another company decided to replace, one by one, 44 corroded bolts on each of the manhole covers of a pressure vessel which contained nitrogen at a pressure of 50 bar. Two fitters, working together, completed one manhole cover before lunch.

After lunch the younger of the two men continued alone. He removed 30 bolts when the cover blew off and killed him.

The Company suggests that men carrying out maintenance work should know:

What to do

How to do it

What will happen if they do it another way

151/7 THE HAZARDS OF OLD PIPELINES — TEST JUST BEFORE WELDING

Earlier Newsletters (145/5 and 127/6) pointed out the importance of testing the atmosphere in a vessel or pipe immediately before work starts; a test several hours or days beforehand is not enough.

It was decided to re-use (for a high-boiling liquid) an old propylene line which had been out of use for 12 years. For the last two years it had been open at one end and blanked at the other.

The first job was welding a flange onto the open end. This was done without incident.

The second job was to fit a 1 inch branch 60 m from the open end.

A hole was drilled in the pipe and the inside of the line tested. No gas was detected. A few hours later, just before welding was about to start, the inside of the pipe was tested again and flammable gas was detected.

Presumably some gas had remained in the line for 12 years and a slight rise in temperature had caused it to move along the pipeline.

Some people might consider that a line that had been out of use for 12 years did not need testing at all. Fortunately the men concerned did not take this view.

Reminder: Newsletters 56/1 and 6/2 described accidents which occurred while dismantling old pipes. Newsletter 94/7 described how someone was shot when an old gun which had not been used for

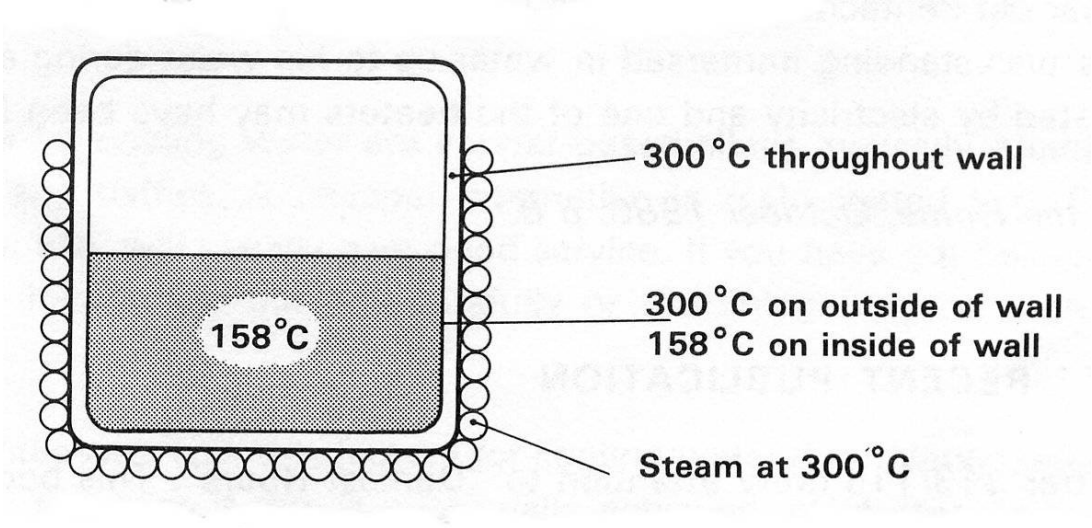
200 years was being restored. Newsletter 51/2 described accidents which occurred while old tanks were being demolished or repaired.

151/8 SEVESO — A MYSTERY EXPLAINED

We all know that in 1976 a runaway temperature rise occurred in a batch reactor in a chemical plant at Seveso, Italy, causing the formation of dioxin and spraying it over the surrounding area when the relief valve lifted and discharged to atmosphere.

When shutting the plant down for the weekend the operators left the reactor contents at 158°C, well below the temperature at which a runaway reaction could start. (Believed at the time to be 230°C but possibly 185°C). The mystery has been: How did the contents of the reactor get hot enough to start a runaway?

An answer has now been suggested by T G Theofanous in *Nature*, 25 June 1981, p 640. The reaction was carried out under vacuum at about 160°C in a reactor heated by steam at about 300°C. The temperature of the liquid could not get above its boiling point at the operating pressure, about 160°C, and so below the liquid level, there was a temperature gradient through the reactor walls. The reactor walls, above the liquid level, were hotter.



When the steam was isolated and, 15 minutes later, the stirrer switched off, the reactor walls below the liquid level fell to the same temperature as the liquid, 158°C. The reactor walls above the liquid level remained hotter. Heat passed by conduction and radiation from the walls to the top 10 cm or so of the liquid which became hot enough for a runaway reaction to start.

There are thus similarities between Seveso and the fire at Feyzin in 1966. (See Newsletter 73/4 and Hydrocarbon Processing, August 1977, p 98). At Feyzin there was a fire under a large pressure vessel containing propane. The fire-fighters were advised to use their limited supplies of water for cooling neighbouring equipment. The relief valve, it was believed, would protect the vessel directly exposed to the fire. Below the liquid level the boiling propane kept the metal cool. Above the liquid level the metal got hot, lost its strength and the vessel burst even though the pressure was normal. The common factor with Seveso is that *unwetted metal can get much hotter than metal in contact with liquid*.

Reminder: Newsletter 141 described some other reactions that went wrong.

151/9 OTHER MEN'S VIEWS No 26

The following, based on a paper by O J Willette of Du Pont, illustrates the difference between the US and UK approaches to safety legislation.

Attempting to protect a worker's safety by describing the way things should be arranged in every industry and every workplace is impossible. American regulations employ just this approach. They are the furthest thing from a performance standard in that they essentially attempt to "design the workplace" rather than provide a generic framework for defining hazards. To analogize, it's like trying to describe how to drive from Wilton to Welwyn by detailing the actions to be taken by the motorist on each piece of roadway, given all the possible traffic situations that the motorist could encounter with all the possible vehicles that could be on the road that given day. Using this approach, the pile of paper needed would probably reach Welwyn before the motorist. Obviously this is not a practical approach.

In practice, the motorist starts out with an objective — in this case getting to Welwyn — and follows a set of reasonably simple guidelines. The Highway Code requires only 70 pages and the Department of Transport Manual "Driving" only 213 pages to describe all drivers' actions, not just those pertinent to a road trip. These publications do not address the detailed engineering specifications of engine components in the car. It does not matter if the engine has a one or two barrelled carburettor or has no carburettor in the case of a diesel. It is only necessary for the motorist's vehicle to be capable of performing as a whole within the rules of the road.

Safety standards should be much like the Highway Code and the Driving Manual used in our example and focus on proper workplace *actions* and set certain fundamental conditions that should be met rather than attempting to detail all possible elements of the workplace. Standards using this approach could be called work practice standards. They would address generic groupings of hazards such as lock and tag and confined spaces entry.

151/10 UNUSUAL ACCIDENTS No 110

A 62 year old Pentacostalist minister in Stockholm was electrocuted in front of his congregation of 200. He was standing immersed in water up to his waist during a baptismal ceremony. The water was heated by electricity and one of the heaters may have been faulty.

Care in the Home, October 1980, p 8.

151/11 RECENT PUBLICATION

Newsletter 113/11d drew attention to "Darkest Hours". This book lists all known accidents from earliest times to 1975 which have killed 20 or more people.

"The Disaster File: The 1970's", edited by G M Ferrara (Macmillan, 1980), contains brief accounts of all disasters known to have occurred during the decade and this brings the story up to date.

For more information on any item in this newsletter please 'phone P.2845 or write to us at Wilton. If you do not see this Newsletter regularly and would like your own copy, please ask us to add your name to the circulation list.

September 1981

An Engineer's Casebook No 51
TUBULAR HEAT EXCHANGERS ON COOLING WATER SERVICE

Water control

Engineers should keep a weather eye open on their operating colleagues in their control of water treatment. Most of our cooling water systems use:

1 Sulphuric acid dosing to convert calcium bicarbonate to the sulphate.

2 Chlorination to inhibit microbiological growth.

3 Sodium chromate as an anodic inhibitor.

Failure to maintain careful control over cooling water quality can result in a rapid increase in fouling and acceleration of corrosion mechanisms. Furthermore, if poor quality is allowed to continue for some time and is then corrected, fouling material can be dislodged to accumulate at points of low velocity causing restrictions in the system.

Exit temperatures should be kept below 40 °C; above this fouling deposition starts to increase.

If it becomes necessary to gag the cooling water flow, always do this on the exit valve to avoid pressure reduction and increased turbulence inlet the channel box.

Materials and protection

Preferred tube bundle materials for cooling water are copper-based alloys, typically Alumbro tubes with Naval Brass tube-plates and baffles. A cheaper alternative is resin-coated (e.g. Sakaphen) carbon steel which, with careful use, will usually give good service. If you have got Sakaphen-lined tubes, make sure your riggers handle the bundles carefully or the lining may be ruptured with subsequent tube failure.

Unprotected mild steel tube bundles are less satisfactory for cooling water duty. Very good control is necessary to prevent corrosion, but even if this is continually achieved, plain steel is much more susceptible to rapid fouling.

Channel boxes, floating-head covers and return covers are usually made from mild steel for cooling water. If you have well controlled water, the internal surfaces of these should be left bare. Coatings to avoid electrolytic attack are a mistake since, when these are damaged, as they usually are, severe localised attack occurs requiring expensive repairs and subsequent restoration of the coating. With a properly inhibited system, attack on the unprotected steel of these large components is likely to be slight.

Tube vibration

It sometimes happens, because of excessive unsupported length or particular operating conditions, that exchanger tubes vibrate or "strum" to an extent that baffles eventually cut through them. When this happens it is usually the peripheral tubes which are most affected. It may be that if only a few tubes at the periphery are lost, they can be plugged off and the consequent small loss of surface area accepted.

However, if the problem is more serious, it can often be cured by introducing small intermediate baffles picking up, say, 8/12 tubes, made of a benign material like Tufnol (assuming it can tolerate the conditions) to halve the 'beam length' and stiffen the tubes.

For more extreme cases, frequently met on large steam condensers working at high vacuum and receiving exhaust steam from turbines, a technique has been developed by Hick Hargreaves of

introducing butyl rubber tubing through the bundle at right angles to the tubes to form a cushion which damps out the vibration. This technique was used successfully on Olefine IV some years ago.

General points

1 U-tube bundles should only be used for very clean tube-side duties. If they are in carbon steel, their use should be limited to steam. Never be tempted to use an old U-tube heater as a cooler; it will foul up and you will not be able to clean it.

2 If the shell-side duty is dirty you should have square pitched tubes. Triangular pitched tubes are either difficult or impossible to clean.

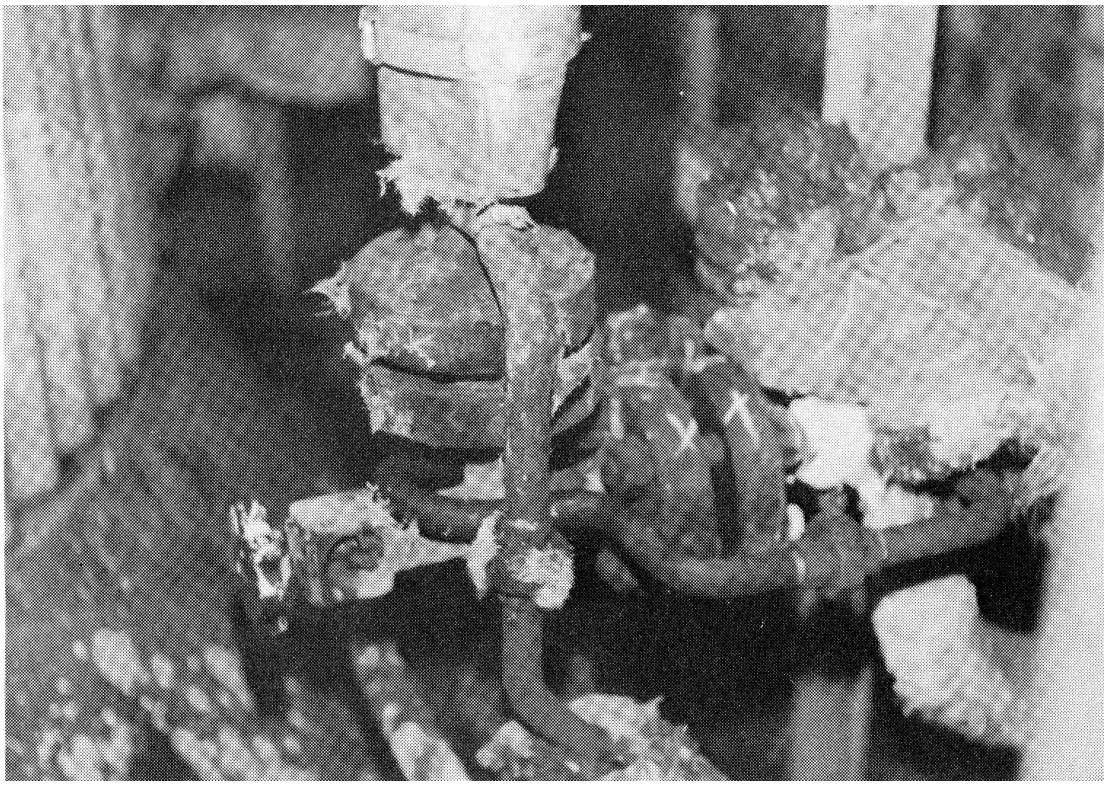
3 For your floating head bundles make sure you are provided with a test ring which you must then look after, properly identify and make sure it does not get lost.

4 Using modern high-pressure water lances with back-flushing jets, you can often satisfactorily clean the tube-side of floating head bundles without removing the end and floating head covers. This saves a great deal of time and expense.

5 Always ensure the use of proper lifting gear for your tube bundles otherwise they will become banana-shaped.

E Ross

WHICH JOINT SHOULD BE BROKEN?



Hard to believe but this happened recently in the Division.

A joint to be broken was marked with chalk. The fitter broke another joint which had older chalk marks on it.