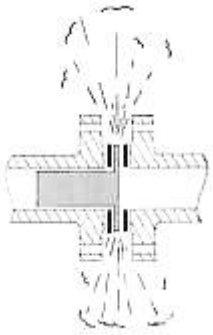
SAFETY NEWSLETTER

No. 118

LEAKS CAUSED BY USE OF THE WRONG

FITTINGS



118/1 A Rubber gasket, left in after calibration, caused a leak of ethylene from a flow measuring assembly.

118/2 A temporary installation caused a leak.

118/3 A radioactive level indicator was fixed to the wrong vessel.

118/4 Look for simple causes first.

118/5 A pump was supplied with a relief valve that was too small.

118/6 An underground explosion.

118/7 Is life on the plant as hectic as this?

A new fibre runs into trouble.

An Engineer's Casebook — Pressure vessels — Code requirements.

A Christmas Quiz.

Best Wishes for a Merry Christmas and a Safe New Year to all our readers.

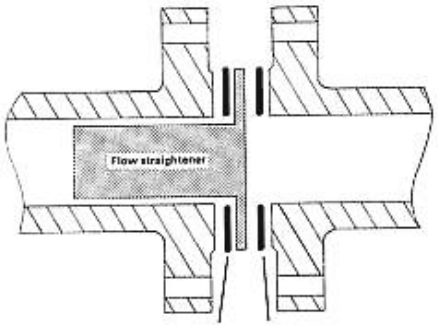
IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

118/1 THE WRONG GASKET CAUSES A LEAK OF ETHYLENE

A tonne of ethylene leaked out over a period of 5 minutes and formed a visible cloud 50 m long and 5 m deep. Some of the ethylene was sucked into a furnace but fortunately did not ignite, presumably because the speed of the gas entering the furnace was greater than the burning velocity of ethylene.

The leak occurred because a rubber gasket had been used in a flow measuring assembly instead of a spiral wound gasket. The flow measuring assembly was a relatively new design and had been sent to a workshop for calibration. Following their normal practice, the workshop staff installed a rubber gasket between the assembly and a flow straightener before calibrating the assembly with water. They then returned the assembly to the plant with the rubber gasket still present and the flow straightener held in position by adhesive tape.



Rubber gasket Spiral wound gasket

The plant staff did not realise that there was a rubber gasket in the assembly and assumed that the assembly as a whole was suitable for use under plant conditions. No part of the flow straightener extends outside the pipe flanges and it was not easy to see that there was an insert between them. The whole assembly was installed in the plant and after five days on line the leak occurred.

The report recommends that all pipeline inserts (such as slip-plates, slip-rings and bursting discs as well as unusual inserts such as flow straighteners) should be identified by tags.

The leak could not be isolated without entering the cloud of vapour and there was no time to set up water sprays (as recommended in Newsletters 114, page 6 and 116/4). The report therefore recommends installation of remotely operated emergency isolation valves (see Newsletters 107/3a, 103/1, 70/2,62/2,60/1,51/3,41/12a,39/2,27/3and 14/1).

The incident shows that compressed gases at pressures above about 50 bar behave like liquefied gases and form clouds of cold flammable vapour when they leak.

The leak described in Newsletter 69/2 was also sucked into a furnace without igniting.

Fortunately, in both cases the furnaces were left running. If they had been shut down, the gases would probably have been ignited by hot brickwork.

For a fuller report of the recent incident see report no PC.200,873/A.

118/2 ANOTHER EXPERIMENTAL DEVICE CAUSES A LEAK

One of the first accidents with which I was involved, about 25 years ago, as an inexperienced plant manager, also involved experimental equipment.

A research worker wished to attach a device to a caustic soda pipeline to measure some property, I forget what. The foreman and I did not like the look of the device, but the research worker assured us it had been used before and was OK. We let him go ahead (Mistake No 1) but decided to watch and see what happened. The device leaked, spraying caustic over the surroundings and injuring a man

who was working on another job and, like the postman in a famous Sherlock Holmes story, had not been noticed. (Mistake No 2 was not roping off a wide area). [It was not Sherlock Holmes but G. K. Chesterton's Father Brown.]

Temporary modifications should be examined with the same thoroughness as permanent ones (See Newsletter 83).

118/3 ONCE AGAIN, THE WRONG EQUIPMENT IS WORKED ON

A plant at Wilton contains two reactors, about 2 metres apart, almost identical in appearance and both fitted with radioactive level indicators. Both indicators were removed so that repairs could be made to the vessels.

The reactors have different numbers but are usually known by their names which are similar. Let us call them the *polysolvent* and *bysolvent* reactors.

The work on the polysolvent reactor was finished first and a request was made for the radioactive level indicator to be replaced. By mistake it was replaced on the bysolvent reactor.

The mistake was discovered when the polysolvent reactor was started up and the level indication was found to be out-of-order. Fortunately it was a weekend and no-one was working on the bysolvent reactor.

The clearance certificate for the replacement of the level indicator did not give the number of the reactor, only its name. The vessel names and numbers were not clearly marked on them.

All equipment given to maintenance should be clearly labelled and the name and/or number put on the clearance certificate. If there are no permanent labels then temporary labels must be used.

***Reminders**:* Other occasions in which the wrong equipment was worked on were described in Newsletters 106/2, 102/5, 99/2, 91/1, 80/2, 59/4, 54/5, 47/1, 44/9, 41/4, 37/1, 32/3, 29/3, 20/1, 13/2, 11/1, 10/1, 9/1 and 1/2.

Other examples of confusion between similar names were described in Newsletter 113/2.

118/4 LOOK FOR SIMPLE CAUSES FIRST

"A bellows manufacturer had porosity troubles when making some Incoloy 825 bellows elements and delivery was threatened. They had materials suppliers check the plate, welding wire, shielding gas and had learned discussions about the shape of the pores. We were called in and went to have a look at the welding machine. It was still protected by a polythene sheet cage supported on Dexion angle erected when we visited the factory about 4 years ago when they had porosity troubles with Incoloy 800 bellows. The top had a thick layer of grime on it one side panel was missing and others were torn. When the main shop doors were opened on a windy day the polythene flapped and dirt showered down. Plate, wire and gas can be faulty but look for the simple causes of contamination first."

From a report issued by another Division in 1972.

118/5 A LOOK BACK AT NEWSLETTER 18 (April 1970)

An interesting insight into motivation was given by Crawford Greenewalt, while President of du Pont. He said that his company had had a safety programme for 150 years. The programme was instituted as the result of a French law requiring an explosives manufacturer to live on the premises with his family!

A pump was ordered capable of delivering 2 m^3/hr. The manufacturer supplied his nearest standard size pump, capable of 3 m^3/hr, but sized the relief valves for only 2 m^3/hr. When the pump was

operated at full rate against a restricted delivery, the connecting rod was bent — fortunately it was the weakest part of the system.

The incident shows again the need to check the safety features of package deals — particularly the sizing of relief valves.

Other sub-standard relief valves on package deals were described in Newsletters 15/3 and 75/1.

118/6 AN UNDERGROUND EXPLOSION

Another company ran a propane line and an oxygen line below the ground. A month later, after three explosions had been heard underground and the concrete had been cracked, they dug up the pipelines and found that both of them were leaking. The copper oxygen line, which was protected by a steel pipe, had ruptured and the propane line was leaking at a weld.

The report says:

"During the execution of the pipe work, doubts were expressed by the works management as to the quality of the workmanship and the qualifications of those workers employed."

Why didn't they do more than just express their doubts?

In general it is not a good plan to run pipelines underground in a factory as corrosive materials may be present in the soil. If pipelines are to be run underground special precautions are needed. The line should be well wrapped, cathodically protected if of any length and the ground around and above the pipeline filled with clean sand or gravel. This, however, will not prevent contamination later.

Copper lines should never be run inside steel pipes as electrolytic action will take place.

118/7 OTHER MEN'S VIEW No 11

Life on the plant

The following description of life on a farm is intended to be an allegory of life in the State Department in Washington but might equally well be an allegory of life on the plant — on a busy day.

"Here a bridge is collapsing. No sooner do you start to repair it than a neighbor comes to complain about a hedgerow which you haven't kept up — a half-mile away on the other side of the farm. At that very moment your daughter arrives to tell you that someone left the gate to the hog pasture open and the hogs are out. On the way to the hog pasture you discover that the beagle hound is happily liquidating one of the children's pet kittens. In burying the kitten you look up and notice that a whole section of the barn roof has been blown off, and needs instant repair. Somebody shouts pitifully from the bathroom window that the pump must have busted — there's no water in the house. At that moment a truck arrives with five tons of stone for the lane. And as you stand helplessly there, wondering which of these crises to attend to first, you notice the farmer's little boy standing silently before you with that maddening smile that is halfway a leer, and when you ask him what's up, he says triumphantly, "The bull's busted out and he's eating the strawberry bed."

From G Kennan, "Memoirs: 1925-1950", Atlantic, Little and Brown, New York, 1967

No wonder operators sometimes forget to close a valve. See Newsletters 109 and 86.

118/8 UNUSUAL ACCIDENTS No 83

GONE WITH THE WIND—£45,000

A Dutch veterinary surgeon was fined 600 guilders (£140) in Zutphen, Holland, for accidentally burning down a farm with a jet of flame from the rear end of a cow.

The farm went up in smoke last September when the vet lit a match to test the gas coming out of a tube inserted in the anus of the cow, which was suffering from a badly-swollen stomach.

The flame set light to bales of hay in a barn and then burned down the whole farm, causing damage estimated at 200,000 guilders (£45,000).

The cow escaped with shock.

A Newspaper Report, March 1977

Congratulations to the Gomia factory of Indian Explosives Ltd, part of the ICI Group, on working ten million hours without a lost-time accident.

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.

December 1978

NEW FIBRE RUNS INTO TROUBLE

"LAND-USE EXCESSIVE, WASTE DISPOSAL IMPOSSIBLE".

The proposals by ICI and other chemical companies to invest millions of pounds in the production of a new fibre are already meeting widespread opposition. While nylon and polyester and the other fibres which have been in use since the dawn of civilisation are manufactured in conventional chemical plants, the new fibre, known as WOOL (Wildlife Origin Oily Ligament) will be grown on the backs of a specially developed breed of *Ovis musimon.*

Opposition to the new fibre centres on the extensive areas of land required for its production. While a million pounds per year of nylon or polyester can be produced in a fraction of an acre, the same quantity of WOOL will require at least 25 000 acres of good land or a larger area of hill land. This land will no longer be available for growing crops or for recreation.

For once the National Farmers' Union and the Ramblers' Association have combined to oppose a development and a public enquiry will be necessary.

The RSPCA has protested at the 'industrialisation' of animals and has asked what will happen if they break loose from their enclosures. Although *Ovis musimon* is docile, all animal species, even man, produce occasional aggressive individuals.

Meanwhile the garment industry has pointed out the importance of quality control and has questioned whether the necessary consistency can be obtained in a so-called "natural" product.

It is assumed that chemical plant process workers will operate the production facilities as they will replace plants traditionally operated by them. Assuming that operators will not be expected to walk more than 200 yards from the control room, the control rooms will have to be spaced 400 yards apart (that is, one per 33 acres). Over 750 control rooms will be required for a million pounds per year operation. Building costs will therefore be much higher than on a conventional plant, and may well make the new process uneconomic, especially now that control rooms are being made stronger than in the past.

The greatest opposition to the new fibre is the result of the waste-disposal problems it will produce. Vast quantities of excreta will be deposited by the animals and will presumably have to be collected and dumped. Have the risks to health been fully considered? Will decomposition produce methane and a risk of explosions? What will happen when the animals become too old for productive use? It has been suggested that they might be used for human food and it is claimed that they are quite palatable after roasting. To quote the Director of the Centre for the Study of Strategic Perceptions, "The suggestion is nauseating. Five thousand years after the dawn of civilisation and 200 years after the industrial revolution, we are asked to eat the by-products of industrial production."

Reminder*: Other new discoveries were described in Newsletters 70 (coal), 94 (water) and 106 (wheels).*

'Technology and Social Shock" by E W Lawless (Rutgers University Press, 1977, $6.95, see Newsletters 111/5 and 115/10), describes 45 new discoveries which are claimed to have produced, or are claimed will produce, unforeseen and undesirable side-effects. In my view, in about half the cases the opponents have exaggerated the threats and that in the other half the danger was greater than the defenders made out.

An Engineer's Casebook No 18

THE USE OF PRESSURE VESSEL DESIGN CODES.

Most of the pressure vessels which are used in the petrochemical or chemical industries are designed and built to an international Code. A few special purpose vessels, such as air receivers, may be made to other British Standards

Pressure vessel codes in regular use are:-

BS 1500 Part 1 Fusion Welded Pressure Vessels for general purposes — Carbon and low alloy steels

BS 1515 Part 1 Fusion Welded Pressure Vessels for use in chemical, petroleum and allied industries — Carbon and ferritic alloy steels

Part 2 Fusion Welded Pressure Vessels for use in chemical, petroleum and allied industries — Austenitic Stainless Steels

BS 5500 Unfired fusion welded pressure vessels

ASME VIII Division 1 Rules for construction of pressure vessels
Division 2 Rules for construction of pressure vessels — alternative rules

BS 1515 and ASME VIII Division 2 are sometimes referred to as 'higher design stress codes' requiring more precise design procedures, certified material properties etc. The recent BS 5500 code uses a similar approach. It should be noted that in May of this year BS 1500 and BS 1515 were withdrawn following the issue of BS 5500 in 1976. BS 5500 is therefore the only current British Pressure Vessel Code. It is more comprehensive than the codes which it has replaced and includes design rules for tubesheets.

Pressure vessels constructed to BS 1500 and 1515 were, of course, quite adequate vessels and copies of these codes will need to be retained for reference when repairs, modifications or uprating/derating queries arise. New vessels should be designed and constructed to BS 5500.

There is a tendency to use pressure vessel codes to determine shell and head thickness, compensation required at branches, stresses at supports etc., i.e., to use the code formulae and allowable stresses, whilst disregarding many of the other code requirements relating to quality assurance during construction. This is probably at its worst with the use of ASME VIII Division 1 (very few vessels are ordered to Division 2). There are few manufacturers in this country who are audited and approved by the American Society of Mechanical Engineers after which, following strict adherence to the verification during manufacture procedure, the manufacturer is permitted to stamp the finished vessel with the ASME 'U' stamp. Many vessels are made allegedly to ASME VIII Division 1 the scantlings of which may have been calculated from that Code but quality control during manufacture has been that established by the manufacturer. Verification of material properties, welder competence, interpretation of radiographs and the like is often left to the manufacturer with some spot checking perhaps on behalf of the purchaser. Such vessels are not really built to the ASME Code. Another common 'error' is to use steel to British Standards for which the ASME Code does not give allowable stresses. Equivalent values are used.

The incomplete and hybrid application and use of pressure vessel design codes is technically incorrect. Where it cannot be avoided steps must be taken to ensure that the end product is at least as good as would have been the case had the full code requirements been applied. These steps should be recorded, in writing, and form part of the pressure vessel history. In future, particularly for vessels in hazardous plants, it will be appropriate to ensure that all vessels have met all aspects of code requirements and carry a formal certificate to this effect.

E H Frank

A Christmas Quiz

HOW WELL DO YOU KNOW YOUR SAFETY NEWSLETTERS? — No 2

The number in brackets tells you where to find the answers to the questions (71/2 means Newsletter 71, item 71/2).

A previous selection of questions appeared in Newsletter 74.

1. Can you think of equipment which should be avoided when possible because it cannot tolerate errors in installation? (71/2, 74/1).

2 Which way up should relief valves be mounted, and why? (75/1).

3 What special design features are necessary when operators open equipment which has been under pressure? (68/2, 75/4, 93/4).

4 What should you do before using an old vessel on a new plant? (76/3, 112/6).

5 Is it safe to take pocket calculators and electric wrist watches into 'No Smoking' areas? (76/4, 94/5).

6 Is it good practise to tie a sheet of polythene over the vent on an empty storage tank, to keep it clean? (77/2, 90 page 19).

7 What does a picture of a broken wineglass on a carton mean? (79/3).

8 Are we expected to learn lessons from accidents which happened somewhere else? (79/5).