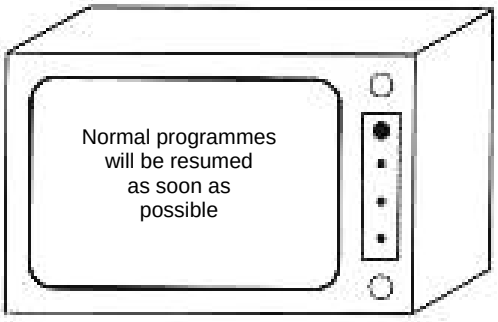
SAFETY NEWSBULLETIN

No. 119

SOME INSTRUMENTS WHICH CANNOT DO WHAT WE WANT THEM TO DO



119/I Measure directly the property you wish to know.

119/2 Can you disarm a trip by pulling out the power plug?

119/3 What is wrong with this sight-glass?

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An Engineer's Casebook — Bursting discs and holders.

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

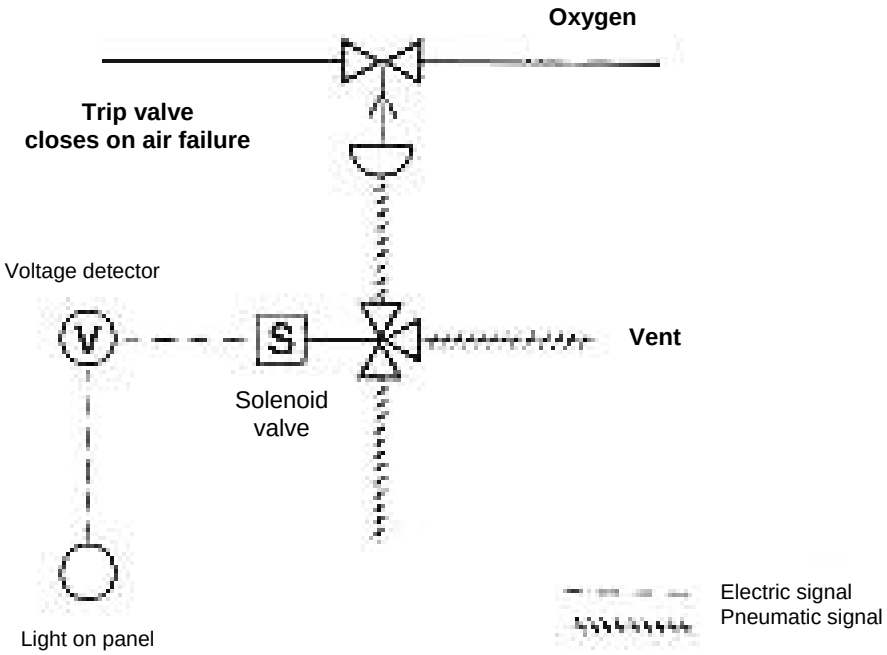
119/1 MEASURE DIRECTLY THE PROPERTY YOU WISH TO KNOW

Another Company ordered a packaged boiler. It was fitted with a trip to shut off the fuel when the air supply fails.

An operability study drew attention to the fact that the flow of air was detected by measuring the voltage supplied to the electric motor which drives the air blower. If the air flow stops because the electricity supply to the motor has failed, or beer~ isolated, then the trip will work. However, air failure might be due to a broken or disengaged belt, to a broken or loose impellor or to a plastic sheet over the fan inlet. In these cases the trip will not work. The air flow should be measured directly and then the trip will work whatever the cause of air failure.

We should always try to measure directly the property we wish to know, not some other property from which it can be inferred.

Another example: An ethylene oxide plant tripped and a light on the panel told the operator that the oxygen valve had closed. As the plant was going to be restarted immediately, he did not close the hand valve as well. Before the plant could be restarted it blew up. The oxygen valve had not closed and oxygen had continued to enter the plant.



The light shows that the solenoid is de-energised, not that the oxygen flow has stopped

The trip valve was closed by venting the air supply to the valve diaphragm, via a solenoid valve. The light on the panel merely said that the solenoid valve had been de-energised. Even though the solenoid valve is de-energised the oxygen flow may continue because:-

(a) The solenoid valve fails to open.
(b) The air fails to vent.
(c) The trip valve fails to move.
(d) With some designs of trip valve, even though the spindle moves, the valve may not close (See Newsletter 117/4).

Actually (b) happened; the vent line on the air supply was choked by a wasp's nest. It seems incredible that a wasp's nest could do this, but the incident occurred in Texas where the wasps are, no doubt, bigger than elsewhere. (See "A Survey of Fires and Explosions in Hydrocarbon Oxidation Plants", available on request).

119/2 A TRIP WAS DISARMED BY PULLING OUT THE POWER PLUG

Soon after a start-up, part of a plant was found to be too hot. Flanged joints were fuming. It was then found that the high temperature trip and temperature controller — a combined instrument — had been unplugged from its power supply.

Most trips operate on loss of power. Have you any that do not?

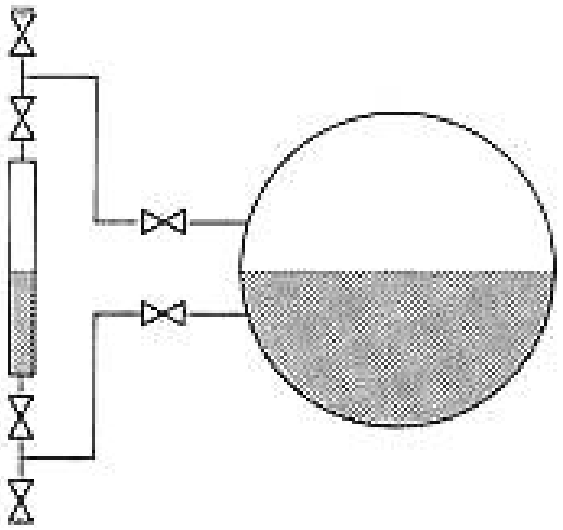
Sometimes we do not want a trip to operate when the power supply is lost. In these cases an alarm should sound when power is lost.

Trips and controllers should normally be independent as the commonest cause of a high temperature or pressure or level is a fault in the temperature or pressure or level control system. See Newsletter 92/4.

Trips should be tested at start-up if they have been worked on during the shut-down. On furnaces and compressors, they should be tested after all major shut-downs.

119/3 WHAT IS WRONG WITH THIS SIGHT GLASS?

A manager found a level glass four feet long connected to vessel branches two feet apart.



The level glass will indicate the correct level only when the liquid level in the vessel is between the two branches.

Reminder: We do not like sight-glasses on flashing flammable or toxic liquids. See our Safety Note 72/20.

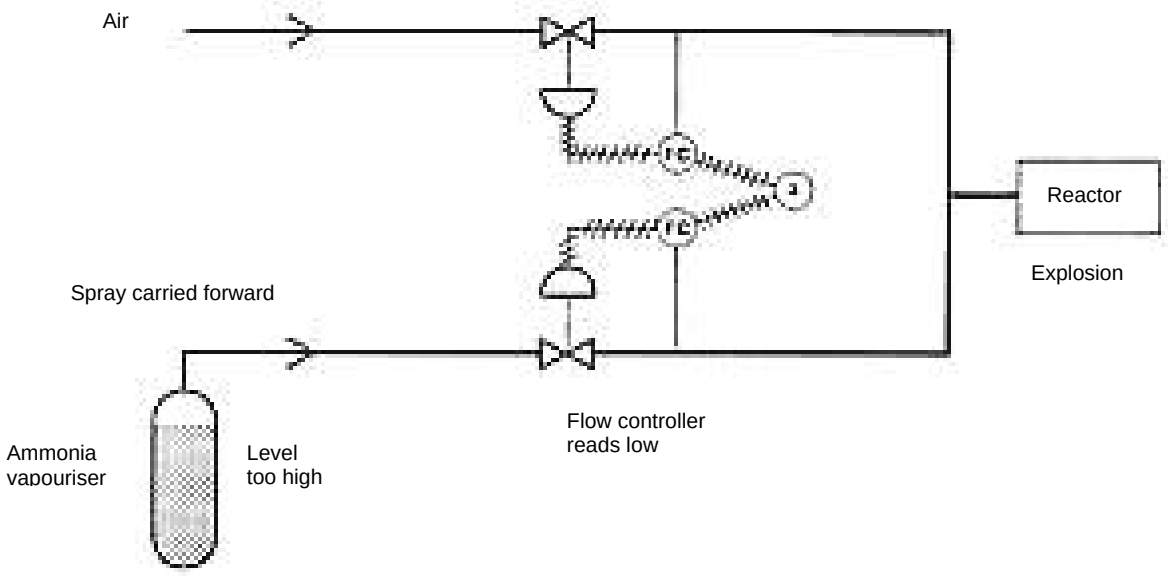
119/4 FLOW MEASUREMENT IS INACCURATE WHEN SPRAY IS PRESENT

"Fertiliser News", November 1973, page 35, described an explosion in a nitric acid plant.

Ammonia is vaporised, mixed with air and passed over a catalyst. The ammonia and air flows are measured and controlled so that the ammonia concentration is always below the explosive level.

The vaporiser level controller was out of order and the level of ammonia was on hand control. The level got too high and droplets of ammonia were carried forward. These were not picked up by the flow ratio controller and an explosion occurred.

All flow measurements are inaccurate when spray is present; the error depends on the detailed design. If the spray increases the density of the gas by 50% then the flow of vapour and liquid could be 25% higher than the flowmeter reading.



119/5 SOME QUESTIONS I AM OFTEN ASKED No 35

HOW DOES ICI COMPARE WITH OTHER COMPANIES?

When I joined ICI in 1944, and for many years afterwards, we never doubted that the lCl ways were the best ways. If other companies in the outer darkness did things differently, that was their misfortune. We were almost arrogant in our self-confidence.

Then, in the 1960's lCl lost its nerve. We began to say, "Perhaps our ways are not right, indeed, cannot be right, for others do things differently". Teams were set up to study the ways other companies organised their activities. Changes were made. Traditional attitudes were swept aside. Looking back, I doubt if in safety (or anything else) we distinguished ourselves in the 1960's.

In the 1970's we got over this period of doubt and recovered some, but not all, of our old self-confidence. Perhaps we were too proud in the old days. We should always be ready to look at the way others do things and be willing to learn. But when we find that another company uses different methods we should not rush off and copy them, but should ask how their performance compares with ours.

If someone tells us, for example, that other companies install fewer trips, gas detectors or emergency valves, have less stringent clearance systems or do less trip testing, let us ask how their accident record compares with ours. How many fires do they have and how big are their insurance claims?

When we ask these questions the answers will often support the view that the ICI way is the best way.

I hope readers in other companies do not think I am being too jingoistic about ICI. During the last decade it has been my privilege to meet people from many other companies and, while I have learnt much from them, particularly in areas of technology which were new to us, they have often reinforced my belief that in areas where ICI has experience, the methods we have developed have much to commend them, for example, hazard and operability studies, hazard analysis, high integrity protective systems, our area classification methods, our clearance systems, our safety discussions, our openness about things that have gone wrong.

I have also been struck by the extent to which our overseas companies follow our ways, not because they have to, but because they have been exposed to our ways and like them. The overseas companies are so much like ICI that visiting them in Australia, India, South Africa and elsewhere I have often felt, like Rupert Brooke,

"That there's some corner of a foreign field
That is forever England".

119/6 A LOOK BACK AT NEWSLETTER 19 (May 1970)

(a) Holes in relief valves

In Newsletter 18, Item 1, I pointed out that the drain holes in relief valve tail pipes must be plugged if the relief valve is connected into a blow-down or other closed system.

Several readers have pointed out that these drain holes must not be confused with the vent holes in the bonnets of balanced bellows-sealed relief valves. If these vent holes are plugged in error then the relief valve will not be able to lift fully or, if the bellows leaks, the pressure may build up in the bonnet destroying the balance and altering the lifting pressure.

The vent holes should be fitted with short pieces of pipe bent *downwards* to prevent rain from entering the bonnets and with bug screens to keep out insects; alternatively they can be piped away to a well ventilated position. But remember the vent has another use — a flow of gas through the hole shows us that there is a hole in the bellows — so make sure the vent outlet is accessible.

Bellows or piston balanced relief valves are necessary on closed blow-down systems which may develop a substantial variable back pressure — relief valves of other types must never be used on such closed systems.

Going back to drain holes — there have been cases where gas coming out of these has been known to fire. The flame is usually not large but make sure that it cannot impinge on plant equipment.

(b) The effect of fluids at pressure on the body

Most people know that compressed air will cause injury if it is allowed to come into contact with a cut or one of the openings in the body (I can let you have a RoSPA leaflet which gives details).

Oil under pressure can also cause injury. Another Company report that a man held his finger over the nozzle of a high pressure grease gun. Grease was injected into his finger, stopping circulation and causing an infection that resulted in gangrene — and removal of the finger.

Another Division have described a similar incident. There was a pin-hole leak in the high pressure (1650 psi) hydraulic hose of a fork lift truck. Another man got hold of the hose to turn the leak away from the driver. He inadvertently grasped the hose over the leak and it punctured his finger. Ill effects were not felt until 12 hours later.

119/7 UNUSUAL ACCIDENTS No 84

Everyone knows that moving machinery can cause accidents in factories. It can also cause accidents elsewhere.

The Times reported on 1 7 March 1 978 that an 1 8 year old girl was nearly suffocated when she raised the bonnet of her car while the engine was running and her scarf became entangled in the fan belt. She was taken unconscious to hospital, but recovered.

One of our overseas companies reports that, while using a paper shredder, the operator's tie was fed into the machine, dragging his head towards the shredding jaws. Fortunately, he was able to switch off the machine. The tie might easily have pulled tight and strangled him.

119/8 RECENT PUBLICATIONS

(a) An article in “Materials Performance”, August 1978, page 33, describes a number of serious pipe and vessel failures caused by hydrogen attack.

(b) Three times within a year, serious vibration occurred in the reaction section of a plant.

Investigation disclosed that when the sonic velocity of the liquid in the feed pumps was reduced by introducing as little as 0.2% gas bubbles, the natural frequency of vibration of the reactors became the same as the pump frequency and resonance occurred.

For Details see Report No CDR 288.

(c) A Government report, mentioned in Newsletter 113/1 1 b, compared the hazards of conventional and nuclear power stations. A recent Canadian report, “Risk of Energy Production”, by H Inhaber, goes further and compares conventional sources of energy with some of the newer ones such as solar space heating and wind power. It shows that these new sources are no safer than coal or oil, and less safe than nuclear power, because of the risks involved in manufacturing the large quantities of equipment required. Inhaber’s report is available free from the Atomic Energy Control Board, P0 Box 1046, Ottawa, Canada.

While looking at the plans of a new police station, a Fire Brigade Petroleum Officer commented that the means of escape from the cells “did not seem to be adequate”.

From The Bulletin, the Journal of the Association for Petroleum and Explosives Administration, volume 17, No 2, October 1978.

Several readers have pointed out an error in Newsletter 118/2. It was not Sherlock Holmes who spotted the invisible postman but G K Chesterton’s Father Brown.

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 1979

An Engineer's Casebook No 19
BURSTING DISCS AND HOLDERS

A spectacular incident in the Division, which occurred about two years ago when a bursting disc assembly did not prevent a reaction vessel being seriously overpressured (see Newsletter 98/1), resulted in an examination of the design, installation and checking of such devices.

The device failed to operate because it had been assembled the wrong way round. The reactor had to be heated during one part of the batch process and, as often happens with such equipment, it was possible on cooling for a vacuum to be created in the vessel. A vacuum or reverse pressure support was consequently specified to support the disc against inwards collapse under these circumstances. Clearly vacuum supports should be placed on the inlet pressure side between the vessel branch and the disc. They are riddled with holes so that they do not prevent the pressure in the vessel being applied over the full area of the bursting disc.

Unfortunately, in this case, the vacuum support had been assembled on the exhaust or venting side of the bursting disc. As the reactor pressure rose, due to a runaway reaction, the bursting disc membrane was prevented from rupturing at the design pressure since it was being supported by the vacuum support behind it. In fact it never ruptured even though the pressure rose to perhaps nearly twice the design pressure. Fortunately the excessive pressure started leaks at the bolted cover and flanged joints and these relieved the pressure thereby preventing possible disruption of the reactor.

Current practice has been to rely on training tradesmen in the correct assembly of all devices, to display exploded assembly sketches in workshops, to have a newly fitted device checked by a supervisor etc. Unfortunately, on close examination, there is considerable opportunity for error in fitting, particularly following the introduction of reverse buckling discs which must be fitted the opposite way round to conventional domed discs. Many manufacturers designs are difficult to check for correct assembly after they have been bolted into the pipeline. Indeed with some designs an inspection after assembly is impossible.

As a result of the investigation the Division has prepared Engineering Specification P1 0601, 'Conventional Domed Bursting Discs and Holders'. This requires installations to comply with certain features aimed at the elimination of much of the error potential inherent in existing installations. Assemblies are not inherently safe by design; however, all vital features can be checked by inspection after the disc has been installed in the plant. This check is an essential part of safe operation.

The main features covered in the new specification which is being applied to all future projects are:

> All discs shall be tagged by the manufacturer using a tag which is rivetted or welded to the disc and extends beyond the outside diameter of the flanges when the, disc and holder is installed. Tag to carry at least:- manufacturer, nominal bore, material, order No., tag No., burst pressure …. at……..
> Tags to be marked 'vent side' at the extremity of the tag and made from corrosion resistant materials.
> Vacuum supports to be expendable type and permanently attached to the disc by the manufacturer.
> Holders and discs to be of the shaped seat (conical or spherical) type wherever possible.
> Holders to carry a 'flow' legend with arrow indelibly marked to indicate the correct direction of flow,

As existing stocks of discs come up for renewal adoption of the new specification should be considered as a means of reducing or eliminating incorrect assembly.

Note the specification does not cover reverse domed and graphite discs or conventional discs less than 1 inch diameter in plug or union type holders.

Copies of P1 0601 are available from Standards Section (Extension P.2813).

E H Frank

WHO'S WHO IN SAFETY

No28 T J BREWER

Trevor Brewer, who has succeeded Charles Cowie as Company Safety Adviser, was born in Newport (Gwent).

He read Chemistry at Jesus College, Oxford and, after a period with Mars Ltd., joined British Nylon Spinners in 1960 as an Area Supervisor at their Gloucester Works. Later he became Production Services Manager and, after British Nylon Spinners had become part of ICI Fibres, he spent a year at Harrogate as Productivity Services Manager.

He went to Kilroot Works, Northern Ireland, as Assistant Works Manager in 1969 and was appointed Works Manager three years later. He was appointed to the Fibres Division Board as Production and Engineering Director in January 1975 and during the last two years has also been a Director of Engineering Services (Wilton) Ltd.

Trevor gained a rugby blue at Oxford, was capped three times for Wales as a wing three-quarter and was also capped for the Army during his national service.

He is married with two daughters, aged 23 and 21.