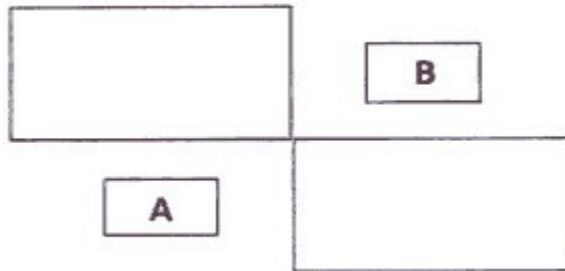


CANADIAN

INDUSTRIAL ENGINEER

No. 134

ACCIDENTS CAUSED BY POOR OR MISSING LABELS



We can design and maintain complex systems. Why can't we make good labels and keep them in position?

- 134/1 The A label was near B fan**
- 134/2 Two sorts of steam, no labels**
- 134/3 Oxygen and nitrogen confused again**
- 134/4 Nitrate and nitrite confused**
- 134/5 Two sorts of slops**
- 134/6 Labels covered by a protective box**
- 134/7 What does 0-1200 psig on a pressure gauge mean?**
- 134/8 Are labels a protective system?**
- 134/9 A new book on Loss Prevention**

An Engineer's Casebook — Pump couplings



IMPERIAL CHEMICAL INDUSTRIES LIMITED
PETROCHEMICALS DIVISION

134/1 THE WRONG EQUIPMENT WAS OVERHAULED

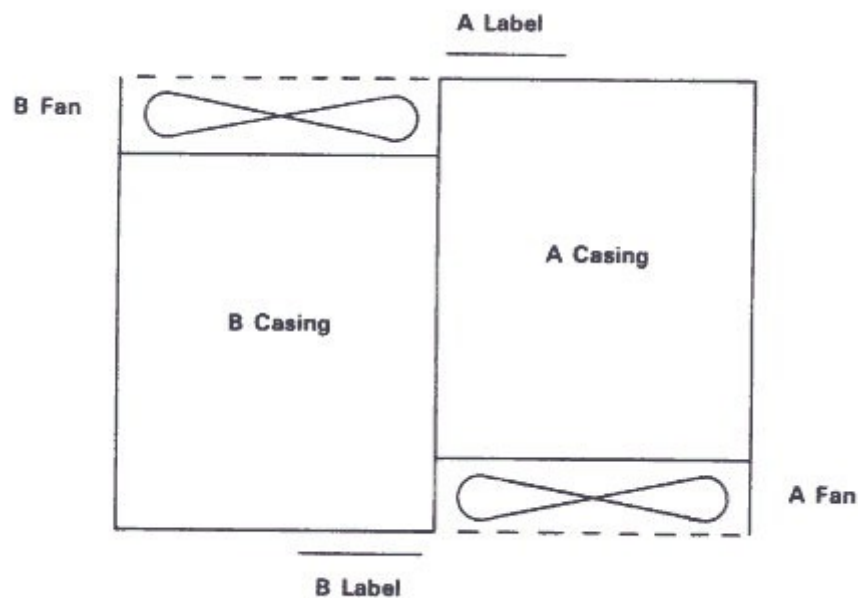
Two air cooler fans, side by side, are called J345A and J345B. B had to be overhauled, so it was defused and a clearance issued for the overhaul.

By mistake A was overhauled instead. The motor was disconnected and later rewired while the power was isolated only by the starter.

While this was taking place neither fan was in use. When the overhaul was nearly complete, one of the fans was needed and as the clearance book showed that B was being overhauled, A was started. Fortunately, by this time the overhaul of A was complete except that the guard had not been put back on the fan.

The mistake occurred because three things were wrong:

(i) The fans were arranged as shown below. The B label was on the side of B cooler furthest away from B fan and near A fan. Not surprisingly, the men doing the overhaul assumed that B fan was the one nearest the B label.



The labels have now been moved.

(ii) The fans were on the structure, 20 m above the ground. The start/stop buttons were on the ground, out-of-sight. When the operator pressed the A button, he could not see that the fan which started had no cover on it.

The start/stop buttons have now been placed near the fans and the emergency stop buttons — previously near the fans — are now at ground level.

(iii) The process and maintenance supervisors should have visited the job while it was in progress. One of them might then have noticed that men were working on the wrong fan.

Are there any misleading labels on your plant?

Are there any starters out-of-sight of the equipment they start?

Reminder: Newsletters 97/3, 91/1, 54/5, 37/1, 37/6, 37/7, 20/1 and 7/8 described other accidents caused by poor or missing labels.

134/2 A STEAM LINE CATCHES FIRE

A steam lance, connected to a 40 psig fire steam supply, was being used to disperse a slight leak. Suddenly the steam seemed to catch fire.

A fitter had been asked to connect the 200 psig steam supply (which is fitted with a non-return valve) via a hose to a process line, in order to clear it. By mistake he connected the 40 psig steam supply (which is not fitted with a non-return valve) to the process line. The pressure in the process line was over 40 psig, so hydrocarbons flowed back up the 40 psig steam line and came out of the steam lance, catching fire on hot process equipment.

If someone is asked to join two lines together with a flex, the two points to be joined should be identified by labels or by numbered tags.

Non-return valves are usually fitted to service points to prevent back flow but they are not fitted to fire steam points as they are not intended for connection to plant equipment.

Reminder: Other occasions on which service lines became contaminated with process material were described in Newsletters 121/5, 98/2 & 3, 79/2b, 21/6 and 5/4.

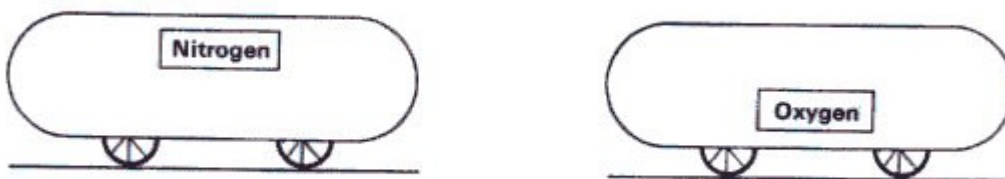
134/3 OXYGEN SUPPLIED INSTEAD OF NITROGEN

Newsletters 117/3, 41/5 and 27/5 described three occasions — two in the Company — in which liquid oxygen was supplied instead of liquid nitrogen, and recommended that all liquid nitrogen is analysed before it is off-loaded.

Now another incident has occurred, in another Company.

The nitrogen was supplied in rail tankers which are also used for oxygen. Before filling the tankers with oxygen, the filling connections are changed and hinged boards on both sides of the tanker are folded down so that they read “Oxygen” instead of “Nitrogen”.

A tanker was fitted with nitrogen connections and labelled “Nitrogen”. Probably due to vibration one of the hinged boards fell down, so that it read “Oxygen”. The filling station staff therefore changed the connections and put oxygen in it. Later nitrogen road tankers were filled from the rail tanker —which was labelled “Nitrogen” on the other side — and supplied to a customer who off-loaded it.



The mistake was found when the customer looked at his weighbridge figures and noticed that on arrival the tanker had weighed 3 tons more than usual. A check then showed that the works nitrogen system contained 30% oxygen.

Analyse all nitrogen tankers before off-loading. Safety Note 73/23 describes a simple method.

134/4 SIMILAR NAMES CONFUSED

In one of our overseas companies, a casual labourer added sodium nitrite to a plant instead of

sodium nitrate. Toxic oxides of nitrogen were given off.

Other similar names that have been confused are sodium hydrosulphide and sodium sulphide, Nutrimaster and Firemaster. See Newsletters 113/2 and 99/6.

134/5 SAME NAME — TWO MEANINGS

The 'slops' tank on a refinery was nearly full so a road tanker was brought in to remove some of the slops.

The tanker was overfilled and the spillage caught fire. The driver was very surprised as he thought 'slops' were dirty water!

Other names with two meanings are soda, hypo and ice. See Newsletters 113/2 and 55/5.

134/6 A SIMPLE CHANGE, BUT...

A Works bought a pack of rechargeable batteries and a special charger to be used with them. So that the batteries could be protected and carried easily they were put inside a metal box and surrounded by foam.

The pack was lent to another Section. When it needed recharging the local electricians were asked to recharge it. They did not know that a special charger was needed; they could not read the label on the pack as it was inside the metal box; so they used an ordinary charger and destroyed the pack.

Now that we know what happened it is easy to say that the label giving details of the charging method should have been put on the outside of the box, but how can we think of this beforehand?

Putting batteries in a box is really a modification and we should try to think what can go wrong.

Other simple modifications that went wrong were described in Newsletter 111.

134/7 A LOOK BACK AT NEWSLETTER 34 (November 1971) A PRESSURE GAUGE IS DAMAGED BECAUSE ITS CORRECT RATING IS NOT KNOWN

Plant pressures are usually transmitted from the plant to the control room by a pneumatic signal. This pneumatic signal, which is generated within the pressure sensing element, usually has a range of 3 to 15 psig covering the plant pressure from zero to maximum pressure, for example, 3-15 psig might correspond to 0 to 1200 psig plant pressure.

The receiving gauge in the control room works on the transmitted pneumatic pressure, 15 psi giving full scale, but has its dial calibrated in terms of the plant pressure which it is indicating. Clearly the Bourdon tube of such a gauge is only capable of withstanding a limited amount of overpressure above 15 psi before it will burst. Furthermore, the material of the Bourdon tube is chosen for air and may be unsuitable for direct measurement of the process fluid pressure.

Recently a pressure gauge of this sort, with a scale reading up to 1200 psig, was installed directly on the plant. The plant pressure was 800 psig and the gauge was damaged.

The report recommends that gauges of this type should have the maximum safe working pressure marked in red letters on the face.

134/8 ARE LABELS A PROTECTIVE SYSTEM?

A reader suggests that labels are a sort of protective equipment and therefore, like all protective equipment, they should be inspected regularly to make sure that they are in working order, that is, securely fixed and legible. He also suggests that we should use the methods used for trip systems to work out how often we should inspect them.

For example, suppose that:

- a valve is operated once/week (Demand rate = 52/year)
- if a label is missing there is a 10% chance that the wrong valve will be operated (Probability operator will make an error if protective system is not working= 0.1)
- we do not want this to occur more than once in 10 years (Hazard rate— 0.1/year)

Then as

Hazard rate = Probability operator will make an error if protective system is not working x Demand rate x Fractional Dead Time

$$0.1/\text{year} = 0.1 \times 52/\text{year} \times \text{FDT}$$

$$\text{FDT} = 0.02$$

that is, the label can be missing for only 2% of the time.

Suppose that the average life of the label is 5 years (failure rate= 0.2/year)

then $\text{FDT} = \frac{1}{2} \times \text{failure rate} \times \text{test interval}$

$$0.02 = \frac{1}{2} \times 0.2 \times \text{test interval}$$

$$\text{Test interval} = 0.2 \text{ year}$$

This calculation suggests that labels need to be inspected 5 times/yr. The figures may not be accurate, they are only examples, but inspection may nevertheless be necessary every year or several times per year. Most labels are never systematically inspected to make sure they are still there and replaced if necessary.

How often do you inspect your labels?

134/9 UNUSUAL ACCIDENTS No. 95

The experimenter demonstrated the power of nitric acid to the subject by throwing a penny into it. The penny, of course, was completely disintegrated . . . While the subject's view of the bowl of acid was cut off by the experimenter, an assistant substituted for it a like-sized bowl of... water...

The hypnotized subject was then ordered to throw the dish of nitric acid (in actual fact, of course, innocuous water) over the assistant who was present in the same room. Under these conditions it was possible to induce, under hypnosis, various subjects to throw what they considered to be an extremely dangerous acid into the face of a human being... Actually, in this particular experiment the person in charge made what he calls a 'most regrettable mistake in technique' by forgetting to change the nitric acid to the innocuous dish of water, so that in one case the assistant had real nitric acid thrown over him.

H J Eysenck, "Sense and Nonsense in Psychology"~ Penguin Books, 1957.

134/10 A NEW BOOK ON LOSS PREVENTION

Although interest in process safety and loss prevention has grown enormously in the last 10-15 years and the literature on them is extensive, there has been no comprehensive survey of the subject since J H Armistead's book, "Safety in Petroleum Refining and Related Industries", appeared about 1963.

This gap in the literature has now been filled by a new book by Professor Frank Lees of Loughborough University, "Loss Prevention in the Process Industries", Butterworths, £75. In over 1300 pages the subject is systematically surveyed in a work that will undoubtedly become a classic, so that Lees will become as well-known as Perry and Beilstein. However, while Perry is theoretical, Lees is more practical. The theory is there but wherever possible it is compared with experiment and experience and advice is given on the action we should (and should not) take.

Extensive extracts from published papers make it unnecessary to continually refer to other works, but the book is far from being a "scissors and paste job". The work of others is well summarised and a few well-written paragraphs draw attention to essential features, strengths and weaknesses. For those who need to follow a subject in depth, many references are given.

This is not a book to put in the library and borrow occasionally. It should be readily accessible by every process safety man, and by every manager and designer, so that they can refer to it frequently and can read the chapters that interest them. It is much more than a work of reference; the chapters on explosions, or fire, or hazard analysis, for example, are excellent introductions to the subjects.

Just as military textbooks tell us how to fight the last war rather than the next, so most books on safety — and there are many — with their emphasis on protective clothing, machinery guarding and the like, deal with the problems of the past and ignore present problems. Frank Lees has written a book which will help us deal with current and future problems.

134/11 COMMENTS FROM READERS — No Dead-ends in ICI Fibres

Newsletter 132/10 recommended cotton pants for winter jogging. Several readers disagree and say that the best way to protect one's prospects is to wear polyester clothing covered by a windproof outer layer of coated nylon.

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.

April 1980

Postscript

"It is necessary for technical reasons that these warheads should be stored upside down, that is, with the top at the bottom and the bottom at the top. In order that there may be no doubt as to which is the bottom and which is the top, for storage purposes, it will be seen that the bottom of each warhead has been labelled TOP."

A Ministry of Defence notice quoted in a BP Safety Bulletin.

An Engineer's Casebook No. 34

PUMP COUPLINGS

In cases where a pump and its drive are separately mounted some flexibility must be built in to the coupling which is used to connect the shaft ends together. This caters for initial mis-alignment, differential thermal growth in vertical, horizontal and axial directions, and physical displacements arising from piping reactions.

Occasionally close coupled couplings of the pin and rubber bush type are used. However spacer type couplings are preferred and are normally specified since they separate the shaft ends by a greater distance. This allows more flexibility to be built into the coupling and, when one or other hub is removed from its shaft end, the removal and replacement of bearings and lip seals without disturbing the holding down bolts of the pump or motor.

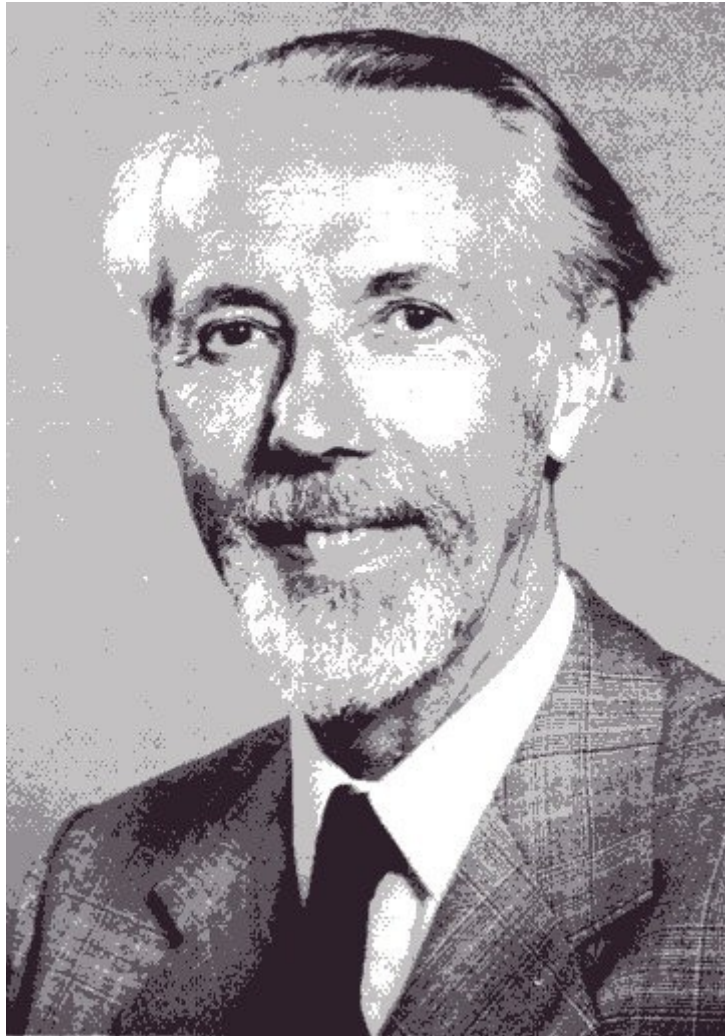
Flexible membranes used in pump couplings can be made from an elastomer, such as the Neoprene type used in the 'Fenaflex' coupling, or from thin steel strips as used, for example, in 'Metastream' couplings. In either case the membrane is flexed during every revolution by an amount proportional to the degree of mis-alignment between the shaft ends. Manufacturers specify operating limits and use fatigue resistant materials; nevertheless in-service failures may be expected and do occur from time to time.

The Division recognises this and specifies designs in Machines Specification MAC 0304 which meet two basic requirements. Firstly, if the coupling is of the spacer type, then it shall be of such a design that the spacer cannot be thrown out in the event of membrane failure. Secondly, that in the event of membrane failure all drive is lost. This latter point is particularly important where drives are located in areas where flammable gases may be present. Designs which permit some crude form of drive to be retained following membrane failure, for example, via bolt heads, are likely to give rise to sources of ignition and precipitate secondary damage.

A recent incident reports the ejection of a spacer from a flexible spacer coupling manufactured by Thomas Rex. An operator noticed that the coupling guard on a pump running on a re-circulation duty was lying beside the pump, the spacer part of the coupling was missing; it was later found 20 yards away and the motor was still running. The pump set was one which had been ordered directly by the Works concerned with a coupling which did not meet the requirements of MAC 0304.

E H Frank

WHO'S WHO IN SAFETY



No 34 — P W H Moon

Although he was born in Wales, Peter Moon counts himself a Bristolian, at which University he took an honours degree in chemistry. He joined Dyestuffs Division during the war and worked at Blackley and Huddersfield Works before coming to Teesside in 1948 as one of the start-up team for the first Nylon plant at Billingham. There are not many of that group of “Nylon Aborigines” still working in the Company, and Peter is rather proud to be one of them.

He came to Wilton in 1964 and helped with the process design of Nylon VII and VIII, and since then has worked on process development, environmental problems and energy conservation in the Nylon field. After taking an Open University degree in mathematics, electronics and computing “to keep his hand in”, he was appointed Division Environmental Adviser and Toxicological Liaison Officer in November 1979 in succession to Barrie Whitefoot (Who's Who in Safety No 22, Newsletter 107) who has now retired.

Married and with three sons (artist, geographer and historian) Peter likes driving sports cars and spends his spare time in woodwork, metalwork, electronics and tape recording. If you ask him what he records he will confess to a passion for fairground organ music!