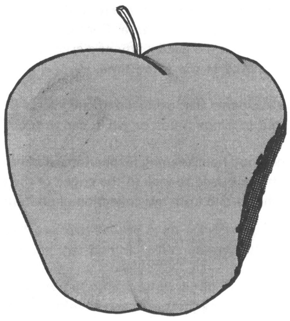
SAFETY NEWSLETTER

No. 132
ROT STARTS AT THE EDGES



132/1 Rot starts at the edges, not in the middle.

132/2 An air line came off a face-piece while a man was in a confined space.

132/3 Beware of scrap.

132/4 A steel plug was put into a bronze pump.

132/5 Dead-head hazards of centrifugal pumps.

132/6 Less maintenance, fewer hazards.

132/7 Some accidents to rail tankers.

132/8 J1001 and JA1001 confused again.

132/9 Are men really more likely to have an accident when they have psychological problems?

An Engineer's Casebook — Pipe schedule numbers

A Gift for our Readers — A Magic Charm to Prevent Accidents

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

132/1 ROT STARTS AT THE EDGES, NOT IN THE MIDDLE

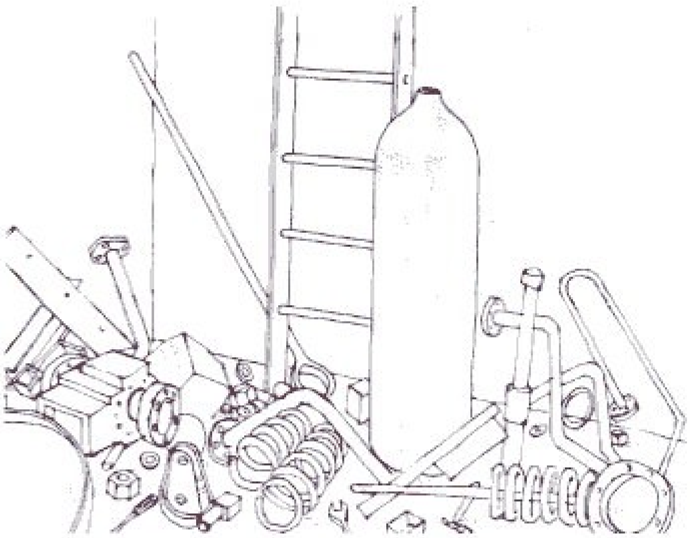
Newsletter 88/2 described an incident which occurred while a relief valve was being changed. Petrol came out of the open end of the flare header soaking the fitter. Plant instructions state that relief valves may be changed on running plants only when conditions are steady and other relief valves are unlikely to lift, but this instruction had not been followed.

The works concerned have now analysed this incident in more detail as part of a study on incidents on flare systems.

The relief valve change took place on a small plant operated by a team whose main job is operating a big plant. On the day of the incident the team were busy testing the trips on the big plant and did not give detailed attention to a job on the edge of their area. Control was left in the hands of a deputy supervisor and the job was re-timed to suit the availability of a crane. The relief valve change and the trip test should not have been attempted at the same time.

Safety Note 73/3 describes all the accidents that occurred in one Works during a three weeks period. A disproportionate number occurred in fringe areas or while carrying our fringe activities.

When I used to carry out safety and good housekeeping inspections, if I knew from experience that the mainstream plants would be shipshape, I used to look to the edges of the plant where horrible sights could often be seen. The drawing shows one from my collection of photographs — a little-used ladder in a little-used store.



Fringe areas and activities must get their fair share of attention.

Operators and managers should visit them regularly and should keep an eye on the relevant readings.

Flare systems are a typical fringe area. They rarely give trouble and so they get forgotten — until something goes wrong and is not spotted in time.

Some flare systems are shared by more than one plant and may suffer because nobody assumes full responsibility, nobody owns them. In one case resinous material got into a flare system. Plant A, who ran the flare system, blamed Plant B. Plant B made resin, but could not find any way in which it could get into the flare system. Eventually the blowdown drain exit became blocked and several tons of resin had to be dug out.

When equipment is shared, responsibility must be made clear.

Reminder Other incidents in flare systems were described in Newsletters 81/1, 60/4, 47/5c, 43/3, 12/4g. 7/3, 5/3 and 3/3. The incident described in Newsletter 81/1 also occurred because two plants shared the same flare system and responsibilities were not clear.

132/2 AN AIR LINE CAME OFF A FACE PIECE WHILE A MAN WAS IN A CONFINED SPACE

A recent incident shows what can happen when unauthorised people purchase their own safety equipment instead of going through proper channels.

A Day Gang decided to purchase compressed air breathing apparatus for their own use, as they use it frequently. The equipment they bought used $^{9}/_{16}$ inch hoses while the standard equipment used on the works used ½ inch hoses. Inevitably, the two slightly different fittings became mixed and a ½ inch hose was secured with $^{9}/_{16}$ inch fixing ring. The two sorts of ring can only be distinguished by close examination.

The hose came off the face-piece while the wearer was working in a confined space. Fortunately the breathing apparatus was being worn as a precaution and the atmosphere in the confined space was in fact fit to breathe.

All $^{9}/_{16}$ inch rings have now been destroyed and all the breathing apparatus is again under the control of the safety section.

132/3 BEWARE OF SCRAP

Newsletter 98/4 described an accident caused by re-using scrap equipment which was contaminated by corrosive chemicals. Now another company has described a similar incident.

Two valves, bolted together, were put on the scrap dump. A man was burning off the bolts in order to recover the valves. Liquefied petroleum gas was trapped between the two valves. It leaked out and ignited and burnt the man’s hair, fortunately not seriously.

Recently, in the Division, a man was injured while removing an old pipe from a scrap dump. Corrosive liquid ran out onto his wrist.

Do not put equipment containing process materials on the scrap dump. If equipment has contained corrosive materials, such as phenols, acids or caustic soda or explosive materials such as peroxides, it should be cleaned by steaming or water washing before dismantling and scrapping. Otherwise equipment need not be cleaned but should be emptied and **all valves should be open**.

Do not re-use scrap equipment without checking it for cleanliness.

Do not weld on it without a fire permit.

Reminder Newsletter 85/2 described the precautions necessary before equipment is sent away for repair or modification.

132/4 WRONG MATERIAL OF CONSTRUCTION AGAIN

A bronze pump (in another Company) was fitted with a mild steel plug. The thread corroded and six weeks later the plug blew out. It passed through the open window of a laboratory and knocked a piece of apparatus off the bench onto the floor. The apparatus was a write-off.

Reminder: Newsletters 125/3, 117/4, 113/3 and 4, 104/2, 98/8, 78/4, 71/6, 61/7-4 and 34/4 described other incidents which occurred because the wrong materials of construction were used. Newsletter

71/6 and an article in Ammonia Plant Safety, Vol 20, 1978, p 22 (published by AIChE) described the precautions taken on new plants to detect wrong materials.

132/5 DEAD-HEAD HAZARDS OF CENTRIFUGAL PUMPS

Loss Prevention Bulletin No 029, published by the Institution of Chemical Engineers, describes a number of incidents which occurred because centrifugal pumps were started up with their suction and delivery valves closed.

In one incident a condensate pump exploded and bits were found 20 m away. In another incident a column of air, saturated with oil vapour, was trapped in the delivery pipework. Compression of the air, as the result of pressure oscillations, caused its temperature to rise above the auto-ignition temperature of the oil and an explosion occurred — a diesel engine effect.

Incidents such as these can be prevented by

(i) Installing a kick-back line from the pump to the suction vessel,

(ii) Isolating the power supply to the motor by a high-temperature trip, or

(iii) Installing a relief valve.

These hardware solutions are usually adopted only on large pumps, on pumps that start automatically or with process materials that may explode if the pump gets too hot. Usually we rely on the operator checking the valves. Remote start facilities are not recommended as it makes it too easy to start a pump without checking.

Reminder: Newsletter 109/1 described another example of the diesel-engine effect.

Newsletter 71/3 described how a pump started automatically while isolated for maintenance, as the auto-start was not disconnected.

132/6 LESS MAINTENANCE — FEWER ACCIDENTS

These Newsletters show that maintenance, including preparation for maintenance and the subsequent start-up, is a common cause of accidents. If we needed to do less maintenance, we would have fewer accidents.

In the nuclear power industry, including the reprocessing of the spent fuel, it is difficult or impossible to maintain the plants and they have to be designed to run for many years without maintenance.

This is not done by massive duplication, or by making everything thicker and stronger or by using more expensive materials of construction but, to quote a recent ICI report,

“This safety and reliability appears to be achieved more by great attention to detail in the process design/mechanical design/construction/operation area rather than by very special types of hardware for the plant units.”

Would it pay us to do the same? Definitely not always, but perhaps on some occasions more time spent on design might save time on maintenance.

For some suggestions on other ways of designing plants for less maintenance see the article by E H Frank in Report No PC.21, 877/B, “Simpler Plants — Proceedings of a Symposium held on 1 February 1979” (available only within ICI).

132/7 ACCIDENTS TO RAIL TANKERS

The US National Transportation Safety Board has issued a "Safety Report on the Progress of Safety Modification of Railroad Tank Cars Carrying Hazardous Materials".

According to the Report, when larger tank cars for liquefied gases were introduced in 1958, safety features included in older tank cars were omitted. The result was a series of accidents which killed 46 people in the period 1969-1978, over half of them during the last year.

The Report lists the progress made in installing various safety features recommended from 1971 onwards — improved couplers, head shields and insulation — and the delaying tactics adopted by some tank car owners.

Missing from the Report, however, is any mention of the fact that the numerous accidents on US railroads are due to the poor state of the track. Would it have been cheaper to have improved the track instead of modifying the tank wagons? This is not discussed, though a temporary speed reduction is recommended.

HMSO have published a report on the railway accident at WeaverJunction on 6 August 1975 (price £1.25). Six caustic soda tank wagons were crushed and two others pierced. The report states that this "in no way indicates an inadequacy of design but clearly shows the severity of the collision" and the author adds, "I am unable to recommend any additional steps which could be taken in the design of these wagons to provide the necessary protection to cope with the force of the severity encountered in this collision".

Caustic soda is, of course, carried in low pressure tank wagons, similar to those used for petrol, and not in the pressure vessels used for liquefied gases.

The accident was due to a failure by the men preparing the train to follow correct procedures. As a result the train was allowed to run too fast for the number of braked vehicles in use. As usually happens when people are not working correctly, this had been going on for some time before the accident occurred and had not been spotted by the manager concerned. Both he, the train crew and the men who prepared the train are criticised in the report.

132/8 COMMENTS FROM READERS

Newsletter 130/6 pointed out that numbers like J123 and JA123 can easily be confused.

A few years ago an operator was asked to prepare JA1001 — a small pump used from time to time — for maintenance. He thought the supervisor said J1001 and went to it. J1001 is a 40 000 HP compressor!

Fortunately, the size of the machine made him hesitate and he asked the supervisor if he really wanted the compressor shutting down.

132/9 OTHER MEN'S VIEWS No 17

It is often said that men are more likely to be involved in an accident when they are under stress as the result of problems at home or at work. For example, one study seemed to show that train drivers are more likely to pass signals at danger when they are suffering from minor psychological disorders than at other times. However, this view has been queried.

"…. the drivers he had investigated were volunteers anxious to rationalise their error by producing a psychological 'excuse' for their 'signal passed at danger' episode; on the other hand, the control

group, presenting themselves for routine examination, had nothing to gain by revealing their psychological problems".

M Andrews, "Human Factors in Train Operation", paper read at a meeting of the Institution of Railway Signal Engineers, 13 November 1979.

Stress is like static electricity — both cause accidents and both are blamed for more accidents than they cause. Static electricity will not cause a fire or explosion unless there is a flammable mixture present and stress will not cause accidents unless closing the wrong valve or a similar error results in an accident. We try to avoid the formation of flammable mixtures whenever possible (except in a few cases where the risk is accepted) and, similarly, we should try to avoid situations in which a simple error results in a serious incident (See Newsletters 123, 109 and 86).

132/10 UNUSUAL ACCIDENTS No 93 — DEAD-ENDS

The hazards of dead-ends were discussed in item 132/5 above and in Newsletters 131/5, 124/4, 99/5, 84/2 and 117/Engineer's Casebook, while Newsletter 132/1 above pointed out that accidents happen at extremities. Another hazard of dead-ends and extremities was described in the *New Scientist*, 10 February 1977 (quoting the *New England Journal of Medicine*, Vol 296, p 178).

A man out jogging when the temperature was -8°C suffered great pain, but fortunately no permanent injury, due to freezing of an extremity. The report recommends cotton, rather than polyester, pants for winter jogging.

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.

February 1980

An Engineer's Casebook No. 32 PIPE SCHEDULE NUMBERS

The designation of pipe wall thickness by a schedule number is a practice widely used in the petroleum industry and has spread into the chemical and petrochemical industries. It originated in America and is now written into ANSI B36.10 and the British equivalent, BS 1600 'Wrought steel pipe for the Petroleum Industry'.

Wall thicknesses are listed under each schedule number, for example, Schedule 40, for a range of pipe sizes such as to give approximately uniform strength against internal pressure. An allowance of 0.1 inch is included in all sizes to cover threading and corrosion together with an under-thickness mill variation of 12.5 per cent on carbon steel and ferritic alloys. A special series of wall thicknesses apply to austenitic chromium-nickel steel pipe and this is designated by the use of the letter S after the schedule number, e.g., 5S, 10S, 40S.

The following derivation is extracted from BS 1600 : 1961:

"The schedule numbers in Table 1 are based on the ratio N of wall thickness t to outside diameter D, intended to indicate for the wall thicknesses listed under each schedule number a range of pipe sizes of approximately uniform strength against internal pressure.

$$N = \frac{2(t-c)}{D} \times 875$$

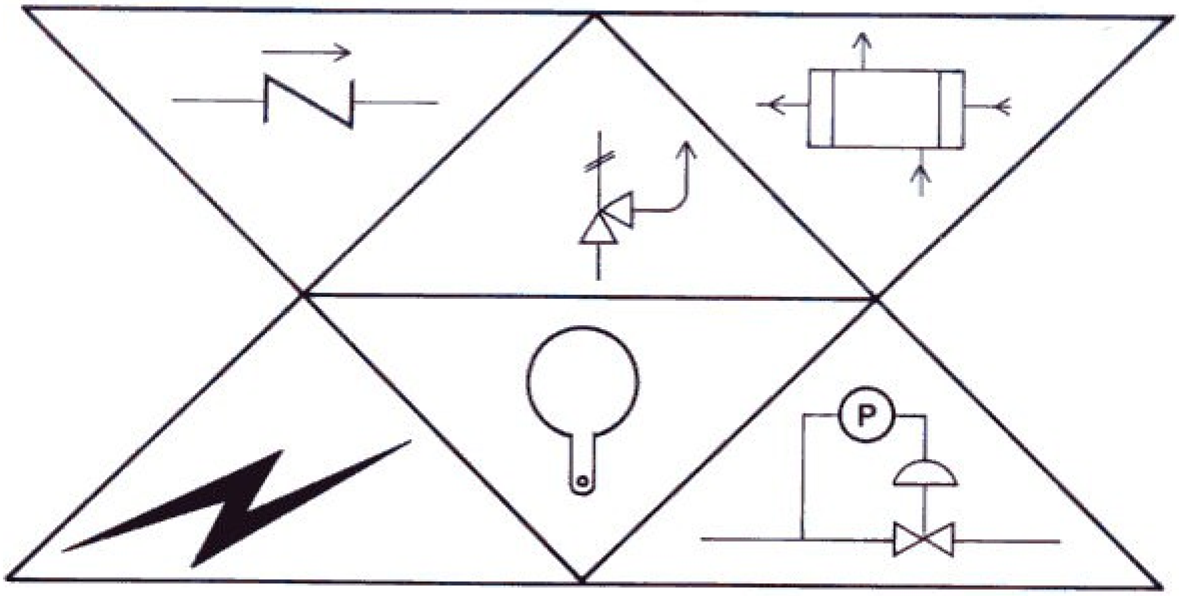
in which c represents an allowance (approximately 0.1 inch) to compensate for threading, corrosion, etc. and the constant 875 provides a mill tolerance on wall thickness of minus 12½ per cent".

Many years ago a range of pipes of approximately uniform strength in each size was available under the designations 'standard wall', 'extra strong' and 'double extra strong' and these terms may still be found in catalogues etc. Wall thicknesses correspond to Schedule 40, 80 and 160 respectively in most cases. The terminology is virtually restricted to screwed barrel nipples today.

Carbon steel pipe to API 5L Grade B has an allowable maximum stress of 20 000 psi at ambient temperature. Pipe of schedule 40 wall thickness to this specification will carry about 1000 psi internal pressure at this stress. Schedule 80 is good for about 2000 psi. In practice, for pipes below about 12 inches, the wall thickness is determined by practical considerations to give a reasonable span between supports, allow for some additional dead weight loading, sufficient stiffness etc. The maximum service pressure is usually limited by flanges or other fittings in the line and is rarely determined by the actual pipe wall thickness.

E H Frank

A Present For Our Readers
A MAGIC CHARM TO PREVENT ACCIDENTS



Used correctly, the charm will reduce the probability that an accident will occur on your plant,

You must carry the charm every day to every part of the plant (or of the area under your control) — into every building, up every structure, past every pump, past every instrument on the panel, Do not forget the 'holes and corners' of the plant — behind the buildings, along the pipebridge walkways and so on.

For the maximum effect the charm must be carried round at a different time each day — and sometimes during the night and at weekends.

If you follow these instructions then by this time next year you will find you have had fewer accidents and dangerous occurrences on your plant.

Photocopies will work just as well if you do not want to cut up your Safety Newsletter.

While taking the charm round the plant look out for anything that looks unusual — what does not look right is usually not right — and anything that has changed since the last visit. Also, look at a few things picked at random. Pick a maintenance job and check that the clearance certificate is correctly made out. Try a shower to see if it works. Look in an eye-wash bottle cabinet. Ask why an alarm light is showing. Look where others do not, behind and underneath equipment.