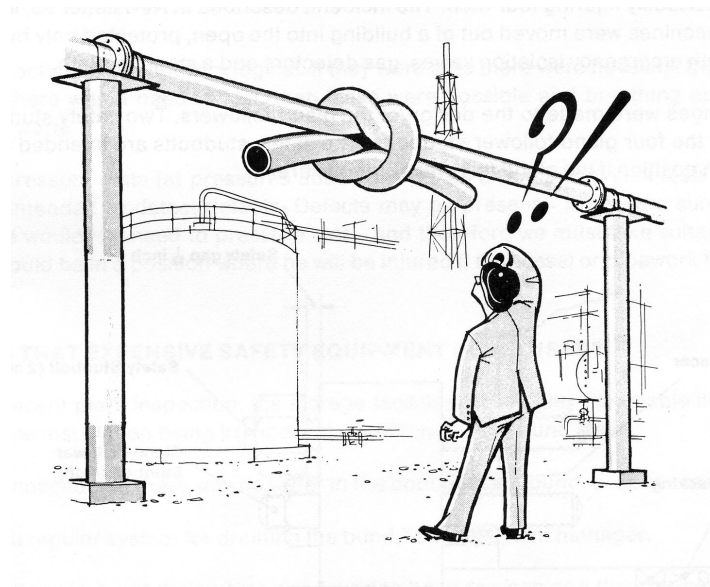


# CAREFREE INSPECTION

## No. 153 CHECKS AND INSPECTIONS



- 153/1      **A safety device was not inspected — and failed**
- 153/2      **Testing for faults we are sure are not there**
- 153/3      **Is that expensive safety equipment being used?**
- 153/4      **Misunderstandings which have caused accidents**
- 153/5      **A look back at Newsletter 53**
- 153/6      **Are you interested in Meccano or dolls?**
- 153/7      **Area classification**

**An Engineer's Casebook — Limited life pressure vessels**  
**Reminder: Newsletter 106 also covered the need for checking**



**IMPERIAL CHEMICAL INDUSTRIES LIMITED**  
**PETROCHEMICALS DIVISION**

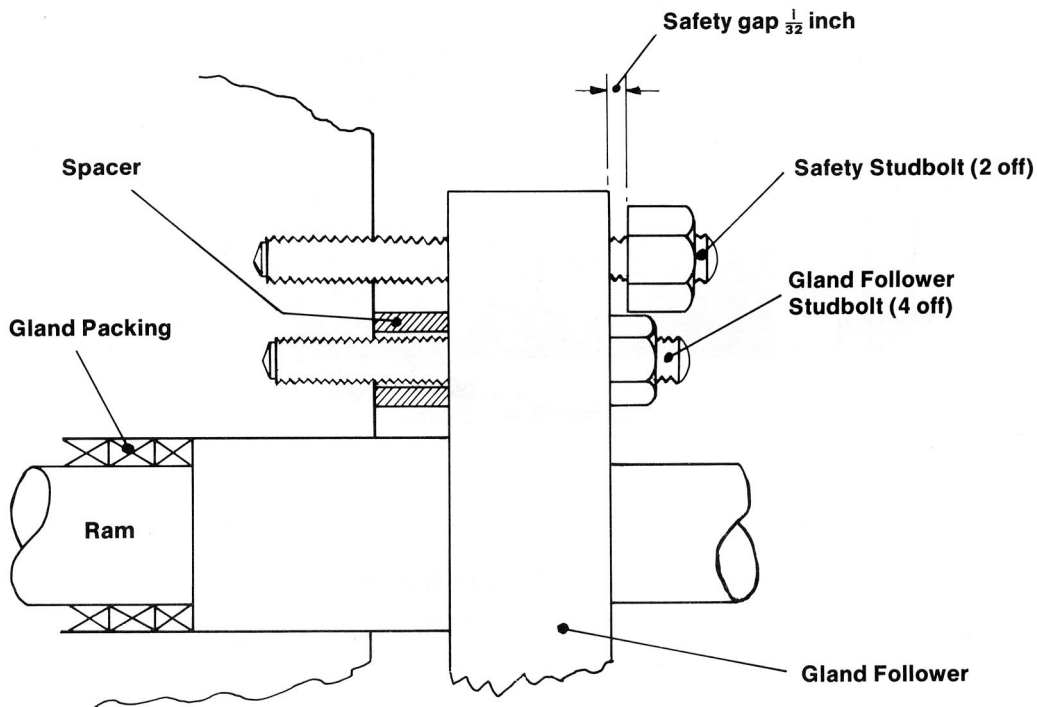
## 153/1 A SAFETY DEVICE WAS NOT INSPECTED – AND FAILED

These Newsletters have often stressed the need to test or inspect all safety devices regularly. If we do not do so, they may not work when required. This applies to simple devices such as fire extinguishers, eye-wash bottles and showers and to more complex ones such as relief valves, trips, emergency isolation valves and nitrogen blanketing. It applies to safety systems, such as clearance procedures, as well as to safety hardware. (See Newsletters 149/9, 148/1, 145/1, 142/4, 137/8, 136/1, 134/8, 130/8, 127/2, 95/4, 76/6, 58/1, 45/6, 28/2 and 7/5).

This need to test is illustrated by a recent accident.

In 1956 fatigue caused the failure of the studbolts holding the gland follower of a large reciprocating pump in place. The gland blew out, followed by liquid propylene which vaporised and exploded, seriously injuring four men. The incident, described in Newsletter 93, led to many changes. The machines were moved out of a building into the open, protected only by a canopy, and provided with emergency isolation valves, gas detectors and a steam curtain.

In addition changes were made to the design of the gland followers. Two safety studbolts were fitted as well as the four gland follower studbolts. The safety studbolts are intended to hold the gland follower in position if the gland follower studbolts break.



The safety studbolts are set  $\frac{1}{32}$  inch clear of the gland followers to prevent them being subjected to pulsating loads.

Nearly 25 years after the original failure, two gland followers studbolts failed again. *One of the safety studbolts also failed* and there was a leak of hydrocarbon.

It was then found that the gland followers and the underside of the safety studbolts were rough so that they were touching. The safety gap between them was too narrow or non-existent and its size was not checked regularly.

*All safety equipment needs regular checking*

*The reason for the setting of a safety device needs to be known.*

Why did the gland followers studbolts fail? It was found that they had been overtightened and that when the glands were repacked, all the old packing had not been removed. This increased the stress on the studbolts.

Newsletter 101/1 described another incident which occurred because equipment was not assembled to the correct tolerance. The reason for the setting had been forgotten.

### **153/2 TESTING FOR FAULTS WE ARE SURE ARE NOT THERE**

After changing a chlorine cylinder, two men opened valves to make sure there were no leaks on the lines leading to the vaporiser. They did not expect to find any leaks so they did not wear breathing apparatus. Unfortunately there were some leaks and they were affected by the chlorine.

The men's actions were not very logical. If they were sure there were no leaks, there was no need to test. If there was a need to test, then leaks were possible and breathing apparatus should have been worn.

Similarly pressure tests (at pressures above design, as distinct from leak tests at design pressure) are intended to detect defects. Defects may be present — if we were sure there were no defects we would not need to pressure test — and therefore we must take suitable precautions. No one should be in a position where he will be injured if the vessel or pipework fails.

### **153/3 IS THAT EXPENSIVE SAFETY EQUIPMENT BEING USED?**

During a recent plant inspection, the storage facilities for a highly flammable liquid were being admired, the installation being in excellent condition and the bund clean.

Someone noticed that there was no water in the bottom of the bund, despite recent rain.

"We have a regular system for draining the bund," said the plant manager.

On inspection the bund drain valve was found to be wide open and the protection for which the bund was designed had been invalidated.

### **153/4 MISUNDERSTANDINGS WHICH HAVE CAUSED ACCIDENTS**

1 This incident occurred in another company. A flat lorry was backed up against a loading dock and loaded with pallets with a fork-lift truck which ran on to the back of the lorry. When the fork lift truck driver had finished he sounded his horn and the cab drove away.

This system had been in use for some time but one day the lorry driver heard another horn, started his engine and drove away. The fork-lift truck was just driving off the lorry at the time and fell to the ground but landed upright. The driver jumped off and hurt himself.

2 Another incident was described in Newsletters 39/5 and 9/2.

A road tank wagon which had contained LPG was being swept out before being sent to the garage for repair. The laboratory staff were asked to analyse the atmosphere in the tanker to see if any hydrocarbon was present. The laboratory staff are often asked to analyse the atmosphere inside LPG tankers but usually to see if there is any oxygen present. Owing to a misunderstanding they assumed that an oxygen analysis was required in this case and reported over the telephone "non-detected".

The process operator assumed that no hydrocarbon had been detected and sent the tanker for repair.

Fortunately, the garage had their own check analysis carried out and this showed that LPG was still present — actually over a ton.

For most plant control purposes telephone results are adequate but where analyses are made for safety purposes, results should be accepted only in writing.

3 A famous accident caused by misunderstanding occurred on the railways in 1873, at Menheniot in Cornwall.

Two trains were standing in a station. The signalman called out “Right away, Dick” to the guard of one train. The guard of the other train, who was also called Dick, promptly started his train, which ran into another one.

*From “Great Western Broad Gauge Album”, by A K Steele, Oxford Publishing Company, 1972.*

4 Misunderstandings can occur because we use imprecise words. What does a designer mean when he recommends that equipment is ‘checked’ or ‘inspected’ every so often? In the incident described in Newsletter 152/1, when the manager asked that the computer should hold everything steady when an alarm sounds, did he mean hold the temperature steady or hold the control valve steady?

### **153/5 A LOOK BACK AT NEWSLETTER 53 (June 1973)**

#### **Draining water from LPG tanks**

One of the worst incidents in the history of the oil and petrochemical industries was the fire at Feyzin in 1966 which started when water was being drained from a tank of liquefied petroleum gas. Following this incident it was agreed that all tanks from which water is drained regularly for process reasons will be fitted with two isolation valves (for details see ICI Engineering Codes and Regulations, Group D, Volume 1.6) and that drains which are used only for occasional maintenance purposes will be kept blanked off. A recent survey of one of the Works in the Division disclosed over 100 drain valves on which the blanks had been removed and either not replaced or left dangling loosely on one bolt.

#### **Training operators to issue clearance certificates - The use of specimen certificates**

When a large part of a plant was shut down last year, it was no longer necessary for an assistant foreman to be in charge and the senior operators were trained to issue clearance certificates.

The manager gave each of these operators a set of completed specimen clearance certificates. This simple act produced a big increase in competence and confidence. The men are much clearer about what they should do and, therefore, less worried.

In addition, the foreman countersigned each clearance until he was satisfied that the operators were fully proficient.

### **153/6 WHAT ARE YOU INTERESTED IN - MECCANO OR DOLLS?**

Logic trees provide a useful way of setting down the various actions and conditions leading to an accident or event. The logic tree is usually drawn by working from left to right and then, if we want to quantify it, we work back from right to left putting in the numbers.

I was at a course where those present were asked to draw a logic tree for “Car fails to start”. Naturally no two trees were exactly the same but Fig. 1 is typical of many that were produced.

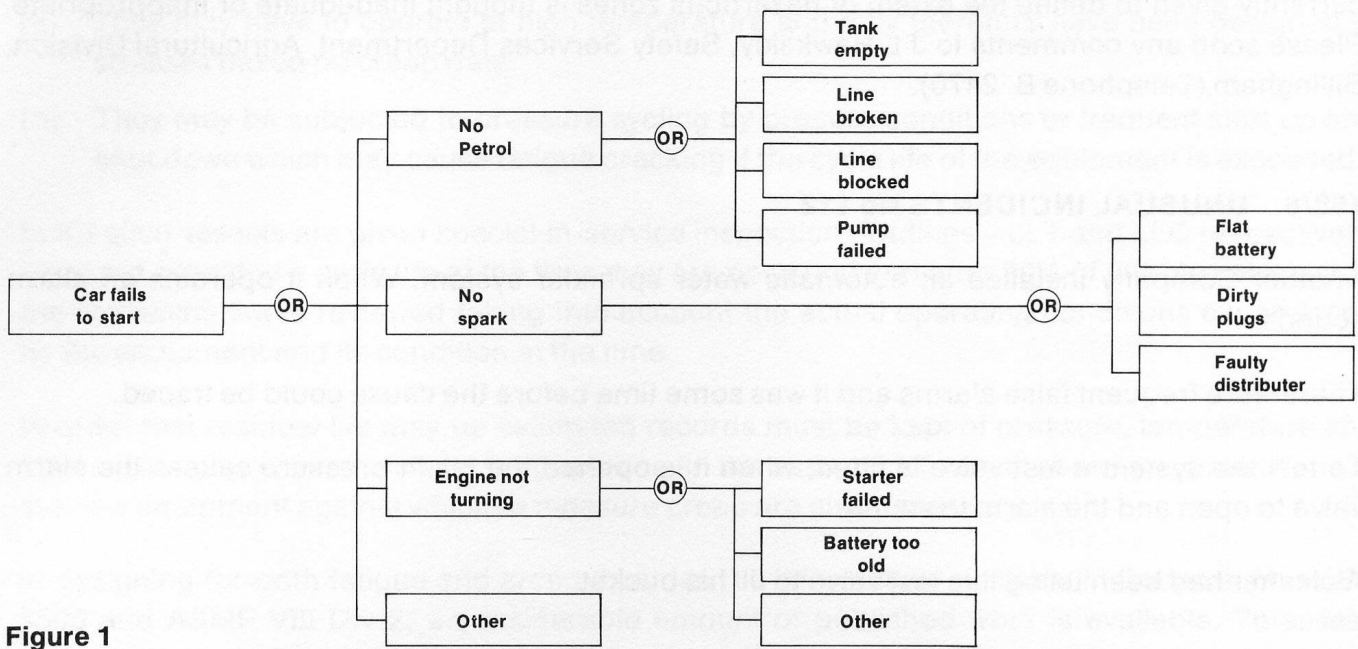


Figure 1

However a few people produced trees like Fig. 2.

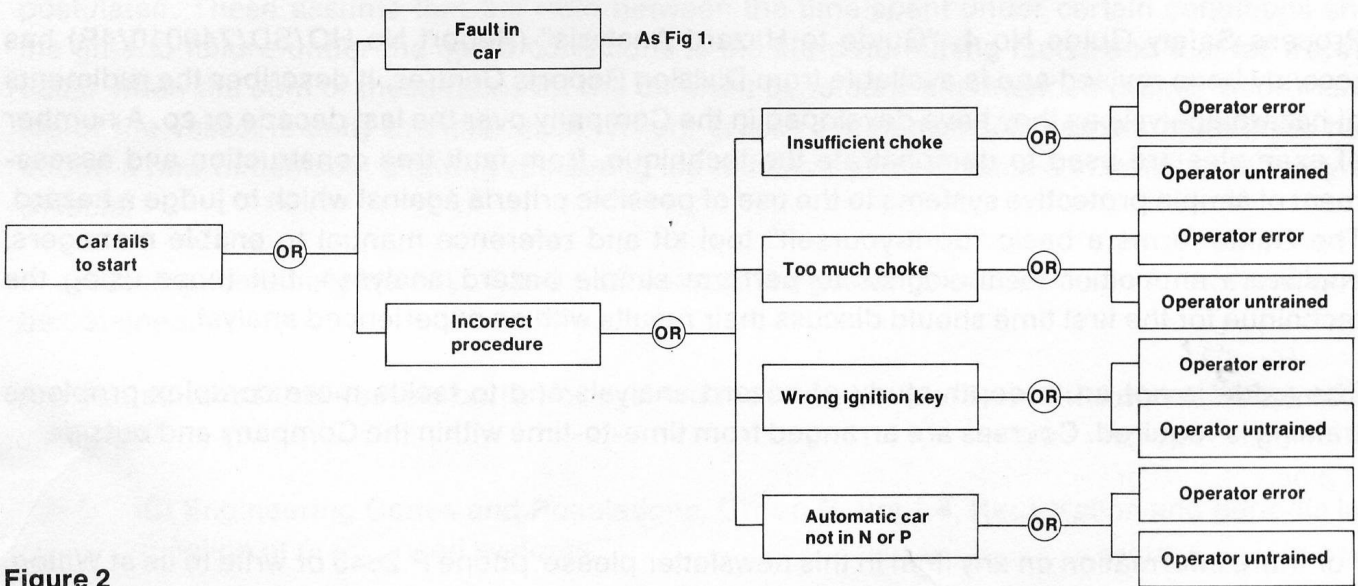


Figure 2

The difference is interesting. Technologists are interested in hardware — otherwise they would not be engineers or scientists — but often less interested in people. As children we played with Meccano rather than dolls.

However a plant, like a car is a mixture of hardware and people and if we are going to operate them safely and successfully we have to understand the people as much as the hardware. See the quotation in Newsletter 144/9.

## **153/7 AREA CLASSIFICATION**

The ICI Engineering Codes and Regulations Group C (Electrical), Volume 1.5, "Electrical Installations in flammable atmospheres" is being revised. This includes updating the guidance given in Table 1 for the extent of hazardous zones, to take account of current engineering practice. For example, spiral wound gaskets are now standard for joints in pipes on LPG duty and for these it is reasonable to assume lower leak rates and hence smaller zone 2 areas than the present Table 1 suggests for joint leaks. In addition the scope of Table 1 and its associated notes will be broadened to take more account of the widely differing properties of some flammable materials.

It would be helpful to know of any particular or general situations for which the guidance currently given to define the extent of hazardous zones is thought inadequate or inappropriate. Please send any comments to J L Hawksley, Safety Services Department, Agricultural Division, Billingham (Telephone B. 2470).

## **153/8 UNUSUAL INCIDENTS No 112**

Another Company installed an automatic water sprinkler system. When it operates an alarm sounds. There were frequent false alarms and it was some time before the cause could be traced.

To test the system a test valve is fitted; when it is opened the fall in pressure causes the alarm valve to open and the alarm to sound.

A cleaner had been using this test valve to fill his bucket.

## **153/9 RECENT PUBLICATION**

Process Safety Guide No 4, "Guide to Hazard Analysis" (Report No HO/SD/740010/4R) has recently been revised and is available from Division Reports Centres. It describes the rudiments of hazard analysis as they have developed in the Company over the last decade or so. A number of examples are used to demonstrate the technique, from fault tree construction and assessment of simple protective systems to the use of possible criteria against which to judge a hazard. The Guide forms a basic "do-it-yourself" tool kit and reference manual to enable managers, engineers and other technologists to perform simple hazard analyses, but those using the technique for the first time should discuss their results with an experienced analyst.

The guide is not an in-depth study of hazard analysis and to tackle more complex problems training is required. Courses are arranged from time-to-time within the Company and outside.

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.

November 1981

## **An Engineers Casebook No 53**

### **LIMITED LIFE PRESSURE VESSELS**

Vessels may have a limited life (ref 1) because:

- (a) They may have to operate at high temperature and may therefore have been designed to stresses based on creep data.
- (b) They may be subjected to pressure cycling by process conditions or frequent start up and shut down which may cause fatigue cracking if the cycle life of the equipment is exceeded.

In ICI such vessels are given special in-service inspection gradings— LLT and LLC respectively. They are allocated a code life at the time they are designed and after 80% of this life has expired the remaining life is reviewed taking into account the actual operating conditions experienced by the equipment and its condition at the time.

In order that residual life may be estimated records must be kept of pressure, temperature and the number of pressure cycles seen in service. In the case of LLT vessels baseline dimensions of the new equipment against which to measure creep are also necessary.

In designing for both fatigue and creep, besides the information available in Codes such as BS 5500 and ASME VIII Div 2, a considerable amount of published work is available. To assess the cumulative effect of cycles of differing amplitude and frequency on the one hand and periods at different temperatures on the other, Miner's law and Robinson's rule have been postulated. These assume that the ratio between the time spent under certain conditions and the time to failure under the same conditions is the life-determining factor and that failure will occur when the sum of these ratios for the different conditions experienced during the working life of the vessel is unity in either case. Where cracks are concerned fracture mechanics has added a new dimension, allowing remaining life to failure to be assessed in terms of severity of defects.

In assessing remaining life of LLT and LLC vessels the guidance of the Design Authority should be obtained.

Are you satisfied that vessels on hot or cyclic duties on your plant have the correct inspection gradings?

Ref 1: ICI Engineering Codes and Regulations, Group B, Vol 1.4, Registration and periodic inspection of pressurised systems.

M O Engel

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## WHO'S WHO IN SAFETY?

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**No 35 A. Rimmer**

Trevor Kletz retires in March 1982. His replacement is Alan Rimmer who became Senior Safety Adviser for the whole of Petrochemicals and Plastics Division on 1 November.

Alan was born in Rochdale and educated at the local grammar school and University College, London where he took an honours degree in chemistry and did research on organic reaction mechanisms. He joined the former Dyestuffs Division in 1949, working first in Research and Development and later in Nylon Works, Billingham as a plant manager.

In 1961 Alan was seconded to a project team in the Division's Engineering Department, working partly with a process design contractor in Switzerland. It was there that he first met his wife, Erika, who was working in their chemical laboratories. Later, on Teesside again, he managed a miscellaneous chemicals section at Wilton before transferring to Nylon Works (Ardeer) for the start-up as Assistant Works Manager.

Following the formation of Petrochemicals Division Alan returned to Nylon Chemicals Works at Wilton to co-ordinate process development in both Works and more recently has been Assistant Works Manager in Olefine Works, where he was responsible for the safety function as well as production.

Having changed location seven times Alan has developed an interest in the civil engineering aspects of gardening! He is also interested in architecture, railways and photography.