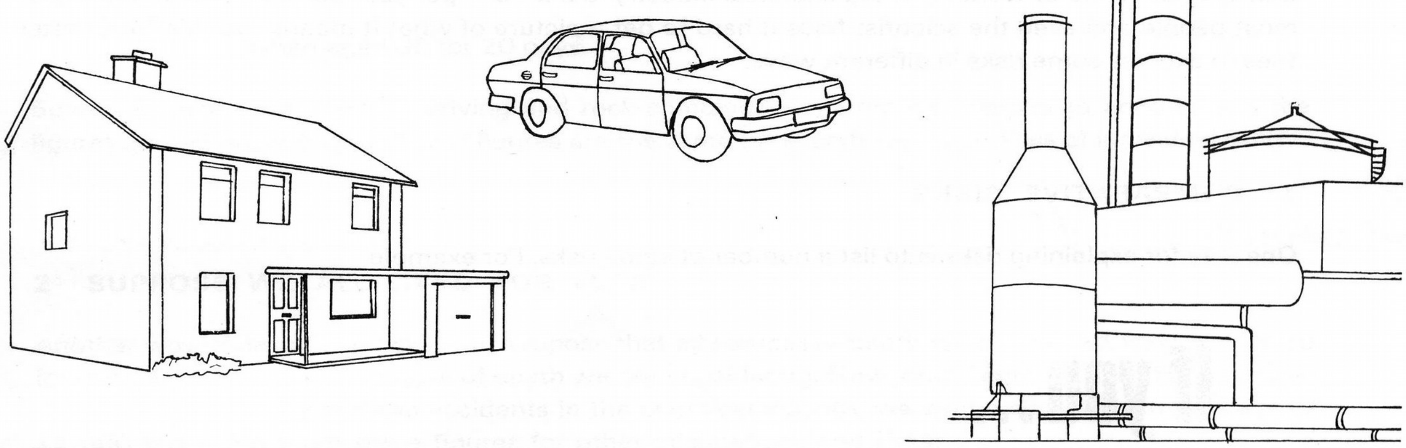
SAFETY NEWSLETTER

No. 138

RISK



Which of these is the riskiest?

Some things are more dangerous than we think, others less.

This Newsletter tries to give us a better feel for some of the risks around us.

An Engineer's Casebook — Surface finish

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

RISK

Are we too risk-averse? Do we go too far in trying to remove all risks? Some people think we do. For example, Bob Murray, former medical adviser to the TUC, has written, “This is the first generation which feels it is entitled to immortality”.

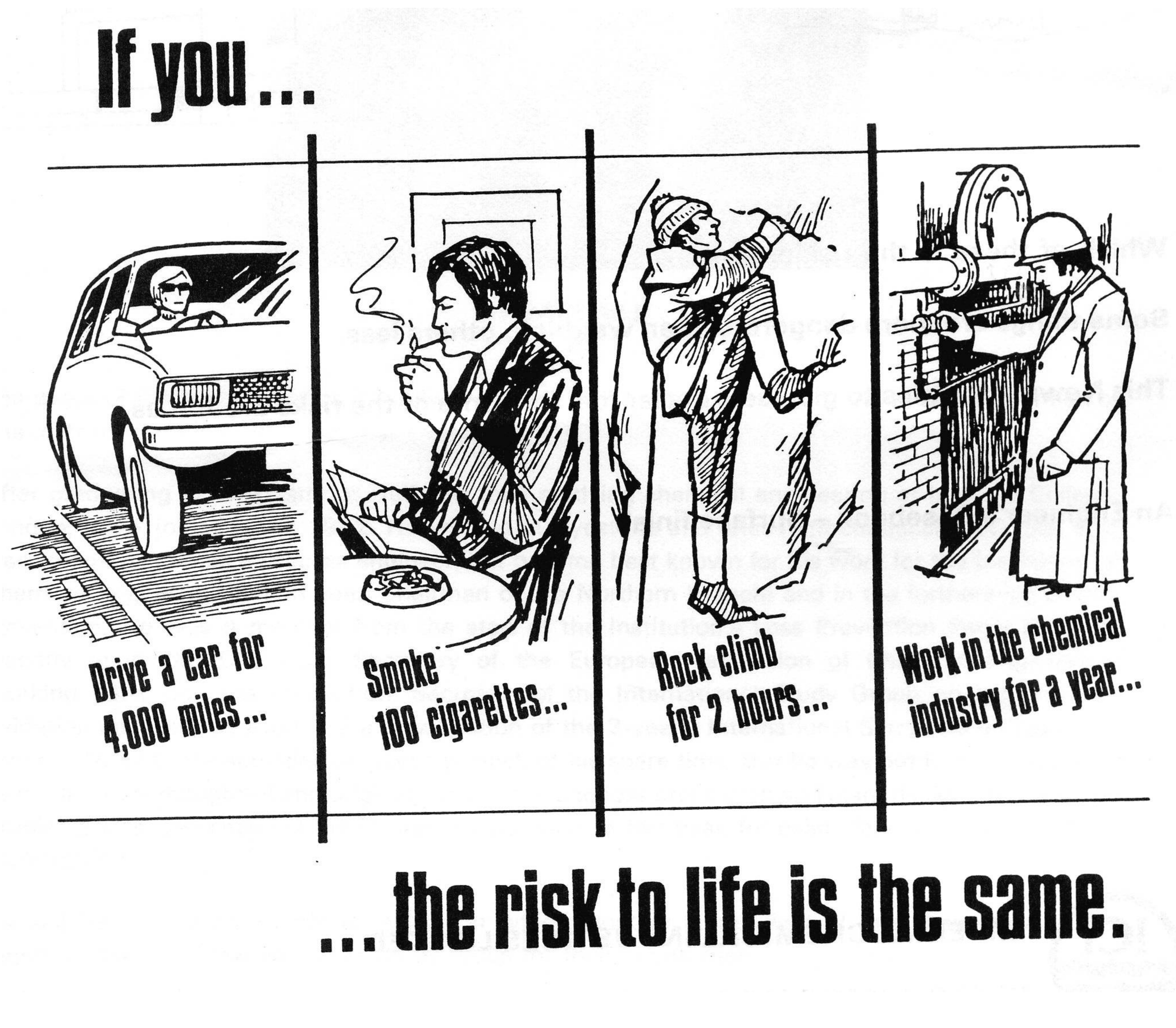
On the other hand, other people think we are too risk-loving, that we take too many unnecessary risks, risks which are out of proportion to the pleasure obtained or the time saved. We smoke or fail to fasten our seat-belts.

The truth is that we are neither risk-averse nor risk-loving but risk-illiterate. We do not know which risks are big and which are little.

This Newsletter tries to explain some risks in ways that are easy to follow. Most writers on risk say that the risk to life of working in the chemical industry is 8×10^{-5} per year but this means nothing to most people and even the scientist finds it hard to get a picture of what it means. So this Newsletter tries to express some risks in different ways.

1 COMPARATIVE RISKS

One way for explaining risks is to list a number of equal risks. For example



Other equal risks are:

Riding a motor-cycle for 350 miles

Staying at home for 16 hrs/day for 2 years. (This is the figure for a man aged 16-65; young children and old people are at greater risk.)

Drinking 40 bottles of wine.

Eating 80 lb of peanut butter. (There is a chance that it may have been made from mouldy peanuts which contain a powerful carcinogen called aflatoxin.)

Living for 10 years in Aberdeen (where there is radioactivity in the granite used for buildings) instead of a brick house elsewhere.

Just being a man aged 60 for a day

Just being a man aged 30 for 20 days.

Some of these risks, such as driving and rock-climbing, vary from one person to another and the figures quoted are averages. Other figures are the same for everybody, regardless of individual skills.

2 SUPPOSE WE ALL LIVED FOR EVER

Another way of describing risks is to suppose that all sources of death were removed and we all lived for ever, except for the one cause of death we are considering. How long would we live? For example, if the only cause of death was accidents in the chemical industry we would all live for an average of 12 500 years. Here are some figures for other occupations and risks:

Working in the steel industry (for 2 000 hours/year)	6 000 years
Railway shunting (for 2 000 hours/year)	1 100 years
Steel erecting (for 2 000 hours/year)	750 years
Driving a car for 10 hours/week	3 500 years
Riding a motor-cycle for 10 hours/week	300 years
Travelling in a train for 100 hours/year	20 000 years
Staying at home for 2 000 hours/year (man aged 16-65)	50 000 years
Smoking 40 cigarettes/day	100 years
Drinking 1 bottle of wine/day	1 300 years
Being struck by lightning	10 000 000 years
Being hit by falling aircraft	50 000 000 years
Being killed by a road accident involving petrol or chemicals	50 000 000 years

[**Transcribers Note:** Some corrections to this table were given in Newsletter 139 and those corrections have been incorporated into this transcription by me]

3 A TAX ON RISKS

In this method of comparing risks, suggested by Professor R Wilson of Harvard, we assume that the Chancellor of the Exchequer, on the lookout for new ways of raising money, decides to tax risks. Everyone who creates a risk has to pay a tax which is proportional to the size of the risk. Let us also assume that the tax is fixed at £1 million per life. This is not the value of a life — the value of a life is whatever we are willing to pay to save it — but an arbitrary figure. However, in the chemical industry our expenditure on safety is now probably much more than £1m per life saved.

Here are some of the taxes we would have to pay:

Cigarettes	70p each cigarette, that is, £14 on a packet of 20
Living with a cigarette smoker	3p per day
Wine	£2 per bottle
Beer	25p per pint
Peanut butter	70p per 12 oz jar
Petrol	50p per gallon if used in a car (This is an average figure— it should be less if we wear seat belts, more if we do not.) £3 per gallon if used in a motor-cycle.
Chest X-ray	£1
Living in a brick house	£6 per year due to the risk from radiation
Living in a granite house	£15 per year due to the risk from radiation
Working in the chemical industry	£1.60 per week
Working in the steel industry	£3.80 per week
Working as a construction erector	£27 per week
Soft drink	2p due to the saccharin
Grilled steak	1p due to carcinogens in the burnt steak
Living near an atomic power station	20p per year due to the radiation

4 THE TOTAL NUMBER KILLED

The following table lists the total numbers killed in the UK every year by various risks. The figures come as a surprise to many people.

Smoking			50 000		
Accidents			26 000		
including:	road accidents			8 000	
	including:	road transport of chemicals and petrol			2
	accidents in the home			5 000	
	including:	falls			2 600
		poisoning			700
		fires			500
	accidents at work			700	
	including:	construction			150
		mining & quarrying			70
		farming			33 *
		chemical industry			15
		ICI			4.5

* In addition, 22 children are killed every year in accidents on farms.

WHAT IS THE USE OF THESE COMPARISONS?

The comparisons above are interesting but are they useful? They can be because they can help us spend our money and efforts wisely, both at work and at home. They can help us to see which are the risks worth worrying about and which we should forget about. We see that the risks from smoking and motor-cycling are very high and that therefore we should do what we can to discourage our children from smoking and motor-cycling. The risks from travelling by car are quite high but most of us feel that the risk is worth the convenience; but we should do what we can to reduce it by wearing our seat belts and using properly designed seats for young children. The risks of staying at home are higher than most people think but we can reduce them by, for example, buying a fire-alarm (see Newsletter 127/10), seeing that poisons are clearly labelled and out of reach of children and, most important of all, taking precautions against falls (no slippery floors or loose carpets, especially on the stairs).

Many people outside the chemical industry think it is dangerous and think of farming as a natural, healthy industry, but farming kills more people, many of them children.

If we were deciding on the height of a wall we would consider it absurd to argue about an extra millimetre, but in the safety field we have no feel for numbers and do argue about the equivalent of a millimetre in the height of a wall. For example, it is absurd to worry more about the road transport of petrol and chemicals, which kills 2 people every year, than about ordinary road accidents, which kill 7000 people every year; it is absurd to worry about the radiation from an atomic power station when we get about 30 times as much from the bricks in our houses.

When a new atomic power station or oil refinery or chemical plant is going to be built there are often objections from members of the public who fear the unknown. But, so far as I know, no member of the public has ever been killed by an explosion or other incident in a refinery or chemical plant in the UK. There is more risk involved in travelling to a protest meeting than in living near the completed refinery or chemical plant. Perhaps more knowledge of the risks will help us to explain them to people who are worried.

It is true that the worst possible accident to an atomic power station or oil refinery or chemical plant could kill many people, but such accidents are very unlikely. The worst possible accident at a football match, a Jumbo jet crashing on the crowd, could kill many people but we do not prohibit football matches or Jumbo jets.

Within ICI, most fatal accidents are not due to chemicals, as the following figures show:

	No of ICI employees killed while at work 1970-79	
Chemical accidents	8	
Mechanical accidents	12	
Transport accidents (on and off site)	23	(including 11 air)
	43	

However, do not use these figures as a reason for relaxing. We must always be on the alert, as shown by the near-misses described in these Newsletters.

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.

August 1980

A PERFORMANCE SPECIFICATION THAT WAS HARD TO MEET

Design engineers know that contractors sometimes have difficulty in meeting all the requirements in a specification.

In 1907 the US Signal Corps issued an "Advertisement and Specification for a Heavier-than-Air Flying Machine". One of the requirements that bidders had to meet was:

"It should be provided with some device to permit of a safe descent in case of an accident to the propelling machinery"

This requirement has still not been met!

Quoted by R L Bailey in "*Disciplined Creativity for Engineers*", Ann Arbor, 1978, p 154.

"Some problems can't be solved, only survived", Dennis Healey

An Engineers' Casebook No 38 SURFACE FINISH

Any surface which has been finished by turning, grinding, milling, shaping, honing or other means will not be absolutely smooth. It will carry a witness by way of surface irregularities depending on several factors relating to the finishing operation such as radius of tool tip, feed rate of tool across the surface, marks due to vibration of the tool or workpiece, damage done by chips etc.

When surfaces have to be machined some guidance must be given to indicate the degree of surface finish which is required, a point often overlooked when preparing sketches or drawings for items ordered on workshops. A common method of doing this is to write the symbols Rf or Sf on the drawing where surfaces require to be machined. The symbols stand for rough machine and smooth machine respectively and though no quantitative indication is given as to how rough or how smooth tradesmen will, as a result of their training and experience, produce a satisfactory result.

It is sometimes necessary to define surface finish in quantitative terms, for example where this can influence the performance of the component or replacement parts are required to exactly match existing ones. In these cases the surface texture must be measured.

Two measuring parameters are used, both of which are now internationally recognised in ISO/R468 'Surface roughness'. They are to be found also in BS 1134 Parts 1 and 2 'Assessment of surface texture'. The main parameter R_a is identical to that previously known as CLA (centre line average). A secondary parameter R_z gives a measure of the average total height of surface irregularities.

A machined surface exhibits a predominant surface pattern which is characteristic of the machining process used. This pattern, which on a flat surface may be likened to a ploughed field, is called the 'lay'. Surface roughness measurements are taken at right angles to the lay and over a standard sampling length.

The R_a is the arithmetical average value of the departure of the profile above and below the reference (centre mean line) throughout the prescribed sampling length. R_a is measured in micrometers (μm) which is the metric equivalent of the previously used micro-inches (μin). 1 μm is one millionth of a meter; 1 μin is one millionth of an inch. Some typical values of R_a are surface grinding 0.03 to 3 μm (1 to 125 μin), face or cylindrical turning 0.5 to 50 μm (20 to 2000 μin), shaping or planing 1 to 100 μm (40 to 4000 μin). Very roughly an R_a of 0.75 μm or 30 μin is a smooth finish whilst an R_a of about 12 μm or 500 μin is a rough finish such as one would find on a raised face flange.

R_z is the ten point height of irregularities, being the average distance between the five highest peaks and the five deepest valleys within the sampling length. R_z values are generally from 4 to 7 times the corresponding R_a values. For most of our work it is sufficient to indicate the required R_a value (the old CLA figure which can be metricated by dividing the μin value by 39.4 to get the value in μm).

E H Frank

OBITUARY

F HEARFIELD

The death of Frank Hearfield on 23 July at the age of 52 has robbed the world of loss prevention of one of its most enthusiastic workers.

After graduating in Chemistry at Hull and then studying chemical engineering at Imperial College, London, Frank joined ICI in 1952. He worked in Dyestuffs and later Petrochemicals Divisions as a plant manager and as a process engineer, but became best known for his work for the Institution of Chemical Engineers (he had been Chairman of the Northern Branch) and in the furtherance of loss prevention. He was a member from the start of the Institution’s Loss Prevention Panel and was recently appointed Chairman, Secretary of the European Federation of Chemical Engineering Working Party on Loss Prevention, Secretary of the International Study Group on Hydrocarbon Oxidation and was involved in the organisation of the 3-yearly International Symposia on Loss Prevention. To all those activities he gave up much of his spare time. But he was not just an organiser; he made many thoughtful and original contributions to loss prevention and plant design. His paper on simpler plants, presented at the Design 79 Conference last year, for example, describes one of the most notable.

He will be missed on all the occasions at which workers in the field of loss prevention gather together; there are few willing to do as much for their fellow men as Frank did.