

CASEBOOK

IMPERIAL CHEMICAL INDUSTRIES LIMITED

No. 159

MIND YOUR Ps AND Qs

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**An Engineer's Casebook — No. 59.
High Speed Centrifugal Pumps and Compressors**



IMPERIAL CHEMICAL INDUSTRIES LIMITED
PETROCHEMICALS DIVISION

159/1 NOT THE RIGHT CUP OF TEA

All groups of people with an interest in common develop a jargon which is a useful shorthand for those in the know. Jargon can however present dangers to those not in the know or who have used the same expressions with different meanings under other circumstances.

Some years ago, on a new plant, the project team were responsible for ordering the initial stock of chemicals. One of the team was asked to get some TEA and placed an order for Tri-ethylamine. In the Works in which he had his training Tri-ethylamine had always been called TEA!

When the newly appointed plant manager placed an order for the continuing supply he asked for Tri-ethanolamine, which he actually needed and which was called TEA in the Works where he had been trained. He therefore used the abbreviation in some of his plant instructions.

In due course drums of both materials were delivered. Fortunately a store keeper, who was used to neither material, noticed that both had been delivered for the same plant and queried whether one delivery was wrong.

Jargon has its place among friends and close colleagues but in instructions and other documents to be used by a variety of people proper names should always be used.

159/2 LABELLING - A CONFUSING MESSAGE IGNORED

Recently a mistake was made with some drums of material which carried proper chemical names. 72 drums of material were received for use in a batch process. 55 of the drums had the correct name of the contents on the top and the side. But 17 drums had the name of the material to be used on the top and a different name on the side. This discrepancy was not noticed and material from both types of drum was used to make two batches of product which were unsuitable for sale. An investigation then revealed the cause. The 17 drums with two different labels did not contain the correct raw material for that process. The labels on their tops were incorrect. Fortunately no damage was done but a lot of expensive material was wasted, cleaning out the plant cost time and money, and some deliveries to customers were delayed.

Make use of all the information available and if there are discrepancies regard them as warnings that a mistake has probably been made. Check before continuing.

159/3 IT CAME TO PIECES IN HIS HAND

We have had another potentially dangerous incident which could just as easily have happened at home as at work. The incident draws attention to the need to check the condition of electrical fittings and for presence of mind when something does go wrong.

A laboratory worker withdrew a 13 amp plug, manufactured to BS 1363/A, from a socket and the live pin separated from the plug and stayed in the socket. Fortunately no one touched the pin and the socket was switched off so that the pin could then be removed immediately and safely.

It would be worthwhile doing a quick check of the plugs you use to see whether any of the pins are loose and getting an electrician to attend to any faults.

If one of your plugs does leave a pin in a socket and it is not a switched socket even more care is needed. Ask someone to keep an eye on it and not to allow anyone to touch it until the electricity has been switched off at the mains supply. Then the pin can be removed safely.

159/4 UNUSUAL ACCIDENTS NO 115: JERICHO REVISITED

A failure of a steel structure has occurred due to mixed use of nuts and bolts manufactured to metric and imperial standards. The bolted connections concerned were at mid-span of the roof trusses of a new concert theatre, and the whole building collapsed during rehearsals when some trumpets sounded.

It was found that 20 mm diameter bolts had been used with $\frac{3}{4}$ inch nuts, and although the nuts appeared to screw on satisfactorily they rested only on the crest of the threads. The nuts then stripped off along the bolts leading to complete failure of the roof trusses and destruction of the building.

We have several different standards for nuts and bolts still in use and when building new plant or maintaining operating plant we must take care that nuts and bolts are correctly matched. The Journal of Occupational Accidents, Volume 3, No 3, from which this anecdote was taken, has some other interesting examples of structural failure.

159/5 THAT LAST FLANGED JOINT

During the commissioning of a new storage installation a serious leak of flammable material occurred from a flanged joint just below a relief valve. The storage tank and all its pipework had been rigorously tested for leaks with a blank flange in place of the relief valve. The blank had then been replaced with a pressure relief valve, correctly adjusted, but a poor joint had been made.

Recently a serious fire occurred in an oil refinery when oil leaked out from the flange below a relief valve and was ignited. It is possible, though not certain, that the joint had not been made satisfactorily when the valve was installed.

Joints made at the very final stages of plant construction sometimes cannot be tested as fully as the others and must therefore be made especially carefully. They should also be watched very carefully during the early stages of commissioning. The fault on the storage installation mentioned above, was detected very quickly as continuous checks for leaks were made as the installation was being filled with product for the first time.

159/6 IMPROVISATIONS NEED WATCHING

Monochloroacetic acid is pretty nasty material and an operator who noticed some dripping from a leaking sight-glass placed a 20 gallon container underneath the sight-glass to catch the liquid. He expected that a road tanker would be coming shortly to empty the tank and it would then be comparatively easy to repair the leak.

Unfortunately the arrival of the tanker was delayed for several days. The leak got worse and the 20 gallon container was not watched carefully enough. Eventually the liquid overflowed on to the ground and thence to a nearby drain. The container, being full, was then difficult to move and a man had to wear full protective clothing to be able to do so safely.

Temporary measures to deal with a problem such as this are commendable, but a permanent cure must be effected as soon as possible.

159/7 WHO GUARDS THE GUARDIANS?

Newsletter 48/7 described how a man was trapped in a lift and sounded the bell, but nobody came. The man trapped was the man who had to take action when the alarm sounds. I was reminded of this when a shift clerk was injured. (Somebody had fallen against the other side of the door as he was about to go through it and the clerk's elbow went through the wired glass panel).

The shift clerk is responsible for informing the emergency services when anyone is injured or any other emergency occurs. In this case he was unable to do so but fortunately he was able to tell the man who fell against the door what to do.

What would happen on your plant if the man who acts in an emergency is himself in need of help?

159/8 BE PREPARED IN GOOD TIME

All airlines have emergency instructions for cabin crew and passengers. One airline has a procedure for the crew to follow when preparing for an emergency landing. Its intention is to alert passengers to the possible need to evacuate the aircraft quickly and to make advance preparations for doing so.

One of the instructions tells the cabin crew to make sure that able bodied persons are sitting next to the emergency exits. I feel that this action ought to be anticipated by making sure that able bodied persons sit next to those exits when passengers board a plane in the first place. It is too late to start moving passengers about when a plane is in flight and an emergency anticipated.

Have your plans for your plant been well prepared and those who may need to take emergency action nominated and trained well in advance? Think of this also next time you travel by air. Are you willing and able to take a lead in an emergency? If so, take a seat next to an emergency exit and learn how it works — but don't try it unless instructed to do so!

For more information on any item in this newsletter please phone P2845 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.

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An Engineer's Casebook No. 59

HIGH SPEED CENTRIFUGAL PUMPS AND COMPRESSORS

Sundyne pumps and compressors have been in use on some plants for 10 to 15 years now, and are looked upon for what they are — reliable single stage machines giving multi-stage capacity and performance. Maintenance problems still arise with these machines and when they do they are generally quite different from those of traditional centrifugal pumps. Recently twenty such pumps were commissioned on a Plant with varying degrees of success. The general difficulties encountered and solutions found may be of benefit to other pump users.

Vibrations

High vibration levels were experienced on the larger size of machines. These were the 331 (400 HP) and 311 (200 HP) units. Vibration levels of 1.2 inches/second and 100 g were not uncommon. Sundstrand literature advises that machines should be shutdown if the velocity level reaches 0.31 inches/second.

The gearbox vibrations can be greatly improved by balancing the high speed shaft assembly as a unit. Sundstrand balance individual components when manufactured and then rely on the combined out of balance of the built-up unit to be within tolerance. Our experience shows that dynamically balancing the output shaft assembly as a whole can reduce the out of balance by more than half and consequently the vibration levels.

Recently we have resorted to balancing the layshaft assemblies to reduce vibration levels even more.

The larger 331 machines can be further improved by fitting helical gears to the input shaft and top of the layshaft. These gears and new bearings are now available as a conversion kit. In addition to dramatically reducing acceleration levels, the noise levels from the gearbox are also reduced by 10 dB to about 93 dB.

Loss of Head

When fitting the diffuser into the pump casing, it is essential to check that the 'O' rings are undamaged. The slightest damage will result in a significant reduction in the delivery pressure of the pump.

Oil Pumps

Internal oil pumps on Sundyne units are driven by a single helical spring type Bissel pin which connects the pump shaft to the gearbox input shaft. It is not uncommon for these pins to shear, causing loss of oil and subsequent bearing failure. It is important to examine and renew these pins following any failure. Do not be tempted to fit a solid pin in place of the spring type. It will almost certainly fail.

The manufacturers have recognised the weakness and now supply double helical Bissel pins.

Lubricating Oil

It is important to remove all traces of water from the gearbox. A very small amount will cause frothing in the oil. The manufacturers recommend the use of Automatic Transmission Fluid but this is expensive and hard to get. On the advice of Lubrication Group we have successfully used Gulf Harmony 46 (previously Harmony 47) oil for many years. Gulf 1351, which is a similar oil to Harmony 46, works equally well.

Bearing Failures

Some early failures of units on this group of pumps were found to be caused by failures of the bottom idler bearing. This is an 11 ball bearing with a nylon cage and is different from earlier machines that had fitted a 12 ball rivetted cage bearing. While it is hoped that the manufacturer will revert back to the rivetted cage bearing, the 11 ball nylon cage is still being fitted. It is important to see that this bearing is installed with the open side of the cage facing the oil jet.

Suction Filters

Although the Syndyne units do not require close clearances for operation, it is extremely important to ensure that the inlet suction filters in the flow to the units are properly maintained. Small foreign bodies can strike the impeller as it rotates at very high speed, cause out of balance and consequent failure.

P J Clements