

Safety Lines

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Calorifier Rupture — A Near Miss

The photograph shows a calorifier which ruptured during operation. It shows the destructive potential of a relatively small pressure vessel operating at moderate pressure.

This incident highlights the need, with such equipment, for:

- Effective management systems;
- Maintenance of records; and
- Regular inspection and maintenance.

The calorifier was used to provide domestic hot water and consisted of a copper shell, bronze tube plate and copper 'U' tube bundle. The water side shell was about 55 years old and was fitted with a relief valve. The tube nest was supplied with steam controlled by a thermostatic temperature controller. The shell longitudinal seam and the end caps were riveted.

The system had been out of service for an extended period and had been scheduled for demolition for the past five years. Because it was "about to be scrapped" it was no longer included in a management plan operated by the facility but, it had not been tagged or otherwise locked out of service.

Following a requirement for extra hot water, the vessel was returned to service and shortly afterwards ruptured under pressure. The vessel tore along the riveted longitudinal seam and around both end caps. The force of explosion moved the vessel about



Ruptured calorifier

two metres off its foundations and severely damaged adjacent equipment and parts of the building in which it was located.

The following is an extract from the preliminary report issued by the inspection body engaged by the controller to investigate the calorifier failure.

"Incident Scene Inspection

On arrival at the 'scene' ...

Inspection of the tube assembly which although being blown out of the shell flange was still intact with the channel head. Cracks were evident on the outer radius of the 'U' tubes bends of all but one tube around the weld areas of an attached restraining bar across the ends of the 'U' bend.

Closer examination of these cracks (through the tube wall) revealed evidence of one of the cracks being present for some time (discoloured fracture surface). The other cracked surfaces were in keeping with a recent, sudden failure.

Examination of the internal surfaces of the shell revealed a definite coloration change at the top of the tubes. Below the tube top level the shell was a whitish copper colour. Above the tube top level the shell was black.

Inspection of the nozzles on the top of the shell revealed quite a lot of restriction in the vent nozzle (reddish brown deposits).

The outlet bore of the safety valve had the appearance of prolonged slight leakage from the valve seat. There was no evidence of the safety valve having lifted recently to relieve pressure.

Close examination of the rivets left in the shell revealed that they had failed in a ductile manner predominantly in the shear mode.

Other damage within the plant room was mainly to associated pipework and fittings. An area of Gib or fibre board wall panelling had been blown outwards in the car park outside the plant room.

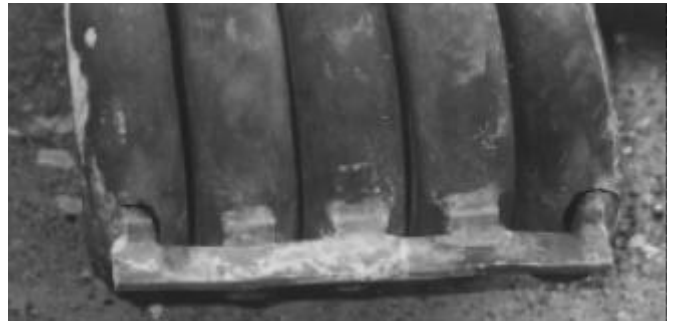
There were no reported injuries ...”

The inspector’s report noted that the bends at the ends of the tube bundle had what appeared to be a long-term minor cracking and evidence of more recent sudden cracking. In his conclusions, he surmised that this more recent cracking caused an overpressure that could not be handled by the relief valve (especially in what appeared to be its impaired condition resulting from a long-term buildup of deposit around the safety valve seat and disc) and the vessel ruptured.

The inspector recommended in the preliminary report that the relief valve be examined and tested. This work was subsequently carried out with the following results:

- The disc and valve seat were found to have a scale build up which appeared to restrict operation of the valve.
- The colour coding of the valve spring indicated a pressure range of 38 to 62 psig but when tested the valve lifted at 195 psig.

(The valve from the second calorifier was found to have been fitted with a spring from a different model with a range of 125 to 175 psig. The disc and seat could not be separated because of scale build up and the valve did not fully lift under a test pressure of 175 psig.)



Tube bundle: Tubes cracked at restraining bar welds

Engineering Safety’s comments on this incident are as follows:

- Inspection and maintenance of the calorifiers, at least in recent years, had been unsatisfactory.

The long-term cracking in the tubes was obvious and should have been picked up.

There was clear evidence of leakage from the relief valve and from the relief valve on an identical adjacent calorifier. They both had a deposit build up around the seat and disc which should have been picked up and the cause corrected. (See *Safety Lines* #40 for an article on the dangers of deposit build up in safety valves and vent lines.)

- The plant management systems need improvement.

The calorifiers had not been tagged or isolated from the system even though they were to be scrapped and had been taken out of service.

Records for this equipment had not been maintained and were no longer available.

The relief valve had been fitted with an incorrect spring. It is not known what the pressure setting should have been but subsequent testing of the valve revealed a ‘pop off’ pressure of 1160 kPa. This compares with a safe working pressure marked on the tube bundle of 100 psig (680 kPa).

A report on this incident was prepared by Ian Baggot, Engineer Surveyor and Wellington Manager of M&I Safety Inspection Services Ltd. Extracts from this report were included in this article with the agreement of M&I and the equipment controller.

The two calorifiers have both been scrapped following this incident. The equipment controller is reviewing and upgrading the plant management systems. Ed

Good News for Exporters to Europe

CE marking approvals can now be obtained in New Zealand. This means that inspection bodies (and laboratories) can now be assessed and approved by International Accreditation New Zealand as Designated Conformity Assessment Bodies (CABs), competent to undertake testing against specific European Directives. This means that mandatory inspection can be completed in New Zealand prior to export. (So far two New Zealand laboratories have been approved as CABs.)

On 25 June, the New Zealand Government and the European Commission signed an "Agreement on Mutual Recognition of Conformity Assessment". The MRA was signed in Wellington by Sir Leon Brittan, Vice President of the European Commission, and the Hon. John Luxton, Minister of Commerce. Under this Agreement, New Zealand inspection bodies and laboratories can be approved as competent to assess products against EU mandatory requirements. Conversely, European inspection bodies and laboratories can be designated as competent to inspect and test against New Zealand regulations.

Sir Leon noted that the MRA would free up access to Europe over seven product sectors, covering around one third of New Zealand's trade with Europe.

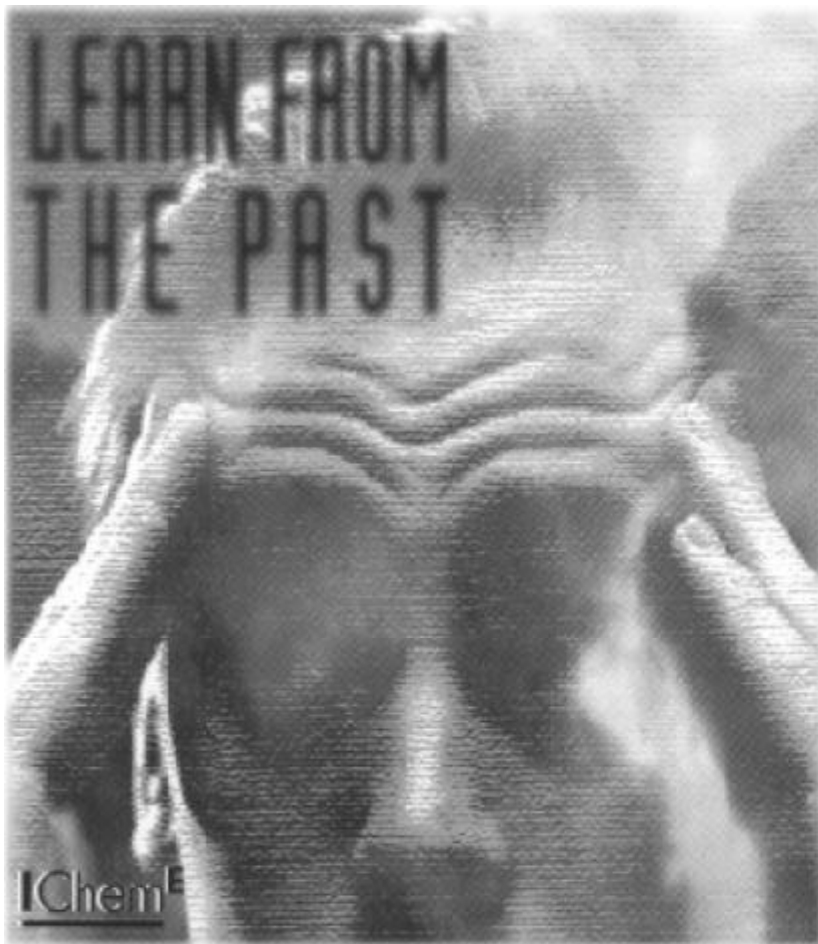
The MRA will come into force as soon as procedural matters are finalised. Other sectors will be added in due course.

Of particular interest to inspection bodies is that those sectors presently covered by the MRA include pressure equipment and machinery. The conformity assessment procedures for most pressure equipment are covered in the 'Simple Pressure Vessels Directive' 87/404/EEC and the 'Pressure Equipment Directive' PED97/231EC. The 'Simple Pressure Vessel Directive' is already in effect and the PED goes into effect, or becomes permissible, on 29 November 1999 and will be mandatory throughout the European community on 29 May 2002.

The MRA includes the 'Simple Pressure Vessel Directive' and negotiations between New Zealand and the European Community on the inclusion of the 'Pressure Vessel Directive' have commenced.

The official signing is the culmination of six years of negotiations and confidence building. "Each side had to

Continued over ...



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be sure the other understood what was required and had reliable systems in place,” explains International Accreditation New Zealand’s Chief Executive, Dr Llewellyn Richards. “Government regulations protect public health and safety. Mutual recognition means trusting others to protect your citizens. The MRA enables product safety assessments to be completed before the product is exported. No further checks are required on arrival. The product can go straight onto the market.”

International Accreditation New Zealand’s role is as the Designating Authority, appointed by the New Zealand government to approve inspection bodies and laboratories as competent to assess products against European requirements.

Signing of the agreement opens the way for New Zealand manufacturers of pressure equipment to have their products CE marked in New Zealand. It does not make it happen, and it will not happen if there is no demand from manufacturers. If manufacturers do not ask Inspection Bodies to provide the service, they will see no advantage in becoming designated as CABs. If there are no CABs for pressure equipment in New Zealand, products will still have to be inspected in Europe, with all the inconvenience and expense of arranging for any alterations “over there”. It should be noted that CE marking is increasingly being specified for equipment in the Asia Pacific region, particularly where European consultants or contractors are involved in major contracts.

The Ministry of Commerce has published a booklet, *Exporting to Europe*, that provides background on CE marking requirements and the NZ/EU Mutual Recognition Agreement. Copies are available from the Ministry free of charge (telephone 04-472 0030). International Accreditation New Zealand can also assist with information.

Inspection bodies wishing to be designated as CABs for European Directives should contact:

Alan Glover or Geoff Hallam
International Accreditation New Zealand
Private Bag 28 908
Remuera
Auckland
Tel 09-525-6655 Fax 09-525-2266

Refrigeration Pipework

Engineering Safety wishes to bring to the attention of readers a reported misinterpretation of ASME B31.5 with respect to the selection of materials for refrigeration pipework.

Some readers have interpreted this code as allowing the use of standard pipe and pipe fittings for refrigeration systems regardless of fluid temperature, imposed loads and potential impact forces.

Design and materials is covered by chapters 2 and 3 of ASME B31.5. and the general requirement is that all ferrous materials subject to temperatures below -20 F shall be impact tested. However, clause 523.2.2 of ASME B31.5 also allows that this testing is not required for temperatures in the range -20 F to -150 F “provided the maximum circumferential or longitudinal tensile stress resulting from coincident pressure, thermal contraction or bending between supports does not exceed 40% of the allowable stress for the material as given in Table 502.3.1 ...”.

In other words, standard grades of ferrous material within this temperature range, may only be used under ASME B31.5 where:

- They are included in Table 502.3.1, and
- There has been full analysis of the loadings which would be imposed on the system, and
- The maximum stresses are within the limits specified in the code.

In conclusion:

ASME B31.5 does not permit the general use of standard fittings and pipe for low temperature applications. It would be a serious error of judgement to stock or use just these fittings in the belief that this code allows them to be used in all refrigeration applications.

Imported Mobile Cranes

Engineering Safety have had reports that some importers of mobile cranes have come to grief when they have attempted to get their newly imported cranes certified for service in New Zealand.

These importers have brought cranes into the country, without the documentation that inspection bodies need for the issue of a Certificate of Inspection. Without this certificate the crane owner has not been able to put the crane into service. Experience has shown that arranging suitable documentation retrospectively can be

very expensive. Engineering Safety understand some crane owners have incurred costs of several thousand dollars.

The information required is described in general terms below and is dealt with in more detail in 'ES Doc 018'. Engineering Safety strongly advises all intending importers to become familiar with this 'ES Doc' and to consult their inspection body on certification requirements prior to committing to a crane.

The documents which are generally required, when importing a new or second-hand crane, are as follows:

1. Where the manufacturer operates within an ISO 9001 quality management system recognised by OSH, statements certifying that the crane:
 - Has been design verified to the relevant standards recognised by OSH;
 - Has been manufactured, inspected and tested according to the verified design and the design standard; or
2. Where the crane is a standard production model, manufactured by an internationally recognised crane manufacturer, then it can be accepted for design verification and fabrication inspection purposes on the basis of the manufacturer's design statement shown in 'Appendix A' of *ES Doc 018*.

In addition to the data required for certification, the owner must get all information necessary to allow the safe operation, maintenance and servicing of the crane. This will include:

- All drawings, manuals and other data covering transportation, erection, installation, commissioning, operating, servicing, maintenance, repair, testing, inspection and any other essential procedures.
- Details of any condition monitoring requirements or finite life limitations that may apply.
- Details of any special use conditions, e.g. Maximum limiting wind speeds or earthquake zones in which the equipment may operate.

All data must be in the English language.

Inspection Certificates and Inspection Reports

Engineering Safety reminds controllers that under the draft PECPR Regulations they are required to keep

documentation establishing compliance with the regulations.

This will include for manufacture and any alteration of equipment, design verification certificates, copies of 'stamped' verified drawings, inspection and test certificates and commissioning inspection certificates and inspection reports.

This will include for in-service inspection of equipment, all inspection certificates and associated inspection reports and any other data relevant to the continued safe operation of the equipment.

Controllers must ensure that this data is kept in the place of work where the equipment is located. They must also ensure that it is readily accessible and made available to any person, including equipment inspectors, who may want to examine this data.

In the event that a controller wishes to change the inspection body providing inspection services for equipment then prospective inspection bodies must be given access to data relating to that equipment prior to entering into a contract for the supply of inspection services.

Controllers shall maintain this data for the life of the equipment or until such time as the equipment is sold or otherwise transferred to a new controller. Where equipment is sold or transferred, all the documentation noted above must be passed to the new controller.

Approved Code of Practice for Passenger Ropeways in New Zealand

All those involved with passenger ropeways in New Zealand will be interested to know that an approved code, setting out requirements for the design, manufacture, fabrication, safe operation, maintenance and servicing of passenger ropeways has been published by OSH.

The code has been prepared in consultation with interested industry parties. The Minister for Enterprise and Commerce has approved it as a statement of preferred work practices and a means of compliance with the OSH legislation under section 20 of the Health and Safety in Employment Act 1992. The code also supports the draft Pressure Equipment, Cranes and Passenger Ropeways Regulations under the Act. A court may pay regard to the approved code of practice in relation to compliance with the relevant sections of the Act itself.

The code replaces the 1991 edition of the New Zealand Mountain Safety Council's *Code of Practice for Passenger Ropeways in New Zealand*. It also takes into consideration applicable provisions of the Canadian passenger ropeways standards CAN/CSA-Z98M91 and Z98-96.

The code outlines a summary of the HSE Act 1992 and an application of the PECPR Regulations. It specifies general technical requirements, as well as additional requirements for the following categories of passenger ropeways:

- Chair lifts and gondola lifts;
- Surface ropeways of T-bar, platter and similar types;
- Surface ropeways (fibre rope) with and without intermediate supports; and
- Reversible aerial passenger ropeways.

The Approved Code of Practice for Passenger Ropeways in New Zealand is printed in loose-leaf format and supplied in an attractive ring binder. The price is \$25 (GST incl.) and your personal copy can be purchased by contacting:

Julie Watterson
Occupational Safety and Health Service
PO Box 3705
Wellington
Phone: 04 915 4317 Fax: 04 915 4640
E-mail: julie.watterson@osh.dol.govt.nz

which enables those involved in the transport and distribution of dangerous goods to comply with government safety, health and environmental protection legislation, transport regulations and best industry practice.”

Kelly says the new standard will include the classification of dangerous goods, labelling requirements, stowage and documentation and transport procedures. It will also provide a comprehensive listing of dangerous goods by UN number and alphabetically as well as listings of generic shipping names, common pesticides, self-reactive substances, organic peroxides and those goods too dangerous to be transported.

The revised standard provides a means of compliance with the Land Transport Rule: Dangerous Goods 1999.

It is expected that the standard will be available for sale from Standards New Zealand by 1 April 1999.

For further information contact:

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Fax: 04 498 5994
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or

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Revised Standard for the Transport of Dangerous Goods on Land

All those involved in the handling and transportation of dangerous goods will be interested to know that a revised standard, which sets out requirements for the safe transport of dangerous goods on land, will be released this year.

Standards New Zealand (SNZ) consultant John Kelly says the new standard is to replace NZS 5433: 1988 *Code of practice for the transportation of hazardous substances on land* to incorporate both international developments as well as changes in national legislation.

“The transport industry has a particular responsibility to ensure potentially hazardous operations do not threaten the safety and wellbeing of the community and our environment. This standard sets out a code of practice

Calibration of Inspection and Test Equipment

Engineering Safety reminds inspection bodies that there is a requirement for inspection and test equipment, used to make ‘critical measurements’, to be calibrated in a manner which will allow ‘traceability of measurement’.

‘Critical measurements’ are generally taken to mean those measurements that:

- Control a process where such control is necessary to ensure compliance; or
- Demonstrate a product or material complies with specification.

‘Traceability of measurement’ requires that a working instrument shall be calibrated against a reference instrument and the reference instrument shall be calibrated against a more accurate reference instrument and so on until the most accurate instrument or device in the chain is reached. This final link in the chain is

usually the national standard or measurement for the physical quantity concerned. Calibrations are said to be traceable when each link back to the national standard is documented and there is evidence as to who carried out each calibration, how it was carried out, what instruments or devices were utilised and what accuracies of measurement were achieved.

It will generally be impractical for an inspection body to carry out an audit of their calibration supplier in order to establish whether there is traceability of measurement. Instead they may rely on the fact that a supplier, which has been accredited by IANZ or, an overseas equivalent, will have satisfied the traceability criteria noted above.

Pressure Gauges Used for Testing

Engineering Safety advise that the management of pressure gauges used for testing should conform with the following requirements.

Equipment inspectors must ensure when using a pressure gauge to test equipment that the gauge has the appropriate range and resolution and has been:

- Calibrated by an organisation accredited by IANZ to provide such calibration services, or
- Checked against a similarly calibrated gauge held by the equipment inspector, or
- Calibrated within an equipment owner's quality management system.

This latter option of using a gauge calibrated within a controller's quality management system is acceptable only where:

- The gauge has a current calibration certificate.
- The calibration procedure is appropriate for the equipment to be tested.
- The calibration is traceable back to a national standard that is IANZ endorsed.

The inspector must get and retain appropriate evidence from the controller, showing that these requirements have been satisfied, otherwise the gauge must not be used for test purposes.

Overseas Inspection Body

Engineering Safety is pleased to advise readers that ETRS Pty Ltd, an Australian-based inspection body, has been recognised as an overseas inspection body.

They have been assessed by National Association of Testing Authorities, Australia (NATA) against

EN 45004 and have been accredited to this standard. ETRS have also been accredited to assess pressure equipment for conformity with the European 'Simple pressure vessels directive' in anticipation of the 'Mutual Recognition Agreement' between Australia and the European Community being concluded. ETRS are also certified to ISO 9001.

ETRS have offices in the major Australian cities and a number of regional locations.

Their authorised representative is Mr Richard Odgers; he can be contacted at:

ETRS Pty Ltd
PO Box 4002
West Footscray
Victoria 3012
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Phone: 0061 3 9689 6533 Fax: 0061 3 9689 6923

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