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Standards for Pressure and Heat

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European Directives and Standards for Pressure Equipment

EC Directives

There are currently six EC Directives which are specifically concerned with pressure equipment:

- 76/767/EEC - General Directive on Pressure Vessels
- 84/525/EEC – Seamless Steel Gas Cylinders Directive
- 84/526/EEC - Seamless Aluminium Alloy Gas Cylinders Directive
- 84/527/EEC – Welded Unalloyed Steel Gas Cylinders Directive
- 87/404/EEC – Simple Pressure Vessels Directive
- 97/23/EC - Pressure Equipment Directive

The first part of the Directive number indicates the year when the Directive was finally agreed by the Council of Ministers.

The Directive that is most relevant to heat transfer equipment is the Pressure Equipment Directive 97/23/EC.

Other Directives that may affect heat transfer equipment include:

- ATEX Directive 94/9/EC - Equipment and protective systems intended for use in potentially explosive atmospheres
- Machinery Directives 98/37/EC and 2006/42/EC (applicable from 29 December 2009)

Pressure Equipment Directive

The Pressure Equipment Directive, 97/23/EC (PED) is applicable to Pressure Equipment products placed on the market in any EU country, and applies just as much to equipment produced for the UK market as for products destined for use in other EU countries. It also applies to products imported from outside the EU.

The PED covers the design, manufacture and conformity assessment of pressure equipment and assemblies with a maximum allowable pressure greater than 0.5 barg.

The consolidated text of the PED, together with hyperlinks to the PED Guidelines, is available on the EC Europa website at:

http://ec.europa.eu/enterprise/pressure_equipment/ped/index_en.html

Information on European Approval of Materials (EAM), Particular Material Appraisal (PMA) and Notified Bodies (NoBos) is also available on this website.

There is a statutory requirement to review a Directive every seven years, and the PED is currently due for that review. There have been surveys, reviews and discussions, but a revision of the PED was not included in the Commission work plan for 2008. Further, as the Commission and European Parliament are due to change in 2009, the earliest that any PED review can now take place is 2010, but it is unlikely that anything will happen in the foreseeable future.

There was a proposal that the PED should be combined with the Simple Pressure Vessels Directive (SPVD) and possibly the Transportable Pressure Equipment Directive (TPED). The draft of the 'new' TPED no longer carries technical requirements (these will be moved to ADR/RID) and a full merge with the PED is no longer considered to be viable. Several of the older pressure sector Directives will be repealed and any relevant remnants of these will be integrated into the revised TPED.

The PED has major shortcomings in an operational sense. Pressure equipment is being imported from some of the emerging industrial nations in the fast east that is claimed to meet the ESRs, but is less than satisfactory by European standards, and is believed by some to be dangerous.

UK Regulations

The PED is implemented in the UK by the Pressure Equipment Regulations 1999 (SI 1999/2001), which became law in February 2000, and the Pressure Equipment (Amendment) Regulations 2002 (SI 2002/1267) which were published in 2002.

The Pressure Systems Safety Regulations 2000 (SI 2000/128) apply to pressure equipment not covered by the Pressure Equipment Regulations, and also to the use and ongoing integrity of pressure systems.

The Pressure Equipment Regulations and the Pressure Systems Safety Regulations may be viewed at www.opsi.gov.uk/stat.htm.

The DTI (now BERR) produced a free guidance booklet (URN 05/1074) for the UK Regulations, and this is available from the Department of Business Enterprise & Regulatory Reform (BERR) website at www.berr.gov.uk/files/file11284.pdf. Other documents, including the list of UK Notified Bodies, are also available from BERR.

CEN Standards

CEN is the European Committee for Standardization, and was founded in 1961 by the national standards bodies in the EEC and EFTA countries. CEN's National Members are the National Standards Organizations of 30 European countries - Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

To date CEN has produced over 13000 publications. The standards are developed by technical committees (TCs), with the work being divided between various working groups (WGs). In the pressure equipment sector the TC chair/secretariats are mainly from Britain, France and Germany, plus a few from Belgium, The Netherlands, Ireland and Italy. The WG conveners and members also include representatives from Austria, Denmark, Finland, Norway, Spain, Sweden and Switzerland.

The main TCs relating to pressure equipment are:

- CEN/TC 54 – Unfired pressure vessels
- CEN/TC 58 – Safety and control devices (gas)
- CEN/TC 69 – Valves
- CEN/TC 74 – Flanges
- CEN/TC 121 – Welding
- CEN/TC 138 – Non-destructive testing
- CEN/TC 267 – Industrial metallic piping
- CEN/TC 268 – Boilers

CEN does not sell standards. In the UK, English language implementations of CEN standards are published by BSI as BS EN standards. Many ISO standards are also approved by CEN as European Standards, and these are published in the UK by BSI as BS EN ISO standards.

There are several designations applied to CEN standards, including:

- harmonised standards
- product standards
- supporting standards
- material standards
- horizontal standards

The PED is what is termed a 'new approach' directive which prescribes Essential Safety Requirements (ESRs) which are intended to maintain existing safety levels within the European Community.

New approach Directives are backed up by harmonised European standards which contain the detailed requirements, and are developed in support of these Directives. The Commission of the European Community mandates the European Committee for Standardisation (CEN) or the European Committee for Electrotechnical Standardisation (CENELEC) to draw up the necessary European Standards.

Harmonised standards are cited in the Official Journal of the European Union (OJ), and contain an informative annex (usually ZA) which correlates the clauses of the standard to one or more of the ESRs in the Directive.

The use of a published harmonised standard in the design and manufacture of a product will give the presumption of conformity to those ESRs listed in Annex ZA of the particular harmonised standard.

Note: The term “harmonised standard” is sometimes applied to standards which have not been cited in the OJ, but only those standards which have been cited in the OJ give presumption of conformity.

Product standards are the main standards that specify the requirements for a particular type of pressure equipment, e.g. unfired pressure vessels or shell boilers.

Individual product standards are unlikely to be self-sufficient and will rely on other supporting and material standards to meet all the requirements of the Directive. These standards are candidates for harmonisation in their own right.

Supporting standards cover items such as flanges, valves and welding.

Note: Just to confuse things further, the term “supporting standards” is also used to describe standards which do not address at least one ESR of a Directive (e.g. the PED), and therefore should not be harmonised.

Material standards are a group of supporting standards that specify the requirements for materials used in pressure equipment.

Horizontal standards (e.g. mechanical testing of material) apply across many sectors and do not uniquely support the PED.

Therefore a manufacturer will have a package of harmonised standards to cover all the relevant essential requirements applicable to the product. About 240 European Standards provide presumption of conformity to the ESRs of the PED. A list of these harmonised standards is available on the europa website.

Note: Although the list is updated regularly, it may not be complete and it does not have any legal validity; only publication in the Official Journal of the European Union produces legal affect.

Conflicting National Standards

Under the CEN rules, when an EN standard is issued, CEN member organisations are required to withdraw any conflicting national standards.

Harmonised Product Standards

The main product standards for pressure equipment falling within the scope of the PED are:

- EN 12952:2001 Water-tube boilers and auxiliary installations
- EN 12953:2002 Shell boilers
- EN 13445:2002 Unfired pressure vessels
- EN 13458:2002 Cryogenic vessels - Static vacuum insulated vessels
- EN 13480:2002 Metallic industrial piping
- EN 14197:2003 Cryogenic vessels - Static non-vacuum insulated vessels
- EN 14222:2003 Stainless steel shell boilers
- EN 14276:2006 Pressure equipment for refrigerating systems and heat pumps

Harmonised Supporting Standards

Harmonised supporting standards as listed on the europa website include:

- EN 287:2004 Qualification test of welders - Fusion welding
- EN 593:2004 Industrial valves - Metallic butterfly valves
- EN 1092:2007 Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated
- EN 1349:2000 Industrial process control valves
- EN 1591-1:2001 Flanges and their joints - Design rules for gasketed circular flange connections
- EN 1759:2003 Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, Class designated
- EN 1983:2006 Industrial valves - Steel ball valves
- EN 1984:2000 Industrial valves - Steel gate valves
- EN ISO 4126:2004 Safety devices for protection against excessive pressure
- EN ISO 9606:2004 Qualification test of welders - Fusion welding
- EN 13133:2000 Brazing - Brazer approval
- EN 13134:2000 Brazing - Procedure approval
- EN 13648:2002 Cryogenic vessels - Safety devices for protection against excessive pressure
- EN 13709:2002 Industrial valves - Steel globe and globe stop and check valves
- EN 14341:2006 Industrial valves - Steel check valves
- EN ISO 15614:2004 Specification and qualification of welding procedures for metallic materials - Welding procedure test

Material Standards

- EN 1653:1997 Copper and copper alloys - Plate, sheet and circles for boilers, pressure vessels and hot water storage units
- EN 10028:2007 Flat products made of steels for pressure purposes
- EN 10213:2007 Steel castings for pressure purposes
- EN 10216:2002 Seamless steel tubes for pressure purposes - Technical delivery conditions
- EN 10217:2002 Welded steel tubes for pressure purposes - Technical delivery conditions
- EN 10222:1999 Steel forgings for pressure purposes
- EN 10253:2007 Butt-welding pipe fittings
- EN 10269:1999 Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties
- EN 12392:2000 Aluminium and aluminium alloys - Wrought products - Special requirements for products intended for the production of pressure equipment
- EN 12420:1999 Copper and copper alloys – Forgings
- EN 12451:1999 Copper and copper alloys - Seamless, round tubes for heat exchangers
- EN 12452:1999 Copper and copper alloys - Rolled, finned, seamless tubes for heat exchangers

Many BS material standards have been replaced by EN standards, although material to the old standards can still be purchased.

Note: There are no EN standards for nickel and nickel alloys, but there are 34 EAMs for nickel and nickel alloys.

Boiler and Pressure Vessel Standards

EN 12952:2001 Water-tube boilers and auxiliary installations - Parts 1 to 16 (Part 4 In-service life expectancy calculations is not a harmonised standard). Partially replaces BS 1113:1999.

EN 12952 is essentially complete with the first 6 parts covering the same scope as BS 1113, and the remaining 10 parts covering the other essential safety requirements as defined by the PED (e.g. safety accessories, etc.).

It is gradually getting used by the industry and certainly will be the standard for any new build coal or gas fired power plant in Europe.

BS 1113 is not formally withdrawn, but neither is it being maintained. It is only a matter of time before it is withdrawn.

EN 12953:2002 Shell boilers – Parts 1 to 12 (Parts 10 Requirements for feedwater and boiler water quality, and 11 Acceptance tests are not harmonised standards). Partially replaces BS 2790:1992.

The situation with EN 12953 and BS 2790 is much the same as that for EN 12952 and BS 1113.

A help desk website is available for users of EN 12952 and EN 12953:

http://www.boiler-helpdesk.din.de

EN 13445:2002 Unfired pressure vessels – Parts 1 to 6, and 8 (Part 7 is CR 13445-7 Guidance on the use of conformity procedures, and is not harmonised). Replaces BS 5500, which was withdrawn.

It was decided by BSI and the PVE committees that the British pressure vessel standard should continue to be published under the new reference PD 5500, with equal content, validity and application to the previous BS 5500, but without the status of a "national standard". There has been some pressure from the EU Commission for BSI to withdraw PD 5500, but there are areas that are not yet covered by EN 13445 so it is considered by BSI that PD 5500 is still needed.

Note: Most other European pressure vessel codes are not national standards (i.e. they are not published by the national standards body of the country in which they apply).

EN 13445 has not been widely used by industry for a number of reasons:

- The standard was not available when the PED first came into force in 1999 (PED not mandatory at this time).
- Use of EN 13445 is not mandatory in the PED.
- Manufacturers found that they could satisfy the essential safety requirements using familiar codes such as PD 5500, ASME VIII Div. 1, CODAP, AD 2000, etc. (see Note).
- The first edition of EN 13445 in 2002 was not sufficiently comprehensive for major purchasers of pressure equipment to adopt it as their preferred standard (e.g. no non-ferrous materials, no creep rules).
- Some of the testing requirements (e.g. impact testing and production weld test plates) were significantly more onerous than other codes.
- The standard is constantly being amended (currently issue 31).

Note: Codes such as PD 5500, ASME VIII Div. 1, CODAP and AD 2000 do not give presumption of conformity with the PED.

Numerous revisions to EN 13445 have been published since 2002 and some of the problems have been addressed. A new edition is due to be published in 2009, and it has been proposed that amendments will then be issued at specific intervals.

The standard is mainly used by manufacturers in Finland, Norway and the new EU member states from Eastern Europe.

A help desk website is available for users of EN 13445 to send technical queries:

http://www.unm.fr/en/general/en13445

ISO Pressure Vessel Standards

In the 1970s work was started on a draft international pressure vessel standard (ISO DIS 2694). This was not generally accepted and was abandoned in the mid 1970s. Some of the material was used in BS 5500.

ISO 16528:2007 - International Standard – Boilers and Pressure Vessels, Part 1: Performance Requirements, and Part 2: Procedures for Fulfilling the Requirements of ISO 16528 Part 1.

Part 1 defines the performance requirements for the construction of boilers and pressure vessels. Part 2 provides a procedure and a standard format for standard-issuing bodies to demonstrate that their standards fulfil the performance requirements of Part 1.

When available, the completed conformance tables will be published on the official website of ISO/TC 11, after the secretariat of ISO/TC 11 has reviewed the tables for completeness and comprehensibility.

Note: ISO 16528 has not yet been published as an EN ISO standard or a BS ISO standard.

ISO, EN the Oil Industry and Heat Transfer Equipment

Most ISO and EN standards are generic and cover a specific product or product group. There are also standards which are developed within the auspices of a specific industry, an example being those standards produced by the ISO Technical Committee 67 for the use of the Petroleum, Petrochemical and Natural Gas Industries. This committee works closely with its parallel CEN committee (CEN/TC12) so that its standards become both EN and ISO standards.

In the oil industry the market leader for developing standards was historically API. Through collaboration with the ISO and CEN organisations many of these have become identical co-branded standards i.e. the same technical content with either an API cover or an ISO EN cover – in the UK these are available as BS EN ISO.

In the heat transfer field we have now published:

- BS EN ISO 13704:2007 Calculation of heater tube thickness (API 530 sixth edition 2008)
- BS EN ISO 13705:2006 Fired Heaters for General Refinery Services (API 560 fourth edition 2007)
- BS EN ISO 13706:2005 Air Cooled Heat Exchangers (API 661 sixth edition 2006). Currently in revision with key target to update winterisation annex.
- BS EN ISO 15547-1:2005 Plate Type Heat Exchangers - Plate and Frame Heat Exchangers (API 662-1 second edition 2006)
- BS EN ISO 15547-2:2005 Plate Type Heat Exchangers - Brazed Aluminium Plate-Fin Heat Exchangers (API 662-2 first edition 2006)
- BS EN ISO 16812:2007 Shell and Tube Heat Exchangers (API 660 eighth edition 2007)

The following standards are in development:

- EN ISO 25457 Flares (revision of API 537)
- EN ISO 12211 Spiral Heat Exchangers (will be new API 664)
- EN ISO 12212 Hairpin Heat Exchangers (will be API 663)

An additional standard with a direct impact on heat exchanger design is:

- BS EN ISO 23251:2008 complete with amendment 1 Pressure-Relieving and Depressuring Systems (API 521 edition 5)

  This standard includes information on over-pressure protection to heat exchangers resulting from tube failure.