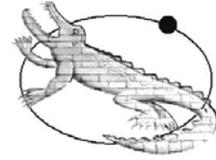


A Code of Practice for Pressure Equipment in the Department of Physics



Scope

This code of practice describes the management of equipment and systems operating above atmospheric pressure in the Department. It complements the code of practice giving advice on the use of compressed gases and cryogens.

Research Groups that only have equipment that has been installed by EMBS or Department Maintenance only need to familiarise themselves with sections 1.2, 2.1 and 3.5 so that they have an understanding of the system that ensures the safety of pressure systems. If they have equipment that they have installed themselves, then they should familiarise themselves with the whole document.

Research Groups that are likely to wish to **design, build and use** their own pressurised equipment should obtain a copy of the more extensive Code of Practice and consult the DSO at an early opportunity.

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Appendix A Form for Registration of a Pressure Vessel/System.

1 Introduction to Pressure Vessels and Pressure Systems

1.1 Technical Terms

CE Marking is mandatory within the European Community, and any new equipment should normally come with a CE mark, and be issued with a Declaration of Conformity. This should indicate that the system has been manufactured and tested in accordance with recognised standards. Many individual items which are not designed to stand-alone will not be CE marked, but should nevertheless be manufactured to a recognised standard and tested to meet a specification, and should be accompanied by a Declaration of Incorporation.

The following terms are defined in The Pressure Systems Safety Regulations 2000, SI 128 (which will be abbreviated to PSSR):

Protective devices – devices that are intended to protect the pressure system against system failure, including bursting discs and devices intended to give warning that system failure may occur. This includes items to prevent the safe operating limits of equipment being exceeded.

Safe operating limits are the operating limits, incorporating a suitable margin of error, beyond which system failure is liable to occur.

Written Scheme of examination – means a written scheme as defined by Regulation 8 of the PSSR (note: the written scheme can be electronic). This scheme will be drawn up by a competent person from the Insurance Company, it will define the checks that must be done, and the frequency of those checks. The examinations themselves will be carried out by a competent person from the Insurance Company.

Transportable pressure vessel is a cylinder, tube or cryogenic receptacle that is used for the storage or transport of a gas. Examples are gas cylinders and the Dewars used in many laboratories. The owner and the user are frequently different employers.

1.2 Definition of Pressure Systems

Pressure systems are defined as belonging to one of the following three arrangements:

A pressure vessel of rigid construction + associated pipework + protective devices, or

Pipework + protective devices + a transportable pressure vessel, or

Pipelines

(Note: since pipelines are specifically for the transport of fluids across the boundaries of the premises they are not discussed further in this document).

Transportable pressure vessels are not of themselves pressure systems, but become so when they are hooked up to other apparatus. They do, however, have to meet safety standards and they are subject to a scheme of examination.

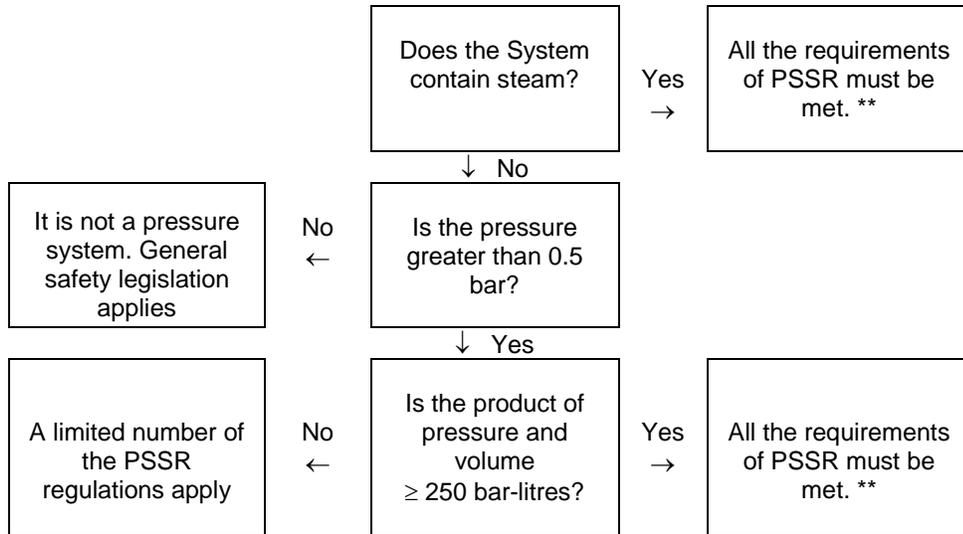
To qualify as a **pressure system** the equipment must contain either

- steam at any pressure, or
- a gas or mixture of gases at > 0.5 bar, or
- a liquid with a vapour pressure > 0.5 bar either at its actual temperature or at 17.5 °C, or
- a gas dissolved under pressure in a solvent contained on a porous substance which could be released without application of heat.

This means that the current document applies to systems containing gases, liquefied gases and steam, but does not apply to systems containing exclusively water or hydraulic fluids.

(Throughout this document pressures are quoted as gauge pressure that is, pressure above the atmosphere, so that 0.5 bar means 1.5 bar in absolute terms. The justification is that most pressure measuring equipment for increased pressures works on the basis that the atmosphere is the datum point.)

The flow chart below summarises in simplified form the thresholds that bring about regulatory requirements.



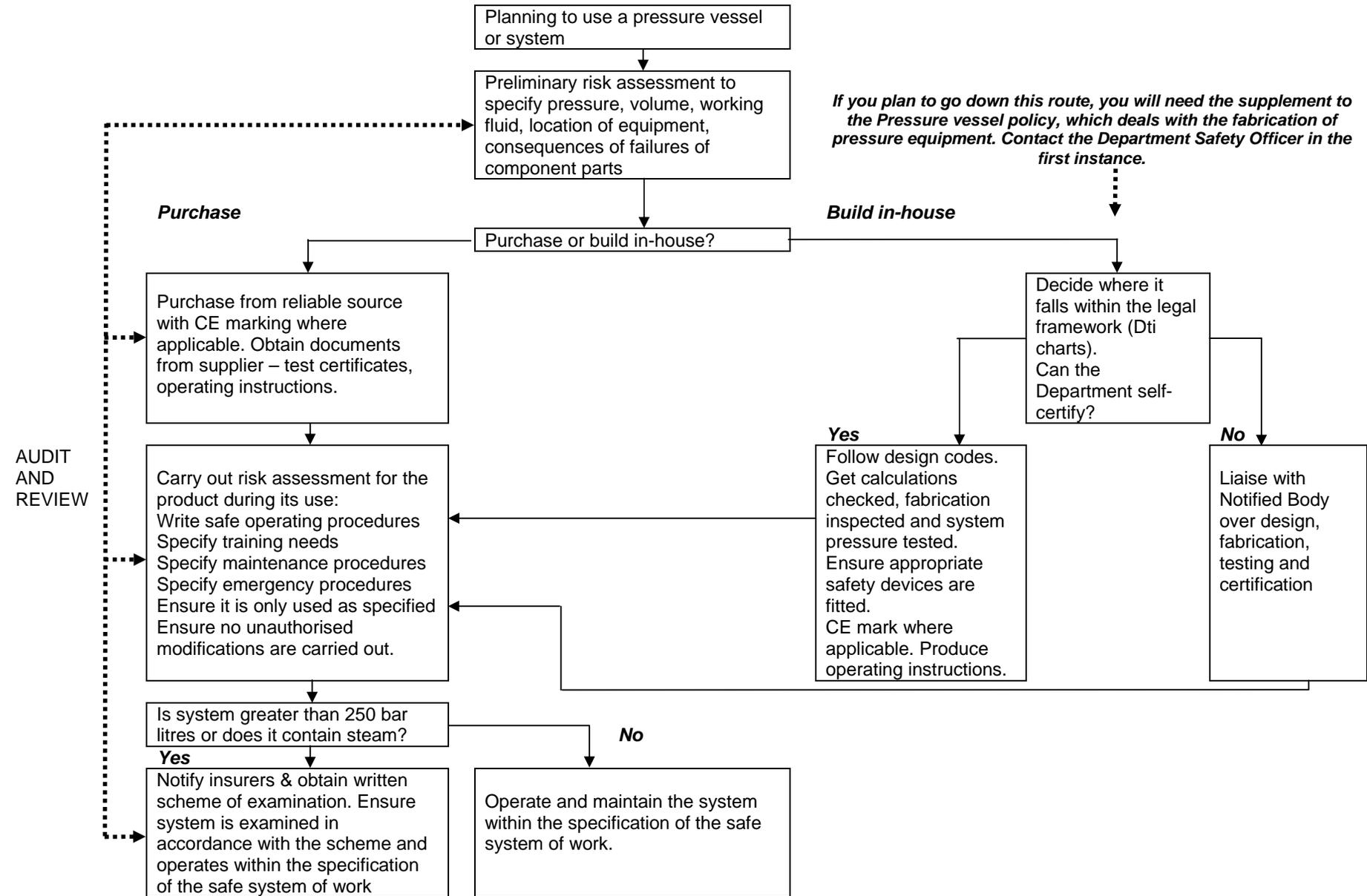
*** these items should all be on the register with the Insurance Company, if they are the property of the University.*

Thus, Department pressure systems are likely to fall into one of the following broad categories

- Above the 250 bar litre threshold, or containing steam: entered on the Insurance register and subject to Written Scheme of Examination.
- Below the 250 bar litre threshold: not named individually on the Insurance register, not subject to a written scheme of examination.
- Not belonging to the University, and therefore the responsibility of another employer.

Regardless of which category a system fits into, it is still our responsibility to conduct a risk assessment so as to define how to install it safely, use it safely and maintain it in safe condition.

The following chart summarises the processes that need to be followed. Note that there is a more detailed code of practice dealing with equipment built in-house.



2 Essential Legal Requirements

2.1 Management of the Pressure Systems that are Named on the Insurance Policy

The Department Safety Officer is responsible for:

- notifying the Insurers of changes to their holdings of pressure vessels,
- keeping the written schemes of examination safe,
- reviewing the Insurers reports, taking remedial action where required, or ensuring that action is taken by an appropriate person.

The legal responsibility for the equipment owned by the Department rests with the Department. Users of pressurised equipment, whether it is equipment on the insurers list or is a more minor system, must undertake risk assessment for the use for the equipment and devise safe operating procedures. They must take into account all the aspects described in section 2.2. Further advice on the use of pressure equipment is in section 4. The responsibility for the safe use of pressure equipment on a day-to-day basis rests with the line management of the user – e.g. research equipment would be the responsibility of the research supervisor.

When we hire a mobile piece of pressure equipment the legal responsibility for the equipment as regards its basic safety and integrity remain with the owner. For example, with few exceptions, transportable cylinders (e.g. gas cylinders) remain the property of the gas company. The integrity of a pressure vessel itself, including the execution of the requirements of the written scheme of examination therefore remain the legal responsibility of the owner and they do not go on our insurance policy.

However, where we **own** transportable cylinders and mobile equipment falling above the threshold we must ensure that they, too, are on the Insurance register and that they are examined according to a written scheme.

2.2 Essential Requirements of PSSR

The following is a summary of the key requirements. Subsequent sections give advice and guidance designed to meet these requirements.

- All parts of a pressure system must be properly designed and constructed
- The system must have protective devices to prevent danger
- The equipment must have sufficient written information to enable the user to meet the requirements of the regulations
- Any person who repairs or modifies a pressure system shall provide sufficient written information about the work to enable the regulations to be complied with.
- The pressure system shall be installed in a way that does not give rise to danger, and so that the operation of any protective device or inspection facility is not impaired.
- Systems shall not be used unless the safe operating limits have been established.
- Systems that contain steam at any pressure and other systems where the pressure-volume product is 250 bar litres or more, shall not be operated unless there is a written scheme of examination.
- The pressure system shall be examined in accordance with the written scheme of examination, at the intervals specified by it, by a competent person.
- Any person operating the system must be given adequate and suitable instructions for the safe operation of the system and the actions to take in an emergency. The system must be operated in accordance with the instructions provided.

- The system must be maintained so as to prevent danger. Any modifications or repairs must not give rise to danger or otherwise impair the operation of any protective device or inspection facility.
- Certain records must be kept.

3 Procedure for the Acquisition of Equipment

3.1 Procedures That Apply to all Equipment

To meet the requirements of section 1.2 and 2.1, the system must be assessed to decide whether it must go on the Insurers list – the simple flowchart in section 1.2 will help in this decision-making process.

It is essential to notify the DSO promptly of any equipment that falls within the full requirements of the PSSR, and a suggested form for this purpose is given in Appendix A.

The recipient of the equipment should check that relevant test certificates and instructions relating to the equipment are received. These need to be stored in a safe place. It is suggested that the users retain the instructions, but that the test certificates, or copies of them, are given to the DSO as a back-up.

3.2 New Equipment Sourced Within the EU

Pressure equipment sourced within the EU is subject to the Pressure Equipment Directive and must be manufactured to meet the essential safety requirements in the Directive.

The equipment should comply with one of the major pieces of legislation, such as the Pressure Equipment Regulations, or the equivalent legislation in the country of origin.

Since the stringency of the requirements for manufacture is subject to a sliding scale, different pieces of equipment will come with different markings and paperwork. Low risk equipment must be fabricated according to the principles of sound engineering practice, and must not be CE marked. Larger pieces of equipment must be CE marked and must then be supplied with a Declaration of Conformity, or, if they constitute only part of a pressurised assembly, such as a pressure release valve, must be supplied with a Declaration of Incorporation. The declaration will detail the standards to which they have been manufactured, and the way in which conformity has been assessed. These documents should be preserved. Contact the DSO if you are unsure about the level of documentation that you have been sent.

3.3 New Equipment Sourced from Outside the EU

Equipment that has come from outside the EU must be assessed for conformity to the requirements of EU legislation before it can be put into use in the Department, and CE marked if relevant.

It is strongly advised that the contract for supply is drawn up in such a way that the supplier or importer is required to do this. Failure to specify this is likely to lead to the Department having to assess the equipment, which could be both time-consuming and expensive. Advice should be sought from the Engineering Department/the Insurers.

3.4 Acquisition of second-hand equipment

The Regulations do not apply retrospectively to second-hand equipment. Thus, second hand equipment does not need to be CE marked. However, it must still be safe. Equipment that is transferred from one department to another must be accompanied by its documentation, and the insurance register must be adjusted accordingly.

3.5 Installation of Equipment into a User Department by EMBS

EMBS have a duty to inform the DSO when equipment is installed in the Department as a result of a project that they are managing.

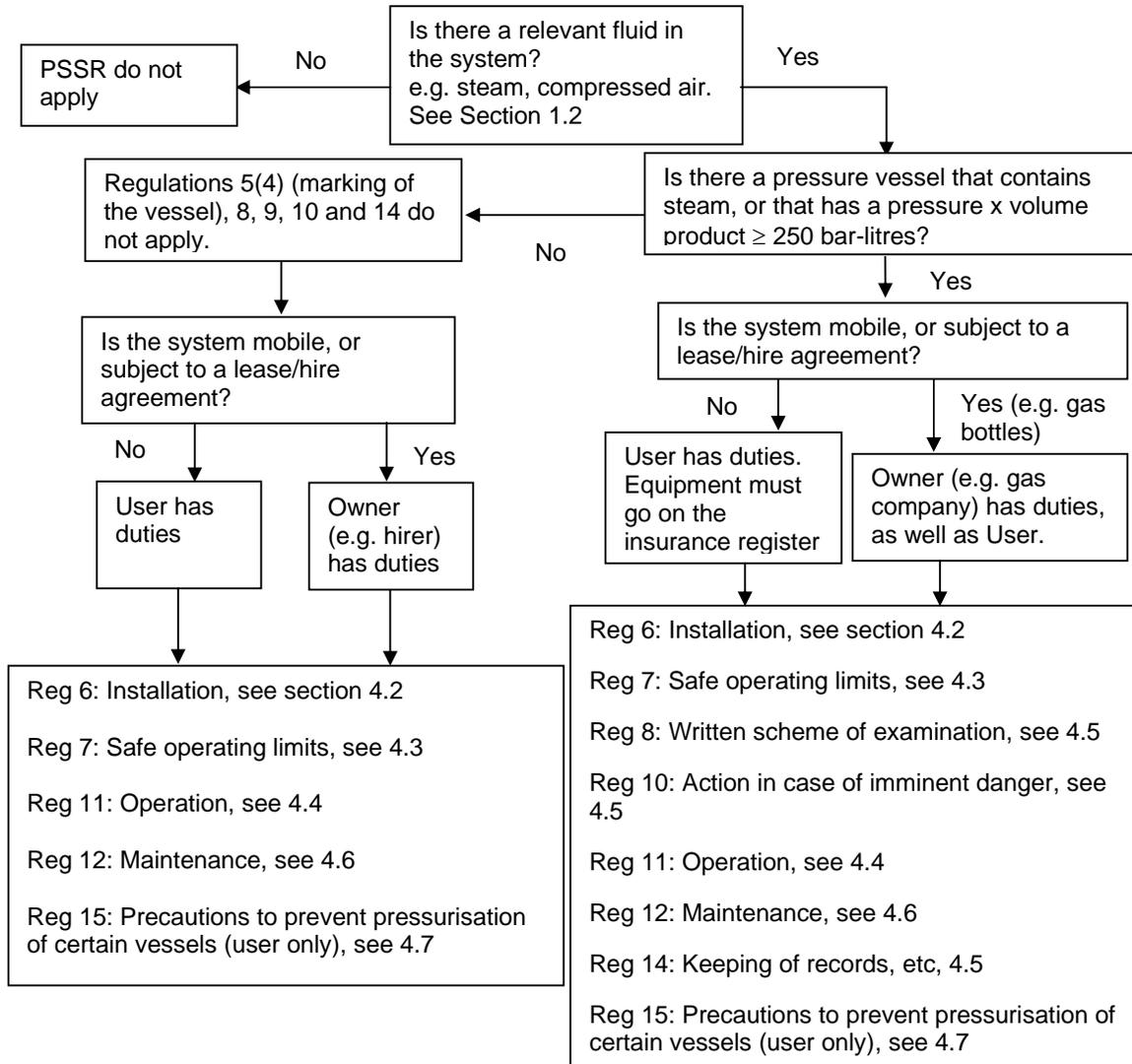
4 Using Pressure Systems

4.1 Risk Assessment

Risk assessments will be required at several points in the life of all pressure systems. These will include:

- Installation and commissioning
- Normal use
- Maintenance and repair, and eventually
- Decommissioning and scrapping (particularly relevant if the system has contained toxic substances).

Whether the Department is responsible for every element of the lifetime of the equipment depends on the status of the equipment. The decision chart below (adapted from the HSE guidance) shows the main distribution of responsibility and the requirements for the two major categories of pressure equipment. The Regulation numbers themselves refer to PSSR.



4.2 Installation

4.2.1 Vessels plus associated pipework and protective devices

It is important to install a pressure system in such a way that it does not give rise to danger. A risk assessment should be done, that should consider not only the risk inherent in physically transporting it onto the premises, but also the risks in its future use that may be reduced at this early stage. Important points would include:

- Preparation of a suitable area for the equipment, taking into account the loads
- How to handle and lift the equipment so as to avoid damaging its protective devices and pipework
- Checking for damage that may have arisen in transit
- Ensuring that the protective devices are clear of obstruction, that they operate properly, and that they discharge to a safe place.
- Ensuring that access doors/hatches are clear of obstruction and operate correctly
- Ensuring that labels and markings are clearly visible
- That there is adequate access for maintenance and examination.
- That the system is adequately protected against accidental damage (e.g. protection of pipes against damage from being climbed on).
- That there is adequate space around and beneath valves
- That the work is checked by a suitably qualified person.

In addition, compressed air systems should be arranged so that they are in a well ventilated, cool environment, that any air-cooled surfaces are located so that the air flow is unobstructed, and that inlet air is drawn from an area that is free from potentially flammable, corrosive contaminants, and excessive dust or moisture.

The system, if falling within the total scope of PSSR should be registered with the designated person in the Department, the DSO (see the chart in section 1.2).

4.2.2 Pipework plus protective devices plus transportable pressure vessel

In this instance the integrity of the pressure vessel is treated separately, because it is either the property of a third party, or is on our insurance register in its own right. However, it is important to design the apparatus that is to be connected to the cylinder in such a way that parts of it cannot become over-pressurised and themselves become dangerous. This may mean that pressure relief devices should be placed at strategic points in the apparatus, to limit the maximum pressure that can accumulate there.

Pressure regulators for gas cylinders should be inspected fully on a five-year cycle. The cost-effective way of doing this is often to enter into an exchange-reconditioning arrangement.

In apparatus where there is a possible source of ignition and the cylinder contains a fuel gas (e.g. hydrogen, LPG, acetylene, methane) some arrangement is required to prevent flame flashing back into the cylinder. A common solution to this problem is to fit flashback arrestors on the outlet of the regulator. These should also be replaced at an interval recommended by the manufacturer, or if this is not defined, on a five year cycle.

4.3 Safe Operating Limits

You must establish the safe operating limits of every pressure system. There is a legal responsibility for the supplier of a mobile system to provide written information specifying the safe operating limits and to ensure that these limits are durably marked on the system.

Second hand systems need to be thoroughly assessed to ensure that the safe operating limits have been established correctly.

The safe operating limits should be reviewed when undertaking the examinations under the written scheme (where applicable) and when significant repairs or modifications are carried out.

The information regarding the safe operating limits must be recorded and kept readily available to the users. This information should be made available to the person responsible for the examinations in

accordance with the written scheme, and it is also recommended that the documentation if made available to the person operating the system.

A system **MUST NOT** be operated outside its safe operating limits. If it is desired to extend the limits of a system, it **MUST** be re-assessed and re-tested so that its safe operating limits can be re-established.

4.4 Operation

The person operating the system must be provided with adequate and suitable instructions for the safe operation of the system and for the action to be taken in the event of any emergency.

The content might therefore include:

- Start-up and shut-down procedures.
- Precautions for standby operation
- Function and effect of controls and protective devices
- Likely fluctuations expected in normal operation
- The requirement to ensure that the system is adequately protected against over-pressure at all times.
- Emergency actions.

4.5 Written Schemes of Examination

Those items that contain steam or are at or above the 250 bar litre threshold **must** have written schemes of examination. A written scheme of examination specifies the periodic examination by a competent person of the following parts of the system:

- All protective devices
- Every pressure vessel and every pipeline in which a defect may give rise to danger
- Those parts of the pipework in which a defect may give rise to danger.

It is the responsibility of the user to ensure that such a scheme is drawn up. In very simple cases it may be possible for the Department to draw up a scheme, which must then be approved by the insurers. However, in the majority of cases the Department will request the Insurers to draw up the scheme. Filling in the form described in section 3.1, and given in Appendix A will trigger the process of getting the equipment on the insurance register and the production of the written scheme of examination. The competent person who will carry out the examinations specified by the scheme will almost always be an engineer sent by the Insurer.

The scheme will include the following:

- Those parts of the system that are to be examined
- Identification of the item of plant or equipment
- The nature of the examination required, including the inspection and testing to be carried out on any protective devices
- The preparatory work necessary to enable the item to be examined safely,
- What examination is necessary before the system is first used, where appropriate
- The maximum interval between examinations
- The critical parts of the system which, if modified or repaired, should be examined by a competent person before it is used again.
- The name of the competent person certifying the scheme
- The date of the certification.

It is the responsibility of the user to ensure that examinations are carried out according to the scheme – individuals should liaise with the DSO.

If the competent person carrying out the examination is of the opinion that the pressure system will give rise to imminent danger unless certain repairs or modifications are carried out they are obliged by law to immediately make a written report to both the user (or owner if a mobile system) and the HSE. The system must be taken out of service forthwith until the specified remedial work has been carried out.

The reports of the competent person in accordance with the written scheme of examination must be retained in any event until replaced by a subsequent report. If the report contains information which will materially assist in assessing whether the system is safe to operate it any repairs to the system can be carried out safely it should be retained.

4.6 Maintenance, Modification and Repair

All systems shall be properly maintained in good repair, so as to prevent danger. The maintenance programme should take account of:

- The age of the system
- The operating/process conditions
- The working environment
- The manufacturer's or supplier's instructions
- Any previous maintenance history
- Reports of examinations carried out under the written scheme of examination (for equipment to which this applies)
- Results of other relevant inspections
- Repairs and modifications to the system and
- The risks to health and safety from failure or deterioration.

When carrying out repairs or modifications, it is essential to ensure that nothing about the way in which this work is done gives rise to danger or otherwise impairs the operation of any protective device or inspection facility.

4.7 Precautions to Prevent Pressurisation of Certain Vessels

Some vessels have a permanent outlet to the atmosphere e.g. a steam vent or vent from a chemical reaction vessel. If blockage of this vent could cause the vessel to become a pressure vessel, the user must ensure that the vent is kept open and free from obstruction at all times when the vessel is in use.

5 References

The Pressure Systems Safety Regulations, 2000, SI 128,

<http://www.opsi.gov.uk/si/si2000/20000128.htm>

Approved Code of Practice and Guidance: L122, HSE Books, ISBN 0 7176 1767 X

The Pressure Equipment Regulations, 1999, SI 2001,

<http://www.opsi.gov.uk/si/si1999/19992001.htm>

6 Contacts for Further Information and Assistance

Engineering Advice:

Dr P Long, Department of Engineering

Advice on Pressure Systems Legislation and CE Marking:

Dr F J Blunt, Department of Physics

Pressure Vessel/System Registration Form

This form is to be filled in whenever a **pressure system** containing a vessel of rigid construction is installed or an existing system is relocated. Its purpose is to register the equipment with the Insurers, and to ensure that a written scheme of examination is prepared for it before it is put into service.

Items which should go on the form

This form should be filled in:

- If the system contains steam, regardless of pressure or volume of the system.
- For all other gases or vapours (including liquid nitrogen, helium, air, carbon dioxide, etc) if the pressure is greater than or equal to 0.5 bar above atmospheric and the product of pressure (in bar) and volume (in litres) is greater than 250 bar litres.

If the product is less than 250 bar litres it is not necessary to have the system named on the Insurance policy and it is not necessary to use this form. Normal risk assessment procedures, which specify safe systems of work, will still apply.

Exceptions:

Do not fill this form in for items that are on lease or hire to the University, e.g. almost all gas bottles.

Name of person who had the equipment installed (originator)		Date	
Contact details of originator (e.g. room number, telephone number, e-mail address)			
Building in which the equipment is situated.			
Exact location of vessel/system (if it is mobile, record here a location where it might be found).			
Type of system (e.g. autoclave, pressurised coffee machine, compressor)			
Manufacturer		Is this equipment new or second-hand?	
Serial number/ID of vessel/system			
What is the working fluid? (e.g. air, nitrogen, carbon dioxide, steam, helium).			
Volume of main reservoir (in litres)		Rated Pressure (bar)	
Name of the person who will receive the written scheme of examination and the reports (e.g. DSO)		Jane Blunt	
Department to which this person belongs		Physics	

Originator: Please copy this form and pass the original to the DSO. Please retain any documents that came with the pressure system, e.g. test certificates, CE declarations of conformity, working instructions.

Designated person: Copy this form and send the copy to the Pressure Vessel database controller, Health and Safety Division.