

**LEAFLET 42****PROTECTION OF PERSONS USING COMPRESSED AIR - RPE****CONTENTS****Para**

- LEAFLET FOR LINE MANAGERS**
- 1 Regulations and standards
- Duties
- 3 Line managers
- 7 Persons or organisations undertaking compressed breathing air maintenance and testing
- 8 Persons using compressed air RPE
- 9 Records
- 12 Guidance
- 13 Related leaflets

**Annex**

- A Guidance for Line Managers

**LEAFLET FOR LINE MANAGERS****REGULATIONS AND STANDARDS**

1 The protection of persons using compressed air RPE is achieved by following the requirement of a number British Standards and will be necessary to achieve compliance with control measures needed as a result of assessments under the following regulations.

- 1.1 The Control of Substances Hazardous to Health Regulations (COSHH).
- 1.2 The Confined Spaces Regulations (CSR).
- 1.3 The Control of Lead at work Regulations (CLAW).
- 1.4 The Control of Asbestos at Work Regulations (CAW).
- 2 The Standards used to ensure the air quality are:
  - 2.1 BS 4275, BS 6244, BS 6060,
  - 2.2 BS EN ISO-2398,
  - 2.3 BS EN 132 - 1994

**DUTIES****Line Managers**

3 Line Managers must carry out a suitable and sufficient documented Risk Assessment whenever it is necessary to use RPE. The Risk Assessment must be undertaken before the operation requiring RPE is undertaken. Such assessments are normally associated with operations that will involve exposure to:

- 3.1 Exposures to a harmful substance that exceed the appropriate Occupational Exposure Limit (See Leaflet - Substances Hazardous to Health);

- 3.2 Work requires staff to enter areas of high contamination levels or oxygen deficient atmosphere;
- 4 Line Managers shall ensure that suitable (for the task and the use of the operator) air fed RPE is provided to protect against the recognised hazard. The hazards may be
- 4.1 Dust, fibres, mists, fumes, micro organisms;
  - 4.2 Gases and vapours.
  - 4.3 Oxygen deficiency.
- 5 Line Managers must ensure that suitable and sufficient training in the use and maintenance of the RPE is supplied to everyone involved in a RPE programme.
- 6 Line Managers shall ensure that where compressed air fed RPE is used the air quality being supplied to the RPE is maintained at the required quality. This may be achieved by
- 6.1 Locally organised inspections and tests.
  - 6.2 Inspections and test carried out as a result of site facilities maintenance.
  - 6.3 Inspections and test carried out by external authorities.

#### **Persons or organisations undertaking compressed breathing air maintenance and testing**

- 7 The inspection and test results on compressed breathing air quality must be made available to the line managers with staff using the compressed breathing air.

#### **Persons using compressed air RPE**

- 8 Must undertake the training necessary to correctly use the RPE and carry out inspections (pre use checks) of its suitability for continued use. They must report any defects immediately to their line managers.

#### **RECORDS**

- 9 Records of training supplied to users of Compressed air RPE should be kept on the personnel files of the individuals.
- 10 Records of the air quality tests should be kept with the Assessment, and should contain identification of equipment, results of tests, date of examination and means of identifying the person who carried it out.
- 11 Inspection records for every compressed breathing air RPE, shall be maintained until the item is replaced.

#### **GUIDANCE**

- 12 Guidance on the maintenance of air quality for compressed air is given in Annex A to this leaflet.

#### **RELATED LEAFLETS**

- 13 Related Leaflets
- Leaflet - Substances Hazardous to Health
  - Leaflet - Health and Safety Risk Assessment
  - Leaflet - Respiratory Protective Equipment
  - Leaflet - Management of Personal Protective Equipment

**LEAFLET 42 ANNEX A****PROTECTION OF PERSONS USING COMPRESSED AIR - RPE****CONTENTS****Para****GUIDANCE FOR LINE MANAGERS**

- 1 Introduction
- 3 Air quality
- 5 Compressor specification
- 10 Air supply system
- 25 Filtration - oil and particulate filters
- 32 Filtration - gases and vapours
- 36 Sampling and analysis
- 38 Examination and testing
- 41 Noise
- 42 General
- 46 Useful references

**GUIDANCE FOR LINE MANAGERS****INTRODUCTION**

1 Compressed air is widely used within MOD for airline breathing apparatus. Departments have a duty to ensure that all equipment provided is properly used and maintained and that systems of work are safe and without undue risks to health. This chapter relates to compressed airline systems, but not to self-contained breathing apparatus or equipment used for diving or fire purposes.

2 Managers of compressed air systems for breathing purposes are to be aware of the following requirements and take steps to ensure that they are met:

- 2.1 Air quality;
- 2.2 Compressor specification;
- 2.3 Air supply system specification;
- 2.4 Filtration requirements; and
- 2.5 Sampling and analysis requirements.

**AIR QUALITY**

3 The quality of air supplied for breathing purposes is to comply with the requirements of section 5.6.3 of British Standard BS 4275 (Recommendations for the selection, use and maintenance of respiratory protective equipment). The quality standard states that air being supplied to the wearer should not contain impurities in excess of the following limits:

- 3.1 Carbon monoxide (CO): 5 parts per million (ppm);
- 3.2 Carbon dioxide (CO<sub>2</sub>): 500 ppm;
- 3.3 Oil mist: at or below 0.5 milligrams per cubic metre (mg/m<sup>3</sup>);

3.4 In addition, paragraph A2 of Annex A to BS 6927 1988 states that the mineral oil content shall be such that the air is without odour of oil. (Odour thresholds vary. In some cases the odour threshold will be well below 0.5 mg/m<sup>3</sup> and may typically be around 0.3 mg/m<sup>3</sup>);

3.5 The air shall also be as free as reasonably practicable from all odour and contamination by dust, dirt, metallic particles and fibres and should not contain any other toxic or irritating ingredients; and

3.6 There should be no free water in the air supply. In addition, para A2 of Annex A to BS 6927 states that the air should have a dewpoint sufficiently low to prevent internal freezing.

4 Where a potential contaminant is not listed in BS 4275, the concentration of the substance in the air supplied to the wearer should be as low as is reasonably practicable. Where Occupational Exposure Limits are published by the HSE, the level should be not greater than one tenth of the lowest exposure limit for that substance published in the current edition of Guidance Note EH40.

### **COMPRESSOR SPECIFICATION**

5 Air intakes are to be sited where the air is free from any noxious emissions from plant, compressor or vehicle exhausts and protected from the ingress of dust, rain, snow etc.

6 The compressed air entering the supply system should be at a comfortable working temperature. It may be necessary in some situations to fit aftercoolers to the compressor to achieve this. The equipment operating temperature should not exceed the manufacturer's safe operating limits. If this cannot be guaranteed the installation of a high air temperature alarm warning device and automatic shutdown control should be considered. It is strongly recommended that the devices described above are fitted in all new systems unless it can be shown they are unnecessary.

7 Compressors and in particular the exhaust valves should be well maintained and not allowed to overheat. Dangerous amounts of carbon monoxide and other gaseous products are readily produced if compressor lubricating oils become overheated.

8 Whenever practicable the use of oil-free compressors are recommended. This is likely to be the chosen option whenever a separate breathing air service is provided which is dedicated to that use only. Where this is the case all take-off points should be clearly marked with a notice saying "breathing air only" and the take-off points should be of a different fitting design to those used for non-breathing purposes.

9 Where life-support applications are concerned and in any other situation where failure of the air supply could result in an immediate risk to health and safety, a low pressure warning alarm should be installed set to avoid false alarms due to minor pressure variations, but giving adequate warning of any impending failure of the air supply. Means of safe escape or a stand-by compressor should be immediately available.

### **AIR SUPPLY SYSTEM**

10 When breathing apparatus is being worn for working in an enclosed space where the atmosphere is suspect or is known to be unsafe, two separate air supplies should be available to the wearer in case of a failure in one, except only where the urgency of rescue operations dictates otherwise. The practice of 2 or more persons wearing airline-breathing apparatus all being connected to a single air supply is not permitted.

- 11 Systems are to include reservoirs of sufficient volume to prevent sudden pressure loss and to provide emergency supply for persons using breathing apparatus to reach a safe location. In calculating the required reservoir capacity the consumption of breathing air is to be taken into account. As a guide it may be assumed that each breathing mask user will require an absolute minimum of 120 litres of air per minute free air. Reservoir inlets should be fitted with a valve, which automatically shuts if the supply pressure continues to fall after the low-pressure alarm is triggered. Note some commercially available non-return valves may not provide sufficient protection. Reservoirs are to include safety valves and gauges to conform with BS 6244.
- 12 Fixed lines are to include drip leg drains and should be designed to avoid unnecessary traps.
- 13 Breathing air systems are to have exclusive use of their own supply lines, separate from tool supply lines, whenever there is substantial demand for air to personal protective equipment.
- 14 Where quick release couplings are used their design is to be such that the air supply is not restricted when internal components become worn with use.
- 15 When disconnected, plugs are to be fitted with protection caps to prevent entry of contaminants or damage.
- 16 Couplings are to be designed not to disconnect or shut off the air supply during normal use (e.g. when dragged along the ground).
- 17 Hoses are to be of sufficient bore to maintain the required line flow rate and should be constructed to the specification in BS 5118 for rubber hoses and BS 6066 for thermoplastic hoses.
- 18 The system is to be designed so that even under maximum demand the required volume of air will be provided to each user.
- 19 Where spray guns are supplied from a breathing air main the take-off for the spray application is to be located before the final breathing air filters and the spray branch is to have its own filter system within the branch.
- 20 The pressure of air admitted to the personal protective equipment is to be compatible with the equipment's requirements and within the safe working pressure for the lines.
- 21 Delivery of stale air from pipelines is to be avoided by the use of ring circuits or controlled bleed-offs, or both.
- 22 All parts of the system after and including the final filter are to be made from non-corrodible materials in order to maintain the required standard of air quality.
- 23 Where general works air supply systems are used for provision of breathing air and in particular where any chemical or effluent plant is involved, effective engineering measures are to be taken to prevent contamination of the breathing air arising from back pressure in the process system. It is also necessary to ensure that an adequate supply of air is available to the breathing lines under all plant conditions.
- 24 All connection points are to be clearly marked BREATHING AIR and individually identifiable in order to avoid the risk of a user disconnecting another user's supply.

#### **FILTRATION - OIL AND PARTICULATE FILTERS**

- 25 No compressed air system is to be used for breathing air unless filters are installed for the effective removal of oil mists (except where oil-free compressors are used) and particulate.

26 For best results filters should be installed to operate at normal mains pressure (normally 600-700 kPa, i.e. approximately 90-100 psig) and where the compressed air is at ambient temperature. However, filters may be damaged by sudden changes in pressure. Portable filter units are particularly vulnerable when connected to, or disconnected from a pressurised system by means of quick release connectors. Control valves should be used to apply system pressure gradually to the filters connection and to isolate the filters before removal.

27 Air supply rates between 120 and 300 litres/man/minute are to be used as the basis for design calculation for filters. If doubt exists on the supply rate to be used advice is to be taken from MOD occupational health services.

28 Filters are to be sized according to the maximum design air flow to avoid serious loss of filtration efficiency under high flow conditions.

29 In multiple user systems the use of individual filter units for each person is preferred. This has the advantage of enabling individuals to monitor the condition of their own filter and to ensure correct maintenance. There are also engineering advantages of such a layout.

30 Oil removal filters are to be preceded by particle and water removal filters in all cases. This prevents excessive particle blockage and prolongs the life of the filters.

31 Filter efficiency and life is largely governed by the quantity of oil or other contaminant presented to the filter. No general rules can be adopted about the efficiency required except to state that filters with an efficiency of less than 99.9% should normally be regarded as inadequate due to the eventual build-up of oil in downstream pipelines.

#### **FILTRATION - GASES AND VAPOURS**

32 The removal of gases and vapours from compressed air supplies is more difficult than the removal of oil and particulate. Correct siting of air intakes and maintenance of equipment are the main factors in preventing contamination of the air supply. It is also important to select materials of construction, which are not likely to outgas or give rise to odour problems in the system.

33 Odours and low concentrations of organic vapours (e.g. hydrocarbons) are to be removed by the use of activated charcoal filter cartridges. It is important however that such cartridges are properly designed, constructed and packed to avoid preferential pathway channelling of air through the packing material.

34 Systems which may produce carbon monoxide are to incorporate appropriate catalytic air purifiers. Measures are to be taken to ensure that carbon monoxide from external sources cannot enter a breathing air system. Particular care is required with small portable compressors to ensure that exhaust gases are not drawn into the air intake.

35 Filters are to be replaced at regular intervals according to the recommendations of the manufacture and the conditions under which the equipment is used. To prevent saturation or poisoning, a regular routine for filter replacement is to be followed. Where doubt exists occupational health services should be consulted for advice.

#### **SAMPLING AND ANALYSIS**

36 In order to ensure that the air supplied to users complies with the quality standard described in para 3 it is necessary for periodical samples of air to be collected and analysed. The air which is to be sampled is to be representative of that which will be breathed. Before collection of the samples commences, sufficient air must be allowed to flow through the system to purge it of stagnant air, to allow the air from the supply system to be carried through to the sampling position. Where long air supply lines are involved purging may take a considerable time.

37 A number of sampling and analytical methods may be used for testing breathing air. The standards for contaminants in breathing air are set usually at one tenth of the long term exposure limit (LTEL). These limits are expressed as a gravimetric or volume concentration in air, time averaged over 8 hours and are published by the HSE in Guidance Note EH-40 Occupational Exposure Limits. This is the maximum acceptable level and the aim should be to eliminate or minimise all contaminants. Methods which are suitable for examination of breathing air quality are published in Technical Guide No 6 published by the British Occupational Hygiene Society. Advice on the use of proprietary testing kits which may be used can be obtained from occupational health services.

## **EXAMINATION AND TESTING**

38 User units and establishments are to carry out a thorough examination of the equipment and test the quality and volume flow rate of the air on a routine basis using approved methods and operated by selected personnel who have received sufficient instruction and training to be competent in the task. It is recommended by the Control of Substances Hazardous to Health Regulations Approved Code of Practice that the volume flow and quality of the supplied air for airline-fed respiratory protective equipment should be tested at least once every month. The testing period should be appropriate to the circumstances. It is likely for example that an airline in continuous service using an oil lubricated compressor may require testing weekly, whereas an oil free compressor may only require a monthly test. Where an airline is used intermittently with a week or more between operations then testing should be carried out on start-up and then at monthly intervals providing the airline continues to be used unless the compressor circumstances require more frequent testing.

39 Where the air supply is from mobile compressors, the volume flow and air quality is to be tested prior to its first use in any new location and subsequently at least monthly.

40 Records of the personnel involved, the training they have received, the method of test used and the results of all testing are to be kept. For airline breathing apparatus, the record of each thorough examination and test carried out should include:

- 40.1 Name and address of manager responsible for the respiratory protective equipment;
- 40.2 Particulars of the equipment and of the distinguishing number or mark, together with a description sufficient to identify the individual item;
- 40.3 Date of examination and name and signature or unique authentication of person carrying out the Examination and test;
- 40.4 Condition of the equipment, including airlines and valves and any defects found;
- 40.5 The volume flowrate of the air supply to the equipment; and
- 40.6 The results of the air quality testing to ensure compliance with the standards given in para 3.

## **NOISE**

41 The use of some types of compressed air breathing apparatus and air-fed helmets may be associated with a potential risk of harmful noise exposure to the wearer. Managers of such equipment are to ensure that exposures are assessed and controlled as necessary. Advice should be obtained from occupational H&S services in cases of doubt.

## **GENERAL**

42 Wherever possible, manufacturers should be asked to confirm that the items of equipment are suitable for the production of compressed air for breathing purposes.

43 All units and establishments using airline breathing apparatus are to adhere to regular laid down maintenance schedules for compressors, distribution and filtration systems and respiratory protective equipment. Full records are to be maintained.

44 All users of compressed air systems used for breathing purposes are to prepare and adhere to documented operating procedures specific to the local installation, which are to include starting up procedures, connections to the system, routine checks prior to use, flushing out stagnant air, etc. Personnel who use the system are to be given with sufficient information, instruction and training to be able to use the system safely and effectively.

45 Heads of Establishments and Commanding Officers may contact the following departmental authorities for further advice:

- 45.1 RN: - Principal Medical Officers for Naval Bases and Naval Medical Officers of Health for ships, units and establishments;
- 45.2 Army: - Environmental Health Teams, RAMC;
- 45.3 RAF: - Command Engineering Officers; and
- 45.4 DPA: - SSO(PE) .

## USEFUL REFERENCES

### 46 Useful References

- BS 4275 Recommendations for the selection, use and maintenance of respiratory protective equipment
- HSE guidance note EH40 Occupational Exposure Limits issued annually
- Guide to the selection and installation of compressed air services (British Compressed Air Society, London WC2H 7BN)
- BS 6244 Code of practice for stationary air compressors
- BS 6066 Specification for thermoplastic hoses for compressed air
- BS 5118 Specification for rubber hoses for compressed air
- Sampling and analysis of compressed air to be used for breathing purposes (British Occupational Hygiene Society Technical Guide No 6, 1985)
- DRAGER Detector Tube Handbook latest edition
- GASTEC Precision Gas Detector System Blue Book
- BS 6927 British Standard Glossary of terms for respiratory protective devices
- The Control of Substances Hazardous to Health Regulations 1999, Approved Code of Practice
- Department of Transport, Marine Division, Code of Safe Working Practices for Merchant Seamen, HMSO.