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CODE OF PRACTICE FOR HEALTH PRECAUTIONS

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INTRODUCTION

Cancer is something which induces apprehension in most of us and more and more its causes are seen to be connected with the way we live, (smoking, for example) and the way we work. Industrial conditions have for long been known to cause cancer in some workers - for instance, mule spinners. Diagnosis both of the disease and its causes has become increasingly precise and more and more materials used in industry have come under suspicion as possible causative agents of cancer.

It is now known that exposure to high levels of vinyl chloride vapour can be associated with a rare cancer of the liver (in medical terms, angio sarcoma). This does not mean that vinyl chloride vapour is any more dangerous now than it was in the past; it simply means that we now know of a previously unsuspected danger and can therefore take steps to make conditions safer.

We first became aware of this new risk in January 1974 when information was brought to my attention that three cases of angio sarcoma had been identified at one USA factory where the process involved the polymerization of vinyl chloride monomer. The employees concerned had worked on the cleaning of autoclaves where they were probably exposed to very high levels of vinyl chloride vapour.

This information was immediately communicated to HM Inspectors of Factories and Employment Medical Advisers throughout the country, and industry on its own initiative set out to ensure that no person would be exposed to amounts of vinyl chloride vapour that were above a concentration of 50 parts per million.

When the Industrial Hygiene Unit of HM Factory Inspectorate visited the six plants in Great Britain engaged on the synthesising and polymerising of vinyl chloride monomer, the monitoring that they carried out showed that good progress was being made in reducing levels of exposure to vinyl chloride vapour. Also greater attention was being paid to the use of respirators, and high pressure cleaning equipment was being installed to reduce the time spent inside autoclaves to clean the inner surfaces.

Although rapid progress was made it was desirable that detailed standard

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be laid down in a Code of Practice. The TUC and the CBI accepted an invitation to form a Joint Working Group with HM Factory Inspectorate and the Employment Medical Advisory Service. As Chief Inspector of Factories, I chaired the first meeting of this Working Group on 14 June 1974; at that meeting the interim hygiene standard given in Appendix 1 of the Code was adopted and two sub-groups were set up to draft the environmental and the medical sections of the Code. These sections were considered by a meeting of the Working Group on 23 December 1974 when the drafts were approved subject to certain amendments. These drafts have now been combined to form the Code as now published.

In essence the Code sets out to:

- (a) define an interim hygiene standard that must not be exceeded;
- (b) require regular monitoring to measure the concentrations of vinyl chloride in the atmosphere;
- (c) outline methods of achieving (a);
- (d) provide for medical supervision;
- (e) provide for joint consultation and education and training.

It is important to note that although the interim hygiene standard has a ceiling value of 50 parts per million, that must not be exceeded; the average exposure over the whole shift must not exceed 25 parts per million. These are the outside limits and it is further asked that exposures should be brought as near as practicable to zero. This standard, which is to be kept under review by the Working Group, therefore encourages progressive reductions of exposure to the lowest possible levels given present engineering knowledge.

Another very important part of the Code is the requirement to monitor for vinyl chloride vapour during each shift in those areas where it is possible that, if controls are malfunctioning, there could be concentrations above the hygiene standard. In fact with the type of sophisticated monitoring equipment now being installed it will be possible to measure concentrations every few minutes. These monitoring results must be posted up within 2 hours of the end of a shift.

They have to be kept in position for at least 48 hours, so that all employees can see the results that are being obtained. Any result above the hygiene standard must be investigated and a report made.

It is always disconcerting to find that a familiar and useful material involves a previously unsuspected health hazard. It had been known for many years that vinyl chloride vapour involved a fire and explosion risk requiring certain controls, but the controls now needed, because of the health risk, are markedly more stringent than any previously required. Hence the need for this detailed Code.

The Code as now published is based on our existing knowledge and will be improved where additional information shows this to be necessary. Our detailed enquiries have so far only located one definite and one probable case of angio sarcoma in Great Britain that can positively be linked with the industries covered by this Code; the total number of cases in the world that can be linked with vinyl chloride vapour is thought to be about 25. Further epidemiological studies are being carried out and additional cases associated with the high levels of exposure in the past may be discovered. We are also endeavouring to check by means of a specific epidemiological study whether any cases can possibly be associated with low levels of exposure.

I have concentrated on the cancer risk associated with vinyl chloride because this risk has the more serious consequences to workers, but the Code is also designed to protect workers from the lesser risks described in paragraph 1 of the Code.

The success of the Code depends primarily on the united efforts of management, supervisors and employees. This is very much a first edition of the Code in temporary format; I hope that those who have suggestions for improving it will put them forward via the joint consultative machinery required by the Code. Such suggestions will be of considerable value to the Health and Safety Executive when the time comes to make any necessary revisions.

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- 1 Information available at present suggests that the health hazards of uncontrolled exposure to vinyl chloride vapour are:
- a. liver damage particularly angio sarcoma of the liver (a rare tumour);
 - b. acro osteolysis (a deterioration of certain bones, particularly the fingers);
 - c. Raynaud's phenomenon (coldness and numbness of the hands and feet);
 - d. scleroderma (a degenerative lesion characterised by stiffness of the skin and soft tissues).
- 2 It should also be noted that vinyl chloride presents a serious fire and explosion hazard, but this aspect is not dealt with in this Code of Practice. A table summarising some of the properties of vinyl chloride is given in Appendix 2.

PART 2 OBJECTIVES

- 3 The objective of the Code is to endeavour to prevent occupational diseases associated with vinyl chloride by limiting the exposure of persons within the interim hygiene standard given in Appendix 1 of this Code on the understanding that wherever practicable exposure should be brought as near as possible to zero concentrations.
- 4 The first priority of the Code is to minimise exposures in the manufacture of vinyl chloride and its subsequent polymerisation to poly vinyl chloride (PVC).
- 5 The medical parts of the Code seek, by establishing medical standards for employment as "supervised workers" and periodic re-assessments of fitness for continued employment, together with suitable education of the "supervised workers", to prevent any harmful or undesirable effects of vinyl chloride monomer. A secondary aim is to provide additional information leading to a fuller understanding of the effects of vinyl chloride monomer.

PART 3 STATUS

- 6 The Code has been produced on the assumption that it will be submitted for approval under the Health and Safety at Work etc Act 1974 (Sections 2, 16 and 17 of the Act are reproduced at Appendix 9).

PART 4 RESPONSIBILITIES

Senior Management

- 7 A member of senior management should be allocated specific responsibilities for the matters covered by the Code of Practice, with appropriate support as may be necessary in individual circumstances. In particular, he should be responsible for ensuring that there is joint consultation with employees' representatives on all aspects of exposure to vinyl chloride, including discussion of results from monitoring carried out in accordance with Part 10 and Appendix 3 of this Code. He should take steps to

satisfy himself that the permits-to-work system, monitoring, examinations, inspections and checks required by this Code are being carried out properly.

Supervisors

- 8 It should be the recognised responsibility of all supervisors to oversee those aspects of the Code of Practice which relate to their particular situation, to report any difficulties and to pass forward suggestions from those under their authority.

Employees

- 9 All employees should comply with the Code of Practice as it relates to their employment and responsibilities, using in the correct manner the facilities and services provided for them in accordance with the Code, and report any material defect or faults forthwith to their supervisors.

PART 5 CONTROL OF VINYL CHLORIDE LEVELS IN THE ATMOSPHERE

- 10 All practicable steps should be taken to keep concentrations of vinyl chloride vapour in the working atmosphere below the hygiene standard (Appendix 1). The control of vapour should be a fundamental objective.
- 11 No one should be exposed to concentrations of vinyl chloride vapour greater than the hygiene standard.
- 12 Access to areas where it is foreseeable that concentrations of vinyl chloride vapour could be above the hygiene standard should be restricted to persons whose duties require them to enter such areas. Where such persons regularly work in such areas they must be authorised in writing to do so and a record of their names should be kept in accordance with Part 17 of this Code.
- 13 If at any time the vinyl chloride vapour level in the working atmosphere is above the hygiene standard, respiratory protective equipment must be worn to the standard outlined in Part 11 and Appendix 4 of this Code.
- 14 Where equipment is not totally enclosed, or where the enclosure must necessarily be breached as a routine process operation, then procedures should be adopted which ensure that vinyl chloride is not released into the working atmosphere. These procedures include local exhaust ventilation or other suitable means.
- 15 When a non-routine operation necessitates opening equipment which may release vinyl chloride to the atmosphere eg, as in the maintenance or repair of equipment, and where it would be impracticable to remove vapours by local exhaust ventilation then respiratory protective equipment must be worn to the standard outlined in Part 11 and Appendix 4 of this Code. Precautions must be taken to ensure that other personnel are not exposed to levels of vinyl chloride above the hygiene standard because of release of vinyl chloride into the atmosphere during this operation. Such an operation should not be conducted without a permit to work from a responsible person designated by management for this purpose.

- 16 The aim should be to provide plant and equipment so designed as to ensure maximum containment of vinyl chloride and where vents/reliefs are essential they should be positioned so that their outlets do not contaminate the working atmosphere or any neighbouring locations where work is normally in progress. They must also conform to the requirements of HM Alkali and Clean Air Inspectorate in relation to the dispersal of emissions.
- 17 HM Inspector of Factories for the area or district should be notified of proposals to install new plant to which this Code will apply or to substantially modify existing plant in any way that might increase the possibility of leakages of vinyl chloride vapour. Such notifications should normally be at least six months before work commences on installing new plant or making substantial modifications to existing plant unless the Inspector will accept a lesser period. HM Alkali Inspector for the District should also be informed when new or modified plant may affect dispersal of emission of vinyl chloride vapour.

PART 6 ENTRY INTO CONFINED SPACES

- 18 By 'confined space' is meant any reactor, autoclave, tank, chamber, vat, pit, pipe, flue, duct, bunker or underground room in which vinyl chloride vapour is known to have been present or is liable to be present.
- 19 Entry into confined spaces involves a particular risk of persons being exposed to concentrations of vapour above the hygiene standard. The number of occasions on which a vessel has to be entered should therefore be reduced to the minimum, and the actual time spent inside on such occasions should be as short as possible.
- 20 A permit-to-work system should be operated at least to the standard outlined in Technical Data Note 47 'Entry into Confined Spaces: Hazards and Precautions'.
- 21 Before a person enters a confined space for any purpose all practicable measures should be taken to reduce the concentration of vinyl chloride vapour inside the vessel to a minimum and the atmosphere should be tested for vinyl chloride vapour before entry.
- 22 Where it is not possible to reduce the concentration of vinyl chloride vapour level to an amount below the hygiene standard, or to ensure that it will remain so during entry, then suitable respiratory protective equipment should be provided and worn and the procedures outlined in Technical Data Note 47 should be followed.
- 23 Suitable protective clothing in accordance with Appendix 5 of this Code should be provided for and worn by persons required to enter any 'confined space' as defined in paragraph 18 of this Code. The standard of protective clothing should be specified by the person issuing the permit-to-work required by paragraph 20.
- 24 Any permit allowing a person to enter a confined space without respiratory protective equipment should positively state that the person issuing the certificate is satisfied:

- a. that the concentration of vinyl chloride vapour has been reduced to below the hygiene standard, and
- b. that in the light of measures taken he does not foresee any circumstances in which the person entering the vessel may be exposed to concentrations of vinyl chloride vapour above the hygiene standard.

PART 7 PROTECTION OF MAINTENANCE WORKERS

- 25 Maintenance work may involve exposure to high concentrations of vinyl chloride vapour. Proper supervision should therefore be exercised to ensure that the principles of protection and control outlined in this Code are followed to protect those engaged in maintenance work.

PART 8 HOUSEKEEPING

- 26 a. Solid waste materials containing significant levels of residual vinyl chloride should be transferred from the plant to special containers located in designated areas within the Works boundary. Subsequently the waste material should be disposed of in accordance with any relevant statutory requirements.
- b. Waste polyvinyl chloride slurry containing significant levels of residual vinyl chloride should be transferred to a settling pit prior to suitable treatment of the liquid waste for general disposal. The solid polyvinyl chloride waste from the settling pit should preferably be recovered as dried polymer but where this is not practicable the waste material should be disposed of in accordance with any relevant statutory requirements.

PART 9 PREVENTIVE MAINTENANCE OF PLANT AND EQUIPMENT

- 27 A high standard of maintenance in the whole plant should be provided to facilitate compliance with the hygiene standard.
- 28 All items of equipment from which the release of vinyl chloride above the hygiene standard can be foreseen should be given a visual check by a responsible person at least once per shift to ensure that there are no obvious defects likely to result in the release of vinyl chloride into the atmosphere.
- 29 The results of these shift checks should be recorded as outlined in Part 17 of this Code.
- 30 Potential areas of vinyl chloride leakage should be regularly checked with a leak detector in accordance with the monitoring plan. Immediate action should be taken to (a) minimise the effects of a leak; and (b) eliminate the leakage. The checks envisaged in this paragraph can either be carried out separately or in conjunction with the visual checks required by paragraph 28 of this Code.
- 31 All ventilation equipment used to control vinyl chloride should be thoroughly examined, using instrument techniques where appropriate,

at least once in every six months, and the results should be recorded as required by Part 17 of this Code. Defects in ventilation equipment should be corrected as soon as practicable.

PART 10 MONITORING

- 32 A monitoring plan should be prepared following the guide-lines given in Appendix 3. This monitoring plan should be open to inspection by HM Inspector of Factories and should be available to employees' representatives on request.
- 33 Monitoring of the atmosphere to detect vinyl chloride concentrations should be carried out at least once each shift in all working areas where vinyl chloride vapour is liable to be present in concentrations above the hygiene standard and in all areas as outlined in the monitoring plan.
- 34 The monitoring should be carried out by, or under the supervision of, a person who has been suitably trained in environmental sampling and analysis, and in the interpretation of the results.
- 35 The results of monitoring should be recorded as outlined in Part 17 and Appendix 8 of this Code or as agreed with HM Inspector of Factories for the area or district.
- 36 Where monitoring reveals situations leading to excursions above the hygiene standard these should be investigated as soon as practicable and the results of the investigation should be recorded as outlined in Part 17 and Appendix 8 of this Code, or as agreed with HM Inspector of Factories for the area or district.
- 37 The results of atmosphere monitoring should be available for inspection by personnel working in the areas where vinyl chloride is liable to be present. The area monitoring results should be summarised on a shift basis showing the shift average level for various work areas in the plant, with an analysis of any excursions above the hygiene standard. The results for each shift should be posted in the area to which they relate within two hours of the end of the shift and should be retained in position for at least two days. Where monitoring is done less frequently than on a shift basis, the results should, if practicable, be posted up in the area to which they relate within 24 hours of the completion of the monitoring. It is recommended that data processing equipment be installed to facilitate the presentation.

PART 11 RESPIRATORY PROTECTIVE EQUIPMENT

- 38 Respiratory protective equipment should be provided for all persons employed in areas where control of vinyl chloride vapour to below the hygiene standard cannot be ensured.
- 39 Respiratory protective equipment should be worn in all situations where concentrations of vinyl chloride vapour are known to be above the hygiene standard and also in situations where such concentrations can reasonably be expected to be present.

- 40 In this Code 'suitable respiratory protective equipment' means a full face or half-mask continuous flow, compressed air line or self-contained breathing apparatus provided with a supply of air adequate for breathing and conforming to BS 4667: Part 3: 1974. No other type of respiratory protective equipment should be used without the agreement in writing of HM Inspector of Factories for the area or district.
- 41 The recommendations on use and maintenance of respiratory protective equipment which are made in BS 4275: 1974 should be regarded as suitable guidance where relevant with particular attention being given to the compressed air supply, and the setting up of a system for cleaning, inspection and issue of equipment.
- 42 All respiratory protective equipment should be inspected by a competent person at least once in every 14 days and records of inspections should be kept as outlined in Part 17 and Appendix 8 of this Code. This requirement should be regarded as substituted for the requirement about inspection in BS 4275: 1974.
- 43 No person should be allowed to rely on protection by respiratory protective equipment unless he holds a respirator licence renewed within the previous 12 months. Such a licence should only be issued after the holder has satisfactorily completed a suitable training or refresher course. A form of licence and list of topics for training are given in Appendix 4.

PART 12 MEDICALLY SUPERVISED WORKERS

- 44 "Supervised workers" are those workers who are occupationally exposed in the manufacture of vinyl chloride monomer (VCM) by whatever method and its subsequent polymerization to polyvinyl chloride (PVC).
- 45 This part of the Code does not apply to those workers who because of the work they are undertaking may be only fortuitously and for a limited period exposed to VCM.

PART 13 MEDICAL EXAMINATIONS OF SUPERVISED WORKERS

- 46 All persons prior to first employment as "supervised workers" should undergo a medical examination.
- 47 Other persons employed as "supervised workers" at the time of the institution of this Code of Practice should undergo a medical examination unless such an examination has been carried out within the previous 12 months.
- 48 The examination should include:
- i) A full medical and occupational history.
 - ii) A clinical examination with particular reference to the abdomen, skin and extremities.
 - iii) An X-ray examination of the hands.

iv) Such further tests as may be indicated by the above procedures or as may be recommended in supplements to this Code.

v) The leaflet describing the early effects of VCM should be given to the "supervised worker" at this examination unless issued previously.

49 Examinations should be undertaken on all "supervised workers" at annual intervals.

50 A "supervised worker" who reports symptoms which may be due to exposure to VCM should be seen by the physician responsible for providing medical supervision. A "supervised worker" who has been absent from work on account of illness for 2 weeks or more should be seen by the physician. Absences from work due to sickness of "supervised workers" should be reviewed both on a group and on an individual basis. If indicated, medical examinations may be undertaken at any time.

PART 14 MEDICAL RECORDS

51 Full and confidential records will be kept for all medical examinations of "supervised workers".

52 These medical records should be preserved carefully by the physician responsible for the care of the "supervised worker". They should not be destroyed without the agreement of the Chief Employment Medical Adviser of the Employment Medical Advisory Service.

PART 15 CLOTHING ACCOMMODATION

53 Suitable cloakroom and changing accommodation should be provided. This should include separate arrangements for the storage of protective clothing and for clothing worn outside the works.

54 Protective clothing should not be allowed in the storage accommodation for clothing worn outside the works, and vice versa.

55 The accommodation should be provided with adequate heating, lighting and ventilation.

56 More detailed advice on clothing accommodation is given in Appendix 6.

PART 16 WASHING AND BATHING FACILITIES

57 Suitable washing facilities should be provided in association with cloakroom and changing facilities.

58 Sufficient shower baths to meet the anticipated needs should be provided for those engaged in work such as maintenance or cleaning of vessels.

59 Shower facilities should also be made available upon request to other persons employed on vinyl chloride processes.

- 60 More detailed advice on washing and bathing facilities is given in Appendix 7.

PART 17 REGISTERS AND RECORDS

- 61 The following detailed records should be kept:
- (a) names and addresses of persons authorised to enter areas to work regularly where vinyl chloride may be present above the hygiene standard (Part 5);
 - (b) permits-to-work (Parts 5 and 6);
 - (c) leakages of vinyl chloride discovered during the operation of the plant, or during visual checks of equipment or leak detection checks (Part 9);
 - (d) thorough examinations of ventilating equipment (Part 9);
 - (e) results of atmospheric monitoring of vinyl chloride (Part 10);
 - (f) investigations of excursions above the hygiene standard (Part 10);
 - (g) inspections of respiratory protective equipment (Part 11).
- 62 These records should contain at least the information listed in Appendix 8 and may be kept in any suitable form provided the information recorded is readily available when requested by HM Inspectors of Factories or the Joint Consultative Committee required by Part 18 of this Code.
- (a) Records of atmospheric monitoring results (61(e) above) should be retained for at least 30 years. They may be kept in the form of the original shift records, or of monthly summaries providing a monthly time-weighted average concentration and details of excursions above the hygiene standard. Records may be kept on microfilm or similar techniques after 5 years, provided they can be retrieved readily when required. If the main records are to be in the form of monthly summaries, then the detailed shift records on which they are based should be kept for at least 1 year;
 - (b) records of persons who regularly work in areas where it is foreseeable that concentrations of vinyl chloride will be above the hygiene standard (ie persons authorised under paragraph 12 of this Code) should also be kept for at least 30 years. These should, where possible, be capable of being linked to monitoring records to enable an estimation of the probable concentration to which any individual has been exposed;
 - (c) records of permits-to-work (61(b)) and of leakages detected (61(c)) should be kept for at least 1 year;
 - (d) all other records should be kept for at least 3 years.

- 63 Where a factory or process to which this Code applies is closed the records kept in accordance with 61(a)(e)(f) of this section should be transferred to the inspector of factories for the area or district unless other arrangements for safe keeping of them are agreed with the inspector.

PART 18 JOINT CONSULTATION

- 64 There should be a formal system of joint consultation between management and employees on all aspects of this Code of Practice.
- 65 The system of consultation in any particular works should be suited to its particular needs and the existing arrangements for consultation. It may therefore consist of a special committee set up for the purpose of consultation on vinyl chloride, an existing works safety committee with suitable terms of reference, or a special sub-committee of an existing committee.
- 66 The membership of the committee should include representatives of senior management and workers' safety representatives appointed by recognised trade unions.
- 67 The committee should have access to any relevant technical or medical expertise available in the company, and to all registers and records (excluding personal medical records) required to be kept by this Code of Practice.
- 68 It should be the duty of the committee to maintain a watching brief over health precautions in the plant with regard to vinyl chloride and the requirements of this Code of Practice; to promote co-operation between management and employees on matters concerning vinyl chloride; and to act as a forum for the exchange of information and the discussion of problems.
- 69 When necessary for the purposes of fulfilling the duties detailed above, the committee or members of it should be afforded facilities to conduct on-site inspections of any parts of the plant covered by this Code of Practice.
- 70 The proceedings of the committee should be suitably publicised within the plant so that every employee in a vinyl chloride process may examine them.

PART 19 EDUCATION AND TRAINING

- 71 All employees likely to be exposed to vinyl chloride above the hygiene standard in the course of their employment should be suitably instructed in the potential health risks and protective measures necessary.
- 72 Such instruction should include in particular the following subjects:
- (a) the health hazards of vinyl chloride and the medical supervision required by this Code of Practice;
 - (b) the general methods outlined in the Code of Practice for protecting persons from the health hazards of vinyl chloride;
 - (c) the role of the employee in safe working methods and personal hygiene;

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- (d) the correct operation of the plant with which the employee is concerned;
 - (e) the correct use of the respiratory protective equipment and any other equipment issued on a personal basis;
 - (f) the significance of the monitoring plan and of monitoring results;
 - (g) works emergency procedures;
 - (h) works rules relating to vinyl chloride;
 - (i) the role of joint consultation;
 - (j) procedures for reporting defects in plant and equipment and for making suggestions.
- 73 Initial instructions should be backed up by refresher courses, talks, publicity, etc., at appropriate times to sustain a high level of awareness amongst the employees.

PART 20 EMERGENCY PLAN

- 74 Each plant should formulate an emergency plan to cater for the contingency of a substantial escape of vinyl chloride vapour and all persons employed in such plants should be trained and exercised in the procedures for dealing with such emergencies. The plan should adequately provide for:
- 1 Raising the alarm
 - 2 Evacuation
 - 3 Control of the occurrence
 - 4 Plant shut down and containment
 - 5 Assistance by Aid groups (Fire and Police) and site resources.

Such plans should be readily available to HM Inspector of Factories and to the Joint Consultative Committee established under the Code.

APPENDIX 1 INTERIM HYGIENE STANDARD

The interim hygiene standard for vinyl chloride is as follows:

a ceiling value of 50ppm and a time weighted average of 25ppm, allowing that wherever practicable exposure should be brought as near as possible to zero concentrations.

APPENDIX 2 PHYSICAL PROPERTIES OF VINYL CHLORIDE

Chemical Formula	$\text{CH}_2 : \text{CHCl}$
Alternative Chemical Name	Chloroethylene
Description	Colourless liquid or gas. Detectable by a slightly sweet odour at concentration above 2000 ppm by volume in air
Molecular Weight	62.5
Boiling Point at 1 atmosphere	-13.6°C
Freezing Point at 1 atmosphere	-159.7°C
Vapour Pressure at 20°C	3.27 bar absolute
Latent Heat of Vapourisation at Boiling Point	335 kJ/kg
Gas Density relative to air at 20°C	2.2
Liquid Density relative to water at 20°C	0.92
Solubility in water at 20°C	1.0g/100 g water (values down to 0.11g/100g water are often quoted in the literature)
Flash point (open cup)	-78°C
Auto-ignition temperature	470°C
Lower explosive limit in air	3.6% vol/vol
Upper explosive limit	26% vol/vol

APPENDIX 3 MONITORING PROCEDURES

General Approach

- 1 Unless sufficient information is available from previous measurements a detailed survey of the whole working area should be undertaken before drawing up the monitoring plan required by paragraph 32 of the Code. Frequency of measurement should be determined by such considerations as the probability of malfunction of equipment and other causes which could give rise to concentrations of vinyl chloride above the hygiene standard and to the likelihood of such concentrations affecting the working area.
- 2 The results of monitoring should be made available to the joint consultative machinery advised in section 18 of this Code and modifications should be made where necessary to the monitoring plan.

Guidelines for Preparing the Monitoring Plan

- 3 The monitoring plan should normally provide at least the following information:
 - (a) a list of the points where monitoring measurements are required and the minimum frequency of measurements required at each point;
 - (b) other programmes of measurement including personal monitoring;
 - (c) the method of measurement to be used at each point and for each programme;
 - (d) procedure for recording data and calculating results;
 - (e) calibration and checking procedures;
 - (f) back-up procedure to be adopted in the case of failure or non-availability of the specified equipment;
 - (g) date of next regular review of the monitoring plan;
 - (h) procedure for changing the plan before the review date.
- 4 Where measurements have to be made at a number of points more frequently than hourly, this should normally be done by some form of automatic system, rather than by manual measurement. The type of system chosen will depend on the number of points involved, the frequency of measurement required, and the presence of other contaminants in the atmosphere.
- 5 Such measurements can conveniently be made by a number of fixed analysers or by an automatic sequential fixed point sampling system attached to a fixed analyser.
- 6 Mobile sample lines may be attached to such a system to allow measurements to be made at other points, either as part of the monitoring plan or for other special purposes.
- 7 Where measurements are required at intervals of greater than an hour or at irregular intervals, these can conveniently be made using a portable sampling or monitoring device. This includes a mobile probe as referred to in the previous paragraph.

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Where measurement is required of the actual integrated concentration to which an individual worker has been exposed this must be done by an integrating monitor or sample collector carried by the worker for the period concerned.

Measuring Equipment

- 8 The sensitivity, range, selectivity and speed of response of an analytical device should be appropriate to the duty which it is required to perform. Electrical equipment in flammable atmospheres should be suitably constructed, protected and installed - guidance is given in BS Code of Practice 1003.
- 9 The following techniques have been found to be suitable for detection and measurement of vinyl chloride:
 - (a) gas chromatography
 - (b) infra red absorption analysis
 - (c) flame ionisation detection (This equipment is not specific for VCM and may therefore give readings which are greater than the actual concentration).
- 10 Gas samples may be taken by any technique which is recognised and acceptable for the analytical technique to be used.
- 11 The following method may be used to measure integrated exposure over a time:
 - (a) portable sampling pump attached to suitable absorbent trap. Analysis by gas chromatography.

Location of Sampling Points for Fixed Analysers or an Automatic Sequential Fixed Point Sampling System

- 12 Sampling points should be located within the working area in such a way as to sample air representative of the air breathed by the workers. The locations should also be chosen, however, so that the probes will detect as soon as possible any increase in concentration of VCM arising as a result of leakage or plant malfunction.
- 13 The probes should normally be situated at breathing height and at places where the air movement is representative of the general working area. They should be situated in such a way as not to impede worker movement, access to or operation of equipment.

Frequency of Analysis

- 14 Where regular measurements are being made they should be carried out at a frequency which is adequate to ensure that the hygiene standards are being met. The minimum frequency required in any area will depend on such factors as the historical record of VCM concentration in that area and the probability of plant malfunction giving rise to VCM concentrations in that area.

- 15 Other measurements should be carried out as and when required, for example, before workers enter an area where men do not normally work continuously and where significant concentrations of VCM may be encountered. It may also be desirable to make periodic checks while workers remain in the area.
- 16 Personal monitoring should be carried out initially sufficiently frequently to ensure that the personal exposure as calculated from other monitoring systems is a reliable measurement of the concentration to which the workers are actually exposed. Thereafter personal monitoring should be carried out at a frequency sufficient to check that the value continues to be reliable.
- 17 Leak detection may be carried out by the following means:
- (a) portable analyser;
 - (b) mobile sample line attached to a non-portable analyser;
 - (c) ultra sonic leak detector.

Checking and Calibration Procedures

- 18 The calibration of all multi-point analysers used for monitoring for hygiene purposes should be checked once a day. The calibration may be checked by introducing a standard sample or by other means appropriate to the type of analyser.
- 19 The operation of all analyser systems and ancillary equipment used for monitoring for hygiene purposes should be checked on a regular basis determined by the characteristics of the components of the system.

Procedures for Recording of Analytical Data and Calculating Results

- 20 Monitoring data may be recorded in the form of computer print out or manually as described in Part 17 of the Code of Practice.
- 21 The "average VCM level" for a given period in the various plant areas can be calculated as the arithmetic mean of the relevant individual results obtained from the analyses made in that area during that period. The time weighted average exposure for personnel can be calculated from the "average VCM level" taking account of the time spent by the personnel within the various areas. Where not calculated over the length of a shift it should be calculated over an 8 hour period.
- 22 For various methods of sampling the following criteria shall be used to calculate whether the ceiling value has been exceeded:
- (a) When an integrated sample is taken over any period not exceeding 30 minutes, a single reading above the ceiling value shall decide.
 - (b) When sequential fixed point monitoring is carried out with a repetition time not exceeding 30 minutes, two successive readings above the ceiling value shall decide.
 - (c) When any instantaneous or very short time sampling is carried out at intervals greater than 30 minutes, any single reading above the ceiling value shall decide.

APPENDIX 4 RESPIRATORY PROTECTIVE EQUIPMENT

Training Outline

- 1 Principles of operation and the use of the equipment.
 - 2 Practical use, correct fitting etc.
 - 3 Limitations of the equipment.
 - 4 Common defects and action required.
 - 5 Company arrangements for issue, cleaning, maintenance etc.
 - 6 Circumstances in which use is required.
-

RESPIRATORY PROTECTIVE EQUIPMENT

RESPIRATOR LICENCE

This is to certify that _____ has been trained in the use
of the respiratory protective equipment detailed below and is competent to use it.

This licence is valid from _____ to _____.

SIGNED

DATE

Equipment to which this licence applies.

Date of last training or refresher training.

APPENDIX 5 PROTECTIVE CLOTHING

- 1 The standard of protective clothing needed to comply with paragraph 23 of this Code will vary depending on the state of the confined space being entered. Three main types of protective clothing are known at present and the responsible person making out the permit-to-work in accordance with Part 6 of this Code will normally be expected to select either 2(a) or 2(b) for that work where substantial body contact with vinyl chloride can be anticipated and 2(c) for that work where the vessel or other confined space being entered is relatively free of vinyl chloride, e.g., having been substantially cleaned before entry by means of high pressure hoses or other methods. PVC gloves and rubber or neoprene boots should complete the protection when types 2(a) or 2(b) of protective clothing are used.
- 2 The types of protective clothing known at present are:
 - (a) completely enclosing air supplied suits of wire re-inforced PVC;
 - (b) PVC or PVC proofed overalls;
 - (c) terylene or cotton or similar overalls.
- 3 Other types of protective clothing not mentioned in paragraph 2 of this Appendix can be used if approved by HM Inspector of Factories for the area or district.

APPENDIX 6 CLOTHING AND CHANGING ACCOMMODATION

General Principles

- 1 Adequate and preferably separate accommodation is required for (1) Street clothing; and (2) Works clothing etc. The accommodation should preferably be close to the washing and showering facilities in such a manner that workers remove dirty clothing in one room before passing into the wash-room or showers and finally into another room where they can put on clean clothing.
- 2 All clothing not worn during working hours should be left in the accommodation provided for it and should not be allowed in working areas or locker areas provided for protective clothing. Similarly, all protective clothing should be removed and kept in the area provided for it and not be allowed in the other parts of the accommodation.

Layout and Design

- 3 In accordance with the general principles outlined above, the facilities should be laid out as far as possible to avoid congestion and with careful consideration to relationships to other facilities such as drying rooms, clothing issue rooms, refreshment facilities and clocking-on points.
- 4 Sufficient accommodation should be provided to cope with the maximum demand, and where lockers are provided they should be allocated on a personal basis. There should also be adequate room for persons changing their clothing. Toilet accommodation and drinking water should be available for persons using the changing accommodation.
- 5 Walls and floors should have smooth impervious surfaces which can be easily washed and cleaned, and as far as possible junctions of surfaces should be rounded to prevent the trapping of dust and dirt. Floors should be non-slip and ceilings should be resistant to condensation.
- 6 The facilities should be well-lit, heated and ventilated, and where necessary double doors should be considered to reduce draughts. Mechanical ventilation is advisable to reduce condensation.

Maintenance

- 7 All surfaces, fixtures and fittings should be maintained in a high state of cleanliness. Floors should be washed at least once daily and disinfected as necessary to prevent the spread of fungal infections. Litter bins should be emptied frequently.
- 8 Renewals and repairs of equipment, fittings, etc should be made promptly and efficiently and employees should be encouraged to report defects. Routine inspection of lockers, etc., should be made to collect the soiled protective clothing of employees who may be absent from work.

Supervision

- 9 A responsible person designated by management for this purpose should be appointed to ensure proper use and maintenance of the facilities.

APPENDIX 7 WASHING AND BATHING FACILITIES

Design and Location

- 1 Facilities should preferably be integrated with clothing and changing accommodation such that they intervene between the areas for works and street clothing.
- 2 Walls and floors should have smooth impervious surfaces which can be easily washed and cleaned. Junctions of surfaces should be rounded to prevent the accumulation of dust and dirt. Floors should be non-slip, and ceilings should be resistant to condensation.
- 3 The facilities should be well-lit, heated and ventilated and consideration should be given to the use of double doors to reduce draughts. Mechanical ventilation is advisable to reduce condensation.
- 4 Toilet accommodation and drinking water should be available to persons using the accommodation.
- 5 In the design of the showers, care should be taken to ensure privacy for the persons using them.

Scale

- 6 A sufficient number of washbasins or troughs and showers should be provided to enable the largest number of persons expected to be using the facilities at any time to use them without undue delay.

Supplies

- 7 Hot water at a maximum temperature of 54°C (125°F) is recommended, with lower temperature at points of use where only warm water is provided. Consideration should be given to the quantity of hot water required to be available at periods of peak demand.
- 8 There should be an adequate supply of soap and clean towels, and for use with showers separate clean towels should be issued and changed daily.

Maintenance

- 9 All surfaces, fixtures, and fittings should be maintained at a high standard of cleanliness. Floors should be washed at least once daily, and disinfected as necessary to prevent the spread of fungal infections. Litter bins should be emptied frequently.
- 10 Renewals and repairs of equipment, fittings, etc should be made promptly and efficiently and employees should be encouraged to report defects. Routine inspection of lockers, etc, should be made to collect soiled protective clothing of employees who may be absent from work.

Supervision

- 11 A responsible person designated by management for this purpose should be appointed to ensure proper use and maintenance of the facilities.

APPENDIX 8 REGISTERS AND RECORDS

- 1 The following is the minimum information required to be kept for the purposes of Part 17 of the Code.

Results of Atmospheric Monitoring for Vinyl Chloride

Area Monitoring Results

- 2 In the areas where multi point sequential analysing equipment is installed results should be summarised on a shift basis for each identifiable work area showing the average concentration in the area with an analysis of any excursions above the hygiene standard. Basic details of the position and number of sample points together with the frequency of sampling and analytical methods should be included at the beginning of the series of records and thereafter only when changes occur in the monitoring plan.

In the areas where sampling is carried out other than each shift the individual results should be recorded and if appropriate may be summarised on a monthly basis showing the average concentration at each location with an analysis of the distribution of the individual results.

Personal Monitoring

- 3 The results of personal monitoring should be summarised on a monthly basis by job category in each plant.

Record of Shift Visual Checks and Leak Detection Checks.

- 4
 - (a) Description of area or plant covered by inspection.
 - (b) Date of inspection.
 - (c) Time of shift.
 - (d) Statement of the defects or leaks found that might result in the release of vinyl chloride vapour above the hygiene standard.
 - (e) Indication of action taken following discovery of fault.

Record of Authorised Persons

- 5
 - (a) Name and address of person.
 - (b) Normal place or places of work, to be related to definite works areas where possible.
 - (c) Date started working in particular area, date transferred to another area (in the case of mobile workers such as maintenance personnel an attempt should be made to indicate those areas where they might normally work).

Permits to Work.

- 6 These should be recorded in the form of copies of the original permits.

Six monthly Examinations of Ventilating Equipment

- 7
- (a) Location and type of plant.
 - (b) Date of examination.
 - (c) Results of instrument readings.
 - (d) Defects noted.
 - (e) Action taken to correct defects.
 - (f) Name and signature of person making examination.

Inspections of Respiratory Protective Equipment

- 8
- (a) Name and description of equipment.
 - (b) Person issued to if on personal issue.
 - (c) Date of inspection.
 - (d) Description of any defect found.
 - (e) Statement of steps taken to deal with defect.
 - (f) Name and signature of person making inspection.

Investigation of Excursions Above the Hygiene Standard

- 9
- Part A : Excursions above the ceiling value (as defined by the criteria in Appendix 3 paragraph 22)**
- (a) Part of factory to which record refers (where it does not refer to the whole factory).
 - (b) Precise location.
 - (c) Date, time and (where known) duration.
 - (d) Maximum concentration recorded.
 - (e) Result of investigation.
 - (f) Action taken.
 - (g) Initials of person making entry.
- 10
- Part B : Excursions above the time weighted average limit as detected during personal monitoring**
- (a) Part of factory to which record refers (where it does not refer to the whole factory).
 - (b) Identification of person wearing sampling equipment.
 - (c) Job description.
 - (d) Where empl y d during sampling period.

- (e) Date, shift and duration of sampling period.
- (f) Calculated time weighted average concentration for sampling period.
- (g) Result of investigation
- (h) Action taken.
- (i) Initials of person making entry.

11 The object in specifying minimum information in this way is to enable flexibility in using computerised records if these are appropriate. If records are kept in the form of registers or of a card index the following suggested layout is provided for general guidance.

SHIFT SUMMARY OF AREA MONITORING

DATE SHIFT PART OF PLANT

IDENTIFIABLE AREA	AVERAGE CONCENTRATION	NUMBER OF RESULTS ABOVE CEILING VALUE

TOTAL NUMBER OF SAMPLES TAKEN DURING SHIFT

MONTHLY SUMMARY OF AREA MONITORING

MONTH PART OF PLANT

IDENTIFIABLE AREA	AVERAGE CONCENTRATION	PERCENTAGE OF RESULTS ABOVE CEILING VALUE

TOTAL NUMBER OF SAMPLES TAKEN DURING SHIFTS

3 (paragraph 3)

SUMMARY OF PERSONAL MONITORING

MONTH

Job Category	Area (where relevant)	No. of Samples taken	Mean T.W.A. Concentration	Range of Concentration including, if appropriate, number above hygiene standard

4 (paragraph 4)

RECORD OF SHIFT VISUAL CHECKS AND/OR LEAKAGE DETECTION
CHECKS

DATE SHIFT PART OF PLANT

DEFECTS FOUND	ACTION TAKEN

UCC
031247

5 (paragraph 5)

PERSONS AUTHORISED TO ENTER VINYL CHLORIDE AREAS

NAME AND ADDRESS	NORMAL PLACE OF WORK	DATE OF AUTHORISATION	DATE REVOKED

6 (paragraph 7)

RECORD OF EXAMINATION OF VENTILATING PLANT

1	PLANT						
2	LOCATION						
3	DATE OF EXAMINATION						
4	RESULTS OF AIRFLOW MEASUREMENTS						
	<table border="1"><thead><tr><th>POSITION</th><th>READING</th><th>REMARKS</th></tr></thead><tbody><tr><td> </td><td> </td><td> </td></tr></tbody></table>	POSITION	READING	REMARKS			
POSITION	READING	REMARKS					
5	DEFECTS REQUIRING ATTENTION						
6	ACTION TAKEN TO CORRECT DEFECTS, WITH DATE COMPLETED						
7	PERSON MAKING REPORT POSITION SIGNATURE DATE Details in Section 6 may be inserted after signing this report, where immediate action cannot be taken, but such additional entries must be initialled by the person making them.						

UCC
031249

7 (paragraph 8)

INSPECTIONS OF RESPIRATORY PROTECTIVE EQUIPMENT

NAME AND DESCRIPTION OF EQUIPMENT

WITH IDENTIFICATION MARK

DATE OF INSPECTION	PERSON ISSUED TO, OR USUAL LOCATION	DEFECTS FOUND	ACTION TAKEN	WHETHER FIT FOR USE YES/NO	SIGNATURE

UCC
031250

8 (paragraph 9)

RECORD OF INVESTIGATIONS OF EXCURSIONS ABOVE THE HYGIENE STANDARD

PART A : EXCURSIONS ABOVE THE CEILING VALUE

(WHERE RELEVANT) PART OF FACTORY

TO WHICH THIS RECORD RELATES

PRECISE LOCATION	DATE, TIME AND APPROX. DURATION	MAXIMUM CONCENTRATION MEASURED	RESULT OF INVESTIGATION	ACTION TAKEN	INITIALS



RECORD OF INVESTIGATIONS OF EXCURSIONS ABOVE THE HYGIENE STANDARD

PART B : EXCURSIONS ABOVE THE TIME-WEIGHTED AVERAGE LIMIT DETECTED BY PERSONAL MONITORING

(WHERE RELEVANT) PART OF FACTORY

TO WHICH THIS RECORD RELATES

IDENTIFICATION OF PERSON WEARING SAMPLING EQUIPMENT	JOB DESCRIPTION	WHERE EMPLOYED DURING SAMPLING PERIOD	DATE, SHIFT AND DURATION OF SAMPLING PERIOD	CALCULATED T.W.A. FOR SAMPLING PERIOD	RESULT OF INVESTIGATION	ACTION TAKEN	INITIALS

— 34 —

UCC
931252

APPENDIX 9 SOME RELEVANT LEGAL REQUIREMENTS

Health and Safety at Work etc Act 1974

General duties
of employers
to their
employees

2-(1) It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees.

(2) Without prejudice to the generality of an employer's duty under the preceding subsection, the matters to which that duty extends include in particular-

- (a) the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health;
- (b) arrangements for ensuring, so far as is reasonably practicable, safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances;
- (c) the provision of such information, instruction, training and supervision as is necessary to ensure, so far as is reasonably practicable, the health and safety at work of his employees;
- (d) so far as is reasonably practicable as regards any place of work under the employer's control, the maintenance of it in a condition that is safe and without risks to health and the provision and maintenance of means of access to and egress from it that are safe and without such risks;
- (e) the provision and maintenance of a working environment for his employees that is, so far as is reasonably practicable, safe, without risks to health, and adequate as regards facilities and arrangements for their welfare at work.

(3) Except in such cases as may be prescribed, it shall be the duty of every employer to prepare and as often as may be appropriate revise a written statement of his general policy with respect to the health and safety at work of his employees and the organisation and arrangements for the time being in force for carrying out that policy and to bring the statement and any revision of it to the notice of all of his employees.

(4) Regulations made by the Secretary of State may provide for the appointment in prescribed cases by recognised trade unions (within the meaning of the regulations) of safety representatives from amongst the employees, and those representatives shall represent the employees in consultations with the employers under subsection (6) below and shall have such other functions as may be prescribed.

(5) Regulations made by the Secretary of State may provide for the election in prescribed cases by employees of safety representatives from amongst the employees, and those representatives shall represent the employees in consultations with the employers under subsection (6) below and may have such other functions as may be prescribed.

(6) It shall be the duty of every employer to consult any such representatives with a view to the making and maintenance of arrangements which will enable him and his employees to co-operate effectively in promoting and developing measures to ensure the health and safety at work of the employees, and in checking the effectiveness of such measures.

(7) In such cases as may be prescribed it shall be the duty of every employer, if requested to do so by the safety representatives mentioned in subsections (4) and (5) above, to establish, in accordance with regulations made by the Secretary of State, a safety committee having the function of keeping under review the measures taken to ensure the health and safety at work of his employees and such other functions as may be prescribed.

Approval
of codes of
practice
by the
Commission

16-(1) For the purpose of providing practical guidance with respect of the requirements of any provision of sections 2 to 7 or of health and safety regulations or of any of the existing statutory provisions, the Commission may, subject to the following subsection and except as regards matters relating exclusively to agricultural operations -

- a. approve and issue such codes of practice (whether prepared by it or not) as in its opinion are suitable for that purpose;
- b. approve such codes of practice issued or proposed to be issued otherwise than by the Commission as in its opinion are suitable for that purpose.

(2) The Commission shall not approve a code of practice under subsection (1) above without the consent of the Secretary of State, and shall, before seeking his consent, consult -

- a. any government department or other body that appears to the Commission to be appropriate (and, in particular, in the case of a code relating to electromagnetic radiations, the National Radiological Protection Board); and
- b. such government departments and other bodies, if any, as in relation to any matter dealt with in the code, the Commission is required to consult under this section by virtue of directions given to it by the Secretary of State.

(3) Where a code of practice is approved by the Commission under subsection (1) above, the Commission shall issue a notice in writing -

- a. identifying the code in question and stating the date on which its approval by the Commission is to take effect; and
- b. specifying for which of the provisions mentioned in subsection (1) above the code is approved.

(4) The Commission may -

- a. from time to time revise the whole or any part of any code of practice prepared by it in pursuance of this section;

- b. approve any revision or proposed revision of the whole or any part of any code of practice for the time being approved under this section;

and the provisions of subsections (2) and (3) above shall, with the necessary modifications, apply in relation to the approval of any revision under this subsection as they apply in relation to the approval of a code of practice under subsection (1) above.

(5) The Commission may at any time with the consent of the Secretary of State withdraw its approval from any code of practice approved under this section, but before seeking his consent shall consult the same government departments and other bodies as it would be required to consult under subsection (2) above if it were proposing to approve the code.

(6) Where under the preceding subsection the Commission withdraws its approval from a code of practice approved under this section, the Commission shall issue a notice in writing identifying the code in question and stating the date on which its approval of it is to cease to have effect.

(7) References in this Part to an approved code of practice are references to that code as it has effect for the time being by virtue of any revision of the whole or any part of it approved under this section.

(8) The power of the Commission under subsection (1)b above to approve a code of practice issued or proposed to be issued otherwise than by the Commission shall include power to approve a part of such a code of practice; and accordingly in this Part "code of practice" may be read as including a part of such a code of practice.

Use of
approved
codes of
practice in
criminal
proceedings

17-(1) A failure on the part of any person to observe any provision of an approved code of practice shall not of itself render him liable to any civil or criminal proceedings; but where in any criminal proceedings a party is alleged to have committed an offence by reason of a contravention of any requirement or prohibition imposed by or under any such provision as is mentioned in section 16(1) being a provision for which there was an approved code of practice at the time of the alleged contravention, the following subsection shall have effect with respect to that code in relation to those proceedings.

(2) Any provision of the code of practice which appears to the court to be relevant to the requirement or prohibition alleged to have been contravened shall be admissible in evidence in the proceedings; and if it is proved that there was at any material time a failure to observe any provision of the code which appears to the court to be relevant to any matter which it is necessary for the prosecution to prove in order to establish a contravention of that requirement or prohibition, that matter shall be taken as proved unless the court is satisfied that the requirement or prohibition was in respect of that matter complied with otherwise than by way of observance of that provision of the code.

(3) In any criminal proceedings -

- a. a document purporting to be a notice issued by the Commission under section 16 shall be taken to be such a notice unless the contrary is proved; and
- b. a code of practice which appears to the court to be the subject of such a notice shall be taken to be the subject of that notice unless the contrary is proved.

Factories Act 1961

Removal
of dust
or fume

63-(1) In every factory in which, in connection with any process carried on, there is given off any dust or fume or other impurity of such a character and to such extent as to be likely to be injurious or offensive to the persons employed, or any substantial quantity of dust of any kind, all practicable measures shall be taken to protect the persons employed against inhalation of the dust or fume or other impurity and to prevent its accumulating in any workroom, and in particular, where the nature of the process makes it practicable, exhaust appliances shall be provided and maintained, as near as possible to the point of origin of the dust or fume or other impurity, so as to prevent its entering the air of any workroom.

Alkali etc Works Regulations Act 1906
(and Alkali etc Works Orders 1966 and 1971)

from Section 7(1)

The owner of any (scheduled work) shall use the best practicable means for preventing the escape of noxious or offensive gases, and for preventing the discharge, whether directly or indirectly, of such gases into the atmosphere, and for rendering such gases where discharged harmless and inoffensive.....

from Section 27

The expression "best practicable means",, has reference not only to the provision and efficient maintenance of appliances adequate for preventing such escape, but also to the manner in which such appliances are used and to the proper supervision, by the owner, of any operation in which such gases are evolved.

from Section 9(5)

A certificate of registration shall be issued on application being made if the conditions of registration are complied with, and one of the conditions shall be that the work is at the time of registration furnished with such appliances as appear to the Chief Inspector, or, on appeal, to the Local Government Board to be necessary in order to enable the work to be carried on in accordance with such of the requirements of this Act as apply to the work.

APPENDIX 10 MEDICAL ASPECTS

The Medical Sub-Group defined its terms of reference: "To examine the medical aspects of exposure to vinyl chloride; to decide in the light of existing clinical, pathological, toxicological and epidemiological information the examinations which should be included in the Code of Practice; and to indicate those which require further research before inclusion in the Code".

- 2 As the earliest effects of acro-osteolysis (AOL) and related conditions are likely to be first noticed by the worker, worker education must play an important role in the early detection of this group of conditions. It is therefore necessary to advise workers to present themselves for appropriate medical examinations and investigations as soon as they notice anything abnormal.
- 3 The object of medical tests related to the liver is to detect changes indicative of the effects of vinyl chloride on the liver at a stage before the development of angio-sarcoma. There are several tests to detect abnormalities of the liver. Experience with their use has however been largely gained with patients in hospital and much has still to be learned of their application to apparently healthy people in whom abnormal test results can frequently be found. In addition, substantial chronic liver damage can be found in the presence of normal test results. Moreover, the tests, if carried out indiscriminately, impose a serious burden both on the exposed person and medical resources.
- 4 To assist in resolving this difficult problem, the Sub-Group has consulted experts on diseases of the liver and in relevant diagnostic procedures and gratefully acknowledges the assistance so willingly given.
- 5 New techniques which might have application to the early detection of disease which may be related to exposure to vinyl chloride are being actively pursued.
- 6 The Medical Sub-Group has concluded that insufficient experience with liver function tests or screening tests is as yet available to enable firm recommendations to be made regarding them in this Code of Practice. Liver function tests for this purpose are however in use at factories making PVC and useful experience is being obtained. As provided for in paragraph 48(iv) of this Code of Practice, formal recommendations may be issued as supplements to the Code in due course.
- 7 It was also agreed by the Working Group that there is a need to continue studies of results of exposure to vinyl chloride. Such studies have been organised jointly by the Employment Medical Advisory Service and the manufacturing companies - see Appendix 11.

APPENDIX 11 EPIDEMIOLOGICAL STUDIES RELATED TO THE MANUFACTURE
AND POLYMERIZATION OF VINYL CHLORIDE MONOMER

Introduction

- 1 There are two main approaches when considering epidemiological studies of industrial hazards. The first approach is to identify a population exposed to particular processes and to study their death rates (known as 'the prospective study'). The second approach is to identify cases of particular diseases, such as angio sarcoma, and to study the medical, social and occupational history of each case (known as 'the retrospective study').

The Employment Medical Advisory Service considered that both approaches should be adopted so that the hazard in the industry might be evaluated as quickly as possible.

Prospective Study of Manufacturers

- 2 Where the information is available all past, present and future workers at each of the factories engaged in the manufacture of PVC are being identified. The information relating to present and future workers should be comprehensive whereas that relating to past workers may be incomplete. The main aim of the study is to compare the death rates for this group of workers to those for the general population and subsequently to relate any differences to manner of exposure both in terms of time and concentration of VCM.

Retrospective Study of Angio Sarcoma of the Liver

- 3 Whereas the prospective study considers the death rates from all causes the retrospective study focuses attention on angio sarcoma of the liver. This is a rare tumour and consequently the Employment Medical Advisory Service is trying to identify all cases that are diagnosed in England, Scotland and Wales. These cases will be followed up in an attempt to identify those which might be attributable to vinyl chloride.