Draft Approved Code of Practice and Guidance on the Control of Inhalable Dust in Coal Mines

Acknowledgements

HSE would like to thank everyone involved in the development of the regulations and guidance, and in particular the following people:

The members of the working group of the Mining Industry Committee:

Alan Allsop	Union of Democratic Mineworkers (UDM)
Adrian Carley	UK Coal Mining
Paul Colbert	National Association of Colliery Overmen and Deputies (NACODS)
Allen Dobbs	UDM
Paul Fenner	UK Coal
David Flack	Federation of Small Mines
Ken Harrison	HSE
Mark Harrison	NACODS
Gerry Huitson	RJB Mining
Stuart Hunneyball	TES Bretby
Kevin Irving	UK Coal
Stuart Jobling	UK Coal
Dr Lee Kenny	Health & Safety Laboratory
Ross Letham	NACODS
David Mark	Health & Safety Laboratory
Sean O'Neil	NACODS
Mick Padley	Coalpower Ltd
Ian Parker	NACODS
Dr Ray Quinlan	Business Healthcare
Dr Douglas Scarisbrick	Business Healthcare
Dr Alan Scott	HSE
Tim Spurry	UK Coal
Andrew Walker	Tower Colliery
Bob Young	British Association of Colliery Managers (BACM)

Officials of the National Union of Mineworkers:

Ian Lavery	Chairman
Steve Kemp	Secretary
Keith Stanley	Chairman, Safety & Health Sub-committee
Nicky Wilson	NUM Scotland Area

The staff from the following collieries who participated in work to test personal sampling equipment:

Aberpergwm,	Hay Royds
Ayle East	Kellingley
Betws	Longannet
Clipstone	Maltby
Daw Mill	Ricall
Ellington	Rossington
Eckington	Stillinglfeet
Gascoigne Wood	Thoresby
Harworth	Tower
Hatfield	Welbeck

In this document the Coal Mines (Control of Inhalable Dust) Regulations 2007 are shown in italic text. The Approved Code of Practice material is shown in bold text and additional general guidance is shown in normal text.

Citation and Commencement

1. These Regulations may be cited as the Coal Mines (Control of Inhalable Dust) Regulations 2007 and shall come into force on 1st October 2007.

Regulation 2: Interpretation

2. In these Regulations—

"the 1954 Act" means the Mines and Quarries Act 1954(1);

"approved" means approved for the time being in writing;

"control measure" means a measure taken to reduce exposure to inhalable dust (including the provision of systems of work and supervision and the provision and use of engineering controls and respiratory protective equipment);

"covered accommodation" means the covered accommodation provided in pursuance of regulation 36(1) of the Management and Administration of Safety and Health at Mines Regulations 1993(2);

"doctor" means a registered medical practitioner competent in occupational health;

"employer" includes the owner if he employs persons at work at the mine;

"the Executive" means the Health and Safety Executive;

"exposure control limit for respirable dust" means the exposure control limit approved from time to time by the Health and Safety Commission for respirable dust in relation to the specified reference period when calculated by a method approved by the Health and Safety Commission;

"exposure control limit for quartz" means the exposure control limit approved from time to time by the Health and Safety Commission for quartz in relation to the specified reference period when calculated by a method approved by the Health and Safety Commission;

"hazard", in relation to inhalable dust, means the intrinsic property of that substance which has the potential to cause harm to the health of a person by inhalation, and "hazardous" shall be construed accordingly;

"health surveillance" means assessment of the state of health of an employee, as related to exposure to inhalable dust;

"inhalable dust" means airborne material which is capable of entering the nose and mouth during breathing, as defined by BS EN 481 1993;

"manager" means in relation to a mine, or part thereof, the person who is appointed under regulation 8 of the 1993 Regulations as the manager of that mine;

"medical examination" includes any laboratory tests and X-rays that a doctor may require;

(**a**) 1954 c. 70; extended by the Mines and Quarries (Tips) Act 1969 (c. 10); relevant amending instruments are S.I. 1974/2013, 1993/1897, 1996/2001 and 1999/2024.

(**b**) S.I. 1993/1897, to which there are amendments not relevant to these Regulations.

"mine" means any mine within the meaning of section 180 of the 1954 Act;

"owner" means any owner within the meaning of section 181 of the 1954 Act;

"quartz content" means, in relation to a sample of air, such portion of the respirable dust content of that sample as is attributable to respirable dust consisting of crystalline silica;

"relevant operations" means work which produces inhalable dust;

"respirable dust" means airborne material which is capable of penetrating to the gas exchange area of the lung, as defined by BS EN 481 1993;

"respirable dust content" means, in relation to a sample of air, the average weight in milligrammes of the respirable dust found to be present in each cubic metre of the air sampled;

"respiratory protective equipment" means all such equipment which is intended to be worn or held by a person at work and which protects that person against risks to his health from inhalation of harmful substances, and any addition or accessory designed to meet that objective;

"risk", in relation to the exposure of a person at work to inhalable dust, means the likelihood that the potential for harm to the health of a person will be attained under the conditions of use and exposure, and also the extent of that harm;

"the risk assessment" means the assessment of risk required by regulation 4(1)(a);

"tourist mine" means a mine the principal activity of which is to demonstrate the mine or the workings of the mine to persons not at work at the mine; rather than the getting of minerals or the products of minerals;

"working day" does not include a Saturday, Sunday or day of public or colliery holiday.

Introduction

Inhalable dust and respirable dust

1 The Regulations use the terms "inhalable dust" and "respirable dust". They set out requirements for managers to control exposure to inhalable dust, whilst requiring compliance with exposure control limits which refer to respirable dust. 'Inhalable dust' includes the larger particles of dust that are normally trapped by the clearance mechanisms in the nose, mouth and throat and are subsequently cleared from the respiratory tract. 'Respirable dust' refers to the smaller dust particles that are small enough to avoid these clearance mechanisms and reach the gas exchange region of the lungs.

2 Pneumoconiosis and emphysema are thought to be caused by the respirable fraction of inhalable dust while the larger fractions may contribute to other lung diseases, such as chronic bronchitis.

3 The regulations that set out general requirements for the control of dust refer to inhalable dust, while those that refer to sampling and exposure control limits refer to respirable dust. This is because, in most cases, control of both inhalable and respirable dust goes together and both are important to health protection. However, it is the level of respirable dust exposure that is the best way of measuring the likely adverse impact on health.

Exposure control

4 These Regulations require workers' exposure to respirable dust and quartz to be controlled so that it is as low as is reasonably practicable; they also require certain action if exposure control limits are breached: this could include stopping work until additional control measures can be put in place.

5 The regulations do not simply require the manager to ensure exposure control limits are not exceeded: they require the manager to reduce exposure as low as is reasonably practicable below the exposure control limits.

6 The regulations also require that the steps to be taken to reduce exposure must be taken in a certain order:

(a) first, as far as is reasonably practicable, eliminate the exposure or reduce the number of workers who are exposed;

(b) if it is not reasonably practicable to eliminate the exposure, then to reduce the level through the use of engineering controls (such as dust suppression and extraction) and organisational controls (systems of work) to as low a level as is reasonably practicable;

(c) if there is still a significant exposure risk, then to use respiratory protective equipment (RPE) to protect the individual.

7 Determining whether action is reasonably practicable involves weighing the risk of exposure and the possibility of an adverse health effect against the trouble, time and cost needed to control the risk. It is reasonably practicable to take measures up to the point when the taking of further measures becomes grossly disproportionate to any residual risk. Ultimately the judgement is an objective one based on the health risks and not the size or financial position of the owner.

Exposure control limits

8 Regulation 10 requires certain steps to be taken if an exposure control limit is exceeded. It is important to note that there is no allowance in regulation 10 for the effect of respiratory protective equipment to be taken into account in deciding whether an exposure control limit has been exceeded. Therefore, control to below the exposure control limits will need to be achieved by engineering and organisational controls alone.

9 Exposure depends on both the concentration of dust in the workplace air and on the length of time spent there. The exposure control limits are therefore time-weighted; this means the longer the period that workers are exposed, the lower the maximum permitted concentration of dust in the air.

10 The time-weighting calculation adjusts the exposure control limit to take account of the effects on respiratory health of exposure to dust. These build up over the long term but are partly offset by the body's natural mechanisms to clear dust from the respiratory tract. Periods without exposure are important to give these natural recovery mechanisms the chance to operate. Workers who are exposed to dust for long periods without a break away from work are likely to be at greater risk of suffering adverse effects than those whose work patterns include such breaks. The regulations therefore require managers to consider not only measures to control dust concentrations in the workplace, but also the potential impact of working hours and shift patterns on health.

11 The definitions of exposure control limits in regulation 2(1) refer to approval by the Health and Safety Commission of both the concentration values and the method of calculating how these values should be varied for differing working hours. Appendix 1 sets out the values and time-weighting calculation method approved by the Commission at the time of publication. Any revisions to the schedule will be included in a revised Notice of Approval.

'Exposure action level' and 'occupational group'

12 The Approved Code of Practice (ACoP) also uses the terms 'exposure action level' and 'occupational group'

(a) "Exposure action level" means the level of exposure (assessed or measured, depending on the context) equal to half the time-weighted exposure control limit for respirable dust or a third of the time-weighted exposure control limit for quartz.

(b) "Occupational group" means a group of workers assessed as likely to have broadly similar cumulative dust exposures because of the jobs they do, hours/shift patterns they work, and the place they work.

Health surveillance

13 As well as requiring mine managers to control exposure the regulations also require employers to ensure that all workers who have a significant risk of exposure are under health surveillance by a doctor.

Information and training

14 Finally, the regulations require employers to provide employees with suitable and sufficient information, instruction and training to understand the potential problems and precautions they need to take. The manager should make sure that workers and safety representatives are aware of this information and are consulted on any action that the manager proposes to take.

The relationship between mine owners, managers and contractors

15 These Regulations place some duties on mine managers, while other duties are placed on either the mine owner or all employers with employees at the mine. Thus, there may be three people responsible for compliance with various aspects of the law at a mine – the mine manager, the mine owner, and any employer of employees working below ground at the mine (such as a contractor).

16 The mine manager is responsible for undertaking the risk assessment, designing the dust control scheme, the sampling scheme and for day-to-day operation of these schemes, while the mine owner is responsible for putting in place the necessary financial and other arrangements for enabling the manager to carry out his responsibilities. At the same time all employers with employees working at the mine have responsibilities for ensuring the well-being of their own employees, including their health surveillance.

17 The type of work many contractors' employees undertake, particularly in development headings, means that they could be among the most highly exposed mineworkers; although where contractors' employees work in mines only occasionally, they will be at very low risk.

Regulation 3: Application

3.—(1)) Subject to paragraph (2), these Regulations shall have effect with a view to protecting persons at work below ground in coal mines against a risk to their health arising from exposure to inhalable dust of mineral origin.

(2) These Regulations shall not apply to a tourist mine.

18 These Regulations only apply to working coal mines. The Control of Substances Hazardous to Health Regulations 2002 (COSHH)[1] as amended by the Control of Substances Hazardous to Health (Amendment) Regulations 2004[2] apply to non-coal mines and to tourist coal mines.

19 The COSHH Regulations also apply to the exposure of workers at coal mines to:

(a) inhalable dust at the surface of the mine, for example from coal preparation, stockpiling or transport activities;

(b) dusts by exposures other than inhalation, for example skin contact with cement dust;

(c) gasses, vapour and liquids, including aerosols of liquids such as oil mist and fumes such as diesel exhaust.

20 If there is lead or asbestos in the mixture of inhalable mineral dust in a coal mine, both these Regulations and the Control of Asbestos at Work Regulations 2002 [3]or the Control of Lead at Work Regulations 2002[4] will apply. Where the employer complies with the specific requirements of the lead or asbestos regulations they will be regarded as complying with these regulations so far as lead and asbestos are concerned.

Regulation 4: Assessment of the risk to health created by work involving exposure to inhalable dust.

4. *—1. No manager shall permit work to be carried out which is liable to expose persons to inhalable dust until—*

(a) he, or a person appointed by him with competence in underground mining practice and sampling techniques, has made a suitable and sufficient assessment of—

(i) the risk created by that work to the health of those persons; and

(ii) the steps that need to be taken to meet the requirements of these Regulations; and

(b) the steps referred to in sub-paragraph (a)(ii) have been implemented.

(2) *The risk assessment shall include consideration of —*

(a) the hazardous properties of inhalable dust likely to occur in the mine;

(b) the level, type and duration of exposure;

(c) the circumstances of the work, including changes in the nature of the work from one shift to the next and differing shift lengths;

(d) activities where there is the potential for a high level of exposure;

(e) the relevant exposure control limits;

(f) the effect of preventive and control measures which have been or will be taken in accordance with regulation 5;

(g) the results of relevant health surveillance;

(h) the results of any relevant sampling of exposure; and

(i) such additional information as the manager may need in order to complete the risk assessment.

(3) *The risk assessment shall be reviewed regularly, and forthwith if—*

(a) there is reason to suspect that the risk assessment is no longer valid;

(b) there has been a significant change in the work to which the risk assessment relates; or

(c) the results of any sampling carried out in accordance with regulation 8 show it to be necessary,

and where, as a result of the review, changes to the risk assessment are required, those changes shall be made.

(4) *The manager shall ensure that—*

(a) the significant findings of the risk assessment; and

(b) the steps referred to in paragraph (1)(a)(ii),

are recorded.

(5) *Within one month of the commencement of work, the manager shall ensure that the results of the risk assessment have been validated by the taking and subsequent evaluation of suitable and sufficient air samples.*

The following section describes the purpose of the risk assessment and goes on to cover the measures necessary to ensure that it is suitable and sufficient, including:

- assessing risks to people, including identifying occupational groups at significant risk;
- recording significant findings;
- validating the risk assessment; and
- reviewing the risk assessment.

21 The health risk from inhalable dust is reduced by minimising the cumulative exposure over an individual's working life and by maximising the opportunities for the body's natural lung clearance mechanism to operate effectively. Quartz is associated with a more rapid progression of disease, particularly when exposure is to freshly cut crystalline surfaces rather than to geologically-aged particles dispersed among clay minerals. The primary purpose of the risk assessment is to enable the manager to make valid decisions about the measures necessary to prevent or adequately control the exposure of workers to inhalable dust below ground in the mine and to monitor their effectiveness. It is not necessary to quantify the risk.

22 The risk assessment required by this regulation provides the manager with the basis for the design of his dust control and sampling schemes. It also enables mine managers to demonstrate readily, both to themselves and to others who may have an interest, for example workers' representatives and mines inspectors, that they have:

(a) considered all the factors likely to contribute to peoples' exposure to inhalable dust;

(b) reached an informed and valid judgement about the risks;

(c) considered situations where prevention of exposure to inhalable dust is possible;

(d) considered the steps which need to be taken to achieve and maintain adequate control of exposure where prevention is not reasonably practicable;

(e) considered what exposure sampling and health surveillance is required; and

(f) identified other action, such as instruction and training necessary to comply with these Regulations.

23 The risk assessment could cover the whole of the mine or could be a series of individual assessments for each district.

24 Mine Managers may appoint someone to assist them in carrying out a risk assessment so long as that person has a working knowledge of underground mining techniques, dust control measures and sampling techniques.

Suitable and sufficient risk assessment

25 Paragraphs 25-48 give guidance on what the mine manager must do to ensure risk assessments are suitable and sufficient.

26 The risk assessment must identify:

(a) parts of the mine where coal or stone is cut by machine;

(b) the type of dust likely to be created; in particular, whether there will be quartz dust from cutting through sandstone or from dispersed and aged particles of quartz in other strata;

(c) any other sources of airborne dust in the mine which may pose a risk to the health of workers who are exposed to it;

(d) through sampling when possible, the level of exposure to respirable dust and quartz likely to be experienced by workers;

(e) workers at most risk of exposure above the exposure control limits; and

(f) additional sampling needed to validate the assessment.

27 The risk assessment must:

(a) be appropriate to the geology, the method of working, the rate of production, the ventilation arrangements and the length of time people are at work in the mine and state the assumptions it is based on.

(b) take account of measures needed to control other hazards, like frictional ignition of flammable gas, which may affect dust controls.

Assessing risks to people

28 The risk assessment needs to identify workers or groups of workers (occupational groups) at significant risk and the steps to take to protect them.

29 The manager must design control measures to protect everyone working below ground. But other measures, like sampling and health surveillance, need to be proportionate to the risk.

30 There will be a range of risks:

(a) low risk (insignificant), for people who go below ground so infrequently that their overall exposure will always be well below the exposure action levels;

(b) medium risk, for those who are regularly employed below ground, but on less dusty work so they are normally below the exposure action levels;

(c) higher risk, for those employed on dust-producing operations or in areas directly affected by them and so frequently exposed above the exposure action level and vulnerable to occasions when an exposure control limit might be exceeded.

31 The manager only needs to consider current and likely future levels of exposure in assessing risks and what steps to take to comply with the Regulations.

32 The risk assessment will need to identify:

(a) the circumstances where workers are likely to be exposed to levels of dust above the exposure action level; and

(b) where to provide RPE and encourage its use; or

(c) where the measures for control of exposure to inhalable dust require it, under regulation 5.

33 The Regulations also require employers to provide health surveillance for anyone with a significant exposure to inhalable dust, or an employment history showing significant exposure. So, employers should not rely solely on the manager's risk assessment to decide if their employees need health surveillance. They will need to take account of exposure accumulated throughout employees' working lives.

34 Table 1 summarises the main steps that flow from the manager's risk assessment.

Table 1

	LOW RISK	MEDIUM RISK	HIGHER RISK
Work pattern	People who work underground occasionally (less than once per week) or for short periods (less than one month in any year).	People who regularly work below ground but in a low dust environment.	People who regularly work below ground in dust-producing operations or in locations affected by dust from these operations.
Assessed exposure (without taking account of RPE)	Up to the time-weighted exposure control limits on the few days worked	Normally below the exposure action level (see paragraph 12).	Frequently above the exposure action level (see paragraph 12). Vulnerable to occasions when an exposure control limit might be exceeded**.**
Control measures	The engineering control measures and use of RPE.	The engineering control measures and use of RPE.	The engineering control measures and use of RPE. (See also paragraphs 68-70)
Sampling arrange-ments	Need not be covered by the sampling scheme. If employer asks for exposure estimates, these can be based on data from sampling regular mineworkers in the same part of the mine.	Periodic checks to confirm that their exposure is still below the exposure action level through annual validation of assessment or monthly sampling representatives from the whole group.	Included in the sampling scheme for regular monthly sampling of individuals or representatives of an occupational group of people with similar work and exposure patterns.
Health surveillance	Not normally required unless work history suggests previous high levels of exposure.	Required	Required
Examples	Surface workers who occasionally work below ground. Most short-term contract maintenance workers. Suppliers' representatives.	People who work mainly in intake roadways. Many others if engineering controls are fully effective. People assigned to lower exposure work on advice of a doctor.	Production and development workers. Some others who work mainly in return roadways.

35 The risk assessment will provide the basis for the sampling scheme required by regulation 8. The occupational groups or people identified in the risk assessment as higher risk will be the most vulnerable to occasionally exceeding the exposure control limits. So, they should be included in the sampling scheme schedule (see paragraph 105). Monthly sampling for these occupational groups or people is required to show compliance with exposure control limits.

36 Where the risk assessment identifies activities, for example shotcreting repairs to shaft lining, with a potential for very high exposure (regulation 4(2)(d)), but the activity will not last for more than five days in any year, the repeat sampling required by regulation 10 will not be possible. In these circumstances, taking investigational samples (beyond the scope of the sampling scheme) will be enough to confirm that RPE is adequate for the workers directly involved and demonstrate that any people downstream have not been exposed above the exposure control limit.

37 The risk assessment will also help identify those people who need health surveillance under regulation 11.

Occupational groups

38 It is not necessary to allocate every worker to an occupational group. The risk assessment may also identify individual jobs which cannot be grouped with others because of a unique pattern of work; such jobs will need to be treated like an occupational group with only one member. Further guidance on occupational groups is given in paragraphs 110-115.

Recording the significant findings

39 The regulation requires the manager to record the significant findings from the risk assessment. Records created to meet requirements of other regulations do not need to be duplicated, as long as these are cross-referenced. The dust control scheme and sampling scheme required by regulations 5 and 8 respectively will normally be a sufficient record of the measures identified by the risk assessment. Other recorded arrangements, such as the scheme of maintenance required by regulation 11(2) of the 1993 Regulations, will also normally be sufficient. The additional records required by this regulation will then just be those needed to demonstrate that the risk assessment has been systematic in considering all relevant factors and that the control measures are appropriate to the hazards. The record will need to set out managers' reasons for selecting the control measures used – and where appropriate the reasons for rejecting alternative measures.

40 Taken together with any cross-referenced schemes, there needs to be an effective statement of hazards, risks and actions taken to protect the health of workers below ground, recorded from the risk assessment. The main control measures must be outlined here, although their specific details may be set out in the schemes.

41 The significant findings of the risk assessment will need to include, as appropriate:

(a) the processes or activities which, under normal conditions, produce inhalable dust to which workers may be exposed;

(b) any circumstances which could result in abnormally high levels of inhalable dust in the workplace if not properly controlled. These include maintenance of dust filters, changes in geology, particularly if quartzitic rock might be thrown into the cut horizon, or other foreseeable incidents;

(c) the design measures taken to reduce the production of dust, for example in selecting cutting equipment;

(d) the engineering controls in place, ventilation provision and the dust suppression system employed;

(e) identification of the likely exposure (low, medium or high) of the workers or occupational groups liable to be exposed;

(f) the conclusions reached on the risks to the health of workers and to any other people who may be affected by the work concerned, taking account of the control measures being used;

(g) which groups of workers need to be under health surveillance;

(h) the commissioning, monitoring and testing required as part of the process of validating the effectiveness of and refining control measures;

(i) the design of the sampling scheme to monitor workers' exposure to inhalable dust;

(j) where appropriate, the reasons for selecting particular types of RPE to secure adequate control, and the circumstances under which RPE must be worn by individuals; and

(k) when the risk assessment will be reviewed or the period between successive reviews.

42 The record of the significant findings will also form the basis for a review and, if necessary, a revision of the risk assessment.

43 The significant findings must be recorded. This record may be kept in electronic form, but it is essential that appropriate arrangements be made to safeguard against accidental loss. This information needs to be readily accessible and retrievable at any reasonable time for use by the manager in reviews or for examination, for example by a safety representative or mines inspector.

Validating the risk assessment

44 For any new risk assessment, including any resulting from a review, unless that review resulted in no material change to the recorded significant findings, the manager will need results from a number of samples to validate the assessment. In the case of a new district, the regulation allows one month to take the validation samples. In other cases, relevant sampling results may already be available; for example an occupational group may have been subject to regular sampling since the previous review.

45 The purpose of validating the risk assessment is to confirm it has correctly identified those jobs with higher risk and therefore that the appropriate individuals and occupational groups have been selected for monthly sampling. The manager also needs to check that, for workers initially assessed as at medium or low risk, these assessments are confirmed as correct and they only need annual or infrequent sampling in the sampling scheme. The number of validation samples will need to be proportionate to the size and complexity of the mine, and may take account of any monthly sample results, perhaps from a previous similar district, that provide relevant information.

46 As a minimum, three validation samples must be taken for each occupational group assessed as medium risk. If all three samples are below the exposure action levels, that will be sufficient validation. If one is greater than the exposure action level for either respirable dust or quartz, at least two more samples will need to be taken. The original assessment will be confirmed if both

of these additional samples and the average of all five samples are below both exposure action levels. In any other case, the group must be re-assigned to higher risk and sampled monthly.

47 In some circumstances, such as commissioning a new production or development district, it might not be possible to validate the risk assessment until operations begin and sampling data is available. So, the manager must make sure that while waiting for such information to confirm the risk assessment's conclusions, a cautious approach is adopted so workers' exposure to inhalable dust is adequately controlled. For example, any plans to increase standard working hours beyond the level considered in the risk assessment should wait for its validation.

48 Regulation 9 requires a record to be kept of the results of validation samples but they are outside the scope of the sampling scheme required by regulation 8 so any results above the exposure control limits do not directly trigger the actions set out in regulation 10.

Reviewing the risk assessment

49 The regulation requires the manager to review the risk assessment regularly and keep it up to date. How often and how fully it is reviewed will depend on how quickly the mine changes. If changes affect only part of the mine or certain workers, only the part of the risk assessment affected needs to be reviewed early. The opening of a new production or development district or a change in working hours are changes which are likely to affect the validity of a risk assessment. In large coal mines, all parts of the assessment will normally need to be reviewed at least once a year. At small mines, the mine manager may simply need to be sure that;

(a) there have been no significant changes in geological conditions;

(b) there have been no changes in working methods; and

(c) the average of sampling results from the previous year are below the exposure action levels.

50 In any event, the risk assessment must be reviewed immediately if there is evidence that it is no longer valid. For example, a review might be prompted by:

(a) the results of examinations and tests of control measures (regulation 7);

(b) the results of sampling exposure (regulation 9);

(c) the results of health surveillance, for example the identification of an adverse health effect or a confirmed case of pneumoconiosis (regulation 11); or

(d) reports or complaints from supervisors, safety representatives or employees about problems with the control systems.

51 The risk assessment will also need to be reviewed where there has been a significant change in the circumstances of work, especially one that may have

affected workers' exposure to inhalable dust. These include changes in:

(a) plant, including engineering controls;

(b) geological conditions;

(c) the ventilation system;

(d) the rate of production; or

(e) shift patterns or working hours;

if any of these are outside the parameters of the original risk assessment.

52 Where the risk assessment is reviewed and the review identifies changes in the extent of the hazard and/or the need for changes to the control measures, the manager must take action to implement any necessary changes and update the record. In particular, it will be necessary to:

(a) re-examine existing control measures to decide whether they can be improved; and

(b) consider whether the controls really reduce exposure as low as is reasonably practicable below the exposure control limits, or just below them.

Consulting workers and their representatives

53 In accordance with Health and Safety (Consultation with Employees) Regulations 1996[5], and the Safety Representatives and Safety Committees Regulations 1977[6], it is strongly recommended that the manager involves his workers and/or their safety representatives when carrying out and reviewing risk assessments. They are in a good position to know what happens in practice and they will use the controls that the mine manager introduces.

Regulation 5: Prevention or control of exposure to inhalable dust

5. —(1) Without prejudice to the requirements of regulation 10, the manager shall ensure that the exposure of persons at work to inhalable dust is either prevented or, where this is not reasonably practicable, reduced to as low a level as is reasonably practicable.

(2)Where it is not reasonably practicable to prevent the exposure of persons at work to inhalable dust, and having regard to the risk assessment, the manager shall comply with his duty under paragraph (1) to reduce that exposure to as low a level as is reasonably practicable by the application of the following measures, in order of priority—

(a) the design and use of appropriate work processes, systems and engineering controls and the provision and use of suitable work equipment and materials;

(b) the control of exposure at source, including adequate local ventilation systems and appropriate organizational measures;

(c) the control of the working environment, including general ventilation; and

(d) the provision of suitable respiratory protective equipment in addition to the measures required by sub-paragraphs (a), (b) and (c).

(3)The measures referred to in paragraph (2) shall be recorded in the form of a suitable and sufficient scheme to reduce exposure to inhalable dust and shall include—

(a) the adoption of suitable maintenance procedures; and

(b) reducing to the minimum for the work concerned—

(ii) the level and duration of exposure, and

(iii) the number of persons subject to exposure.

(4)As soon as is practicable, the manager shall provide the Executive with a copy of the scheme required by paragraph (3) and, thereafter, any significant revision to that scheme.

(5)Respiratory protective equipment provided by an employer in accordance with this regulation shall be suitable for the purpose and shall—

*(a) comply with any provision in the Personal Protective Equipment Regulations 2002(**1**); or*

(b) where no provision referred to in sub-paragraph (a) applies, be of a type approved or shall conform to a standard approved, in either case, by the Executive.

General duty

54 Regulation 5 makes clear that it is not enough just to comply with the exposure control limits; exposure must be reduced to as near zero as is reasonably practicable. This is particularly important in the case of respirable quartz from cutting sandstone because of the increased risk to health from quartz particles with freshly exposed surfaces. For example, the most effective available dust extraction systems should be selected for headings with sandstone beds in the cut section even if less costly versions would control to the exposure control limits.

55 The duty to minimise exposure is placed on the manager but the mine owner has to give him the resources (Regulation 6(2) of the 1993 Regulations), and other employers have to co-operate with the mine manager (Regulation 4 of the 1993 Regulations).

The following section starts by discussing issues the manager will need to consider to prevent or control exposure. It then goes on to cover specific control measures such as:

- the manager's dust control scheme;
- the provision of suitable respiratory protective equipment; and
- control of working hours.

(1) S.I. 2002/1144, to which there are amendments not relevant to these Regulations.

Prevention or control of exposure

56 The manager will first need to consider whether there are circumstances when it would be reasonably practicable to prevent workers being exposed to sources of inhalable dust. For example by:

(a) eliminating the work activity causing exposure;

(b) providing shearers with controls which allow the operator to stay on the intake side;

(c) arranging the auxiliary ventilation of a heading so that return air is not used to series ventilate another place of work;

(d) organising activities in face return gateroads, such as materials transport and firedamp drainage boring, at times when there is no coal cutting on the face.

57 Where it is not reasonably practicable to prevent exposure to inhalable dust, the manager must adequately control exposure. This will be achieved through:

(a) reducing the amount of dust in the air (through dust suppression and extraction/ventilation);

(b) controlling the length of time people are exposed; and

(c) using RPE to protect people.

58 The regulation requires the manager to give priority to engineering controls. This means that exposure levels must be reduced to as low a level as is reasonably practicable through engineering controls (eg dust suppression/extraction systems to keep dust out of the air) and then organisational controls (eg systems of work that reduce workers' exposure to dusty air).

59 Where it is not possible to achieve the exposure action level through engineering and organisational controls alone, additional controls relying on RPE will be needed. RPE must only be used as a complement to engineering controls and never as a substitute.

60 The manager's aim must be to select those control measures which in practice will work best to protect the health of everyone working below ground, as long as they do not adversely affect measures intended to control other hazards, such as ignitions of flammable gas. It will not always be possible or necessary to apply all the kinds of controls listed in regulation 5(2).

61 The managers may appoint others to advise on the prevention or control of exposure, so long as they are competent to do so in accordance with these regulations. The people who carry out this work will need to have adequate knowledge, training and expertise, for example in the design of mining methods and equipment, ventilation and PPE.

Specific control measures

Manager's dust control scheme

62 One of the objectives of the risk assessment is to select the controls or combination of controls that are proportionate to the risk and which will achieve

adequate control of exposure. Adequate control of exposure can be achieved through a combination of reducing the amount of dust in the air workers breathe to a minimum and limiting the amount of time that workers are exposed to the dusty air.

63 The manager will need to consider at least the following control measures:

(a) at the design stage, adopting methods of work and layouts which minimise the need for workers to be downwind of major dust sources;

(b) selecting equipment with design features aimed at minimising dust production, such as cutting machines giving picks the slowest radial speed but greatest penetration rate possible in the circumstances;

(c) providing the capability to change the method of working to reduce the amount of dust produced if faults or other strata changes are encountered, say from machine cutting to drilling and blasting;

(d) providing good general ventilation where exhaust auxiliary ventilation would not be possible or adequate;

(e) using exhaust auxiliary ventilation systems with dust collection to remove dust from the air;

(f) using horizon control systems to avoid or minimise the cutting of stone, particularly if this has a high quartz content;

(g) adopting the best available means of dust suppression on mineral cutting machines, such as high pressure water sprays to each pick and recirculatory air curtain drums;

(h) fitting maintenance aids to dust suppression equipment such as water pressure and flow gauges and tamper-resistant control valves; and

(i) using the best available means of dust suppression on mineral conveyors, particularly those on the intake side of working places, including bottom belt sprays.

64 When deciding whether to apply particular control measures, the manager will need to take into account their ease of use, tamper prevention features and ease of maintenance as well as their effectiveness and cost.

Documenting the scheme

65 The manager has to record the selected control measures in a scheme (referred to as the dust control scheme in this ACOP). This will also need to be sufficiently detailed to provide the information required by those people who install, operate, monitor and maintain the measures, and their supervisors. It needs to allow the manager's design intention, as identified in the risk assessment, to be applied in a practical way. The dust control scheme for the mine may be subdivided into schemes for specific parts of the mine or specific kinds of dust source if that will help its application.

66 In designing the scheme and specifying control measures, the manager will need to consider:

(a) the results from the risk assessment on the extent of exposure of different occupational groups; and

(b) the time-weighted exposure control limits applying to those groups.

67 In the scheme the manager must specify each control measure. It will need to include the following:

(a) the standard hours worked and equivalent time-weighted exposure control limits for each occupational group and individual job outside an occupational group identified in the risk assessment;

(b) an outline description of the plant or processes identified in the risk assessment as sources of inhalable dust;

(c) details of the equipment provided in connection with each of these sources to prevent or minimise dust being produced or becoming airborne;

(d) details of any equipment provided to remove inhalable dust from the air before it reaches a workplace;

(e) the design and minimum operating criteria for such equipment, including as appropriate, flow rates, pressures, pick sharpness etc;

(f) the design and minimum required ventilation flow rates;

(g) the systems of work to be adopted to eliminate or reduce the need for workers to go into hazardous areas close to or downstream of dust sources;

(h) arrangements for supervision and maintenance of control measures. This will include any monitoring of controls by machine operators during a shift; and

(i) the RPE to be provided (such as dust masks or filtered air helmets) and rules about when it needs to be used to best effect, while taking account of risks to workers' health and safety from other hazards which may be made worse by the use of certain types of RPE.

Respiratory protective equipment

68 Individuals or occupational groups identified in the risk assessment as being at higher risk (those above the exposure action levels defined in paragraph 12) will have to be provided with RPE. RPE should also be freely available to those assessed as being at medium or low risk. Regulation 12 requires information, instruction and training on how to best use the RPE.

69 The manager's scheme, reflecting the results of the risk assessment, will need to specify those circumstances when wearing RPE is mandatory. These requirements may be specified in terms of particular groups of workers, types of work, areas of the mine or periods of time. As a minimum, the scheme should require the use of suitable RPE by workers affected by all of the following risk factors:

(a) downstream and in the same air circuit as a mineral-getting machine that routinely cuts significant sandstone beds; and

(b) a significant proportion of quartz (more than 10 %) in the respirable dust; and

(c) exposure to quartz significantly above the exposure action level.

70 Where RPE must be worn in hot and humid workplaces, the scheme will need to be designed to balance the reduction in people's risk from exposure to quartz dust against any potential increased risk arising from the heat and

humidity. The manager must consider whether there is scope for adopting working arrangements to minimise the need for prolonged wearing of RPE. For example on a longwall face it may be possible to rotate workers between a hot and dusty return end and a cooler and less dusty intake end. In headings, use of RPE might be restricted to the cutting part of the cycle if that is when the bulk of the dust is produced.

Suitable respiratory protective equipment

71 To be suitable, RPE issued to workers should be capable of reducing their actual exposure (ie including the effect of the RPE) to no more than the exposure action levels. The selection should be based on a range of considerations:

(a) the protection rating of the equipment as defined by the relevant European/British standard;

(b) the climatic conditions in the mine; the type of work to be done; the physical effort required to do it; the length of time the equipment will have to be worn; the requirements for visibility, comfort and the need for employees to communicate with each other;

(c) the different facial characteristics of RPE wearers, ensuring that the equipment fits correctly, and is matched to the wearer;

(d) the equipment must be matched to the job and the environment in which it is to be used. Equipment should be selected in full consultation with the wearers. This will help to ensure that wearers have the most comfortable equipment best suited for them and which, as a consequence, is likely to be the most effective in use;

(e) the equipment must comply with the relevant European Standard. (For half-face dust masks the relevant standard is BS EN 149:2001 *Respiratory protective devices. Filtering half masks to protect against particles* [7]). Equipment (eg airstream helmets) manufactured before 1995 and HSE-approved may also be used. Further guidance can be found in the HSE publication Respiratory Protective Equipment at Work: A Practical Guide[8].

72 RPE made to BS EN 149 type FFP1 is designed to reduce the exposure by a factor of four (ie to a quarter of the exposure level without a mask. But, this type of RPE is usually less effective at filtering out the very fine particles typical of quartz. FFP1 RPE is sufficient where:

(a) the level of quartz is normally below the exposure action level;

(b) the likely respirable dust levels are above the exposure action level but below the exposure control limits.

In other cases, RPE with a higher protection rating than FFP1 will be required. The choice between FFP2 and FFP3 will depend on the exposure conditions and the way it is to be used. In general FFP2 will be more appropriate for extended wear and FFP3 for intermittent wear.

73 Equipment designed for repeated use should be cleaned and maintained in accordance with the manufacturer's instructions. In particular, filters should be replaced at recommended intervals or even earlier if they become clogged.

74 It is essential that the RPE properly fits the face of the user. The manager should make sure the selected facepiece is the right size and can correctly fit each

wearer required to use RPE. It is important to pay particular attention to those users with glasses, beards and moustaches. Managers need to be aware that particular makes of mask may not necessarily fit all users and they will need to offer a choice of sizes and/or makes. Where the manager has identified that FFP3 equipment is required as a result of the risk assessment, it should be fit tested, or substituted with powered RPE with a loose-fitting facepiece. Fit testing is not required where the manager decides to make FFP3 masks available in circumstances where FFP2 or FFP1 masks would offer sufficient protection. Further guidance on fit testing methods is given in the HSE publication *Fit testing of respiratory protective equipment facepieces*[9].

Control of working hours

75 In places where the standard working hours (including planned overtime) below ground exceed 40 hours a week or 12 hours a day, the measures set out in the dust control scheme must be designed to ensure adequate control below the relevant exposure control limits, as reduced by the time-weighting calculation described in Appendix 1.

76 The adjustments for time-weighting purposes must be made for the standard working shift and standard working week specified for the occupational group in the manager's dust control scheme. This applies even if an individual being sampled to represent the group works for a shorter time.

77 The scheme will also need to set out the arrangements for checking that workers do not work more than the standard hours specified in the scheme and what measures should be taken to protect individuals in the event that this happens.

78 There will need to be measures in place in the management system to ensure people working additional overtime over that included in the standard hours are not exposed above the exposure control limits over the long term. This measure would normally include reducing the individual's next working week below standard by at least the same number of hours as were worked on non-standard overtime in the current week.

79 If the manager can demonstrate, with a suitable assessment of exposure during non-standard overtime activities, validated by sampling, that those exposures are significantly less than during normal work, the time off may be reduced in proportion, so long as the person concerned agrees.

Dust control scheme: General

80 The manager needs to make sure everyone at work in the mine understands the parts of the dust control scheme that are relevant to them (regulation 12). The full scheme must be posted in the covered accommodation (regulation 36 of the 1993 Regulations). In large mines the parts relevant to particular districts in the mine should be posted at the entrance to those districts too.

81 The dutyholder responsible for preparing, implementing and maintaining the dust control scheme is the manager, but contractors or other employers have a duty to co-operate with the manager under regulation 4 of the 1993 Regulations and therefore must ensure that their employees adhere to the manager's scheme.

Submission of dust control schemes to HSE

82 The manager must submit a copy of the schemes made under this regulation to the appropriate HM Principal District Inspector of Mines. A scheme prepared on commissioning a new district will need to be submitted, unless the district is a like-for-like replacement anticipated in a previously submitted scheme. Any revision, whether arising from a review of the assessment or otherwise, if it will affect the exposure of people to inhalable dust, will also need to be notified, by resubmitting the full scheme or replacement pages with the significant changes.

83 It is not necessary to notify revisions unlikely to affect dust exposures, such as replacement of a fan with one of similar performance from a different manufacturer. The copy submitted to HSE should not include individuals' names. Occupational groups should be described in terms of people's jobs.

Regulation 6: Use of control measures etc.

6. —(1) Every manager who provides any control measure, other thing or facility in accordance with the scheme required by regulation 5(3), shall take all reasonable steps to ensure that it is properly used or applied as the case may be.

(2) Every employee shall make full and proper use of any control measure, other thing or facility provided in accordance with the scheme required by regulation 5(3) and, where relevant, shall—

(a) take all reasonable steps to ensure it is returned after use to any accommodation provided for it; and

(b) if he discovers a defect therein, report it forthwith to his supervisor.

84 The manager needs to establish procedures to ensure that control measures, including RPE and anything else required by the dust control scheme, are properly used or applied and are not made less effective by other work practices or by improper use. The arrangements need to include:

(a) visual checks and observations at appropriate intervals;

(b) making sure that where more than one item of PPE is being worn, the different items are compatible with each other;

(c) supervising workers to ensure that the defined methods of work are being followed; and

(d) prompt remedial action where necessary.

85 Workers must use the control measures in the way they are intended to be used and as they have been instructed. They need to:

(a) follow the defined methods of work; and

(b) report promptly to a supervisor any defects discovered in any control measure, including defined methods of work, device or facility or any item of RPE.

Regulation 7: Maintenance, examination and testing of control measures

7.—(1) Where the manager provides any control measure to meet the requirements of regulation 5, he shall ensure that, where relevant, it is maintained in an efficient state, in efficient working order and in good repair.

(2) Where engineering controls are provided to meet the requirements of regulation 5, the manager shall ensure that thorough examination and testing of those controls is carried out at suitable intervals as part of the scheme required by regulation 5(3).

(3) Where respiratory protective equipment (other than disposable respiratory protective equipment) is provided to meet the requirements of regulation 5, the manager shall ensure that—

(a) thorough examination and, where appropriate, testing of that equipment is carried out at suitable intervals; and

(b) a well-defined place is used for storage of that equipment.

(4) The manager shall keep a suitable record of the examinations and tests carried out in accordance with paragraphs (2) and (3) and of repairs carried out as a result of those examinations and tests, and that record or a suitable summary thereof shall be kept available for at least 5 years from the date on which it was made.

Maintenance of control measures

86 The regulation requires the manager to ensure that control measures are maintained in an efficient state, in efficient working order and in good repair. It also requires him to make arrangements for testing and examination at periodic intervals.

87 The objective of this regulation is to ensure that all control measures perform as originally intended and continue to prevent or adequately control the exposure of workers to inhalable dust. It applies to procedural controls a well as engineering controls and the duty to maintain their effectiveness only ceases to apply when people are no longer exposed, for example when the relevant dust source has been shut down. The manager's dust control scheme made under regulation 5 should set out the arrangements for maintenance of control measures.

88 To comply with the duty in regulation 5(1), the mine manager will need to monitor the performance of the engineering controls. Without this information it will not be possible to know whether they are operating efficiently or effectively.

89 The most important information in this will be the monitoring of results from the samples taken under the sampling scheme. The manager will need to consider the information from these samples from the point of view of:

(a) whether or not the exposure control limits are complied with; and

(b) the information they provide on the performance of the dust control measures. Increases in the dust levels may indicate the need to improve the performance of control measures beyond the normal maintenance checks on equipment required by regulation 5(2).

90 Although samples taken under the sampling scheme are an important source of information, they may need to be complemented by fixed point samples to monitor the performance of key items of equipment or combinations of dust control measures. Fixed point sampling may be required if workers are not usually present for sufficient time for personal samplers to provide a

representative result, for example to check the performance of a dust extraction unit or levels of intake contamination.

91 In any case, in a mine operating a mechanised longwall face, the control measures monitoring sampling must include a sample taken each month 70 m from the face in the return gate road. However, this requirement is subject to review by the Mining Industry Committee. When carrying out this sampling, the sampler pumps should be switched on and off when the instrument is at the specified sampling point and run for the duration that workers from the shift being sampled are on the face.

92 It is important to stress that these samples do not form part of the sampling scheme required under regulation 8 and so do not lead to the actions required by regulation 10. However, the analysis should be carried out to the same standards (see paragraphs 125-126). Records will also need to be kept and made available to safety representatives (see paragraph 133).

Periodic testing and examination of engineering controls

93 The dust control scheme must:

(a) identify those dust control measures requiring periodic testing and examination;

(b) specify the tests and examinations and when they should be carried out;

(c) specify arrangements for recording and reporting the results;

(d) where appropriate, specify the operating parameters or criteria for further maintenance work (eg replacing filters).

Action in the event of a defect

94 The dust control scheme needs to set out the action to take if a defect is found. This will include arrangements for repair or replacement of equipment, as well as for assessing whether relevant dust-producing operations will need to be suspended while the defect is remedied and whether supplementary control measures are required.

95 Any defect resulting in a dust control measure not performing as specified in the scheme should normally be put right before resuming the dust producing operation the measure is controlling. This applies unless the manager is satisfied that there will be no adverse effect on exposure levels.

Reusable Respiratory Protective Equipment (RPE)

96 The regulation requires the manager to provide well-defined accommodation so reusable RPE can be safely stored or kept when not in use. The storage must be adequate to protect RPE from contamination, loss or damage by, for example harmful substances, damp or sunlight. It is strongly recommended that equipment ready for use is clearly segregated from equipment awaiting repair or maintenance.

Suitable records

97 The manager will need to keep a suitable record of each examination and test carried out under regulation 7(2) and (3). These records may be kept as part of the manager's scheme for the mine under regulation 11 of the 1993 Regulations. They must be kept for at least five years from the date they were

made whether or not they are kept with the records from the 1993 Regulations. Records may be kept in electronic form, but it is essential that appropriate arrangements are made to safeguard against accidental loss. The records need to be readily accessible and retrievable at any reasonable time for examination by a safety representative or mines inspector.

Regulation 8: Sampling scheme for respirable dust

8—(1) The manager shall operate a suitable and sufficient sampling scheme designed to measure the levels of respirable dust and quartz to which persons are exposed below ground at the mine.

(2) The sampling scheme required by paragraph (1) shall specify—

(e) the method by which samples are to be taken;

(f) the persons who are to be sampled;

(g) the locations at which samples are to be taken;

(h) the frequency with which samples are to be taken; and

(i) the type of sampling instrument which is to be used.

(3) *Every sample taken under the sampling scheme required by paragraph (1) shall be so taken as to be representative of the general body of the air in the vicinity of the persons in relation to whom it is taken throughout a working shift below ground.*

(4) *The manager shall appoint a competent person to supervise the operation of the sampling scheme required by paragraph (1).*

Evaluation of samples

The following section starts with guidance on the purpose of the sampling scheme and goes on to cover:

- sampling methods;
- occupational groups;
- frequency of sampling;
- ensuring samples are representative; and
- training.

Purpose of the sampling scheme

98 The purpose of the sampling scheme is to set out the arrangements for sampling at the mine. It must include a schedule of the samples that are to be taken each month to measure the exposure of all the occupational groups at significant risk.

99 The sampling scheme must be recorded in sufficient detail to be carried out as the manager intends. All or part of the record may be in electronic form.

100 If there is anyone working at the mine who has been transferred to work with reduced dust exposure on the advice of a doctor, the sampling scheme must also provide for sampling their exposure. The sampling frequency and the permitted exposure will be specified by the mine owner to reflect the advice of

the doctor, but must be at least once a year and permitted exposure not more than the exposure action level. Access to the person's name and sampling requirements must be limited to those who need to know, in accordance with arrangements made by the mine owner.

101 The document setting out the sampling scheme may also list additional fixed point samples the manager requires, for example to check the effectiveness of engineering controls. But these should be identified as beyond the scheme's requirements, so the actions required by regulation 10 are not triggered.

102 The owner is responsible under regulation 9(1) for arrangements away from the mine, including:

(a) arrangements for laboratory analysis;

(b) the method for determining if exposure control limits have been exceeded; and

(c) the action to take to alert the mine manager in that event.

103 The manager may appoint someone to assist in drawing up the sampling scheme. A person with knowledge of exposure sampling strategies and training and expertise in measurement techniques and their interpretation may be able to help.

104 The manager must appoint someone to supervise the sampling scheme's operation. This person must have adequate knowledge of what the scheme must achieve, be familiar with the sampling equipment, measurement techniques and their interpretation and what factors could invalidate the results. At small mines, managers could appoint themselves if they have the necessary expertise/competence.

105 The sampling required by the scheme must be designed to provide a representative picture of the levels of respirable dust and quartz to which people working below ground are exposed. There should be particular emphasis on those at greatest risk of exposure above the exposure control limits. It is not necessary to measure everyone's exposure and every dust source to achieve this. The sampling schedule needs to be based on the risk assessment carried out under regulation 4. This should include periodic validation checks to make sure there has been no material change to the exposure of those not sampled monthly.

106 The sampling scheme needs to cover:

(a) the identity of occupational groups and the names of people in each group to be sampled;

(b) the names of anyone not allocated to occupational groups to be sampled;

(c) where fixed point sampling is used because personal sampling is impracticable, the locations to be sampled;

(d) the frequency of sampling;

(e) the sampling equipment to be used;

(f) the arrangements for issuing sampling equipment;

(g) the responsibilities of the sampling scheme supervisor;

(h) the responsibilities of people wearing or taking care of samplers; and

(i) the supervision of sampling equipment use by inspecting and supervising officials.

107 Employees have a duty under section 7(b) of the 1974 Act to co-operate with their employers so far as necessary to enable them to comply with the law. A worker who refuses to wear a personal sampler could be in breach of this and regulation 5 of the 1993 Regulations, which also places a duty on employees to co-operate with the manager of the mine and the system of safe working.

Sampling methods

108 The regulation does not specify the use of personal sampling. So, it is open to the manager to rely on fixed point sampling if personal exposures cannot be sampled directly, for example in seams so thin that workers must lie on their sides. However, the manager will need to demonstrate that:

(a) personal sampling is not reasonably practicable; and

(b) the sampling equipment has been appropriately located to provide a measure of the exposure of the most exposed groups, which is at least as representative as that provided by personal sampling.

109 Unless being used for investigational samples beyond the requirements of the sampling scheme or regulation 10, personal sampling pumps must be switched on at the surface just before the wearer enters the mine and switched off on return to the surface.

Occupational groups

110 The number of workers in an occupational group will also need to reflect the level of risk of dust exposure. It is important that if there is a risk of high dust exposure, there is only a small number of jobs in the group. In this way sampling of anyone within a group will be more frequent for those at highest risk. Some examples follow:

(a) small groups associated with major dust sources, such as cutting of coal and stone by machine in a mechanised heading or the movement of powered supports on a longwall face;

(b) larger groups covering jobs in the same air circuit associated with secondary sources of dust, like roadway repair and supply work on intake transport roadways or the back-up activities in a heading; and

(c) a group covering all jobs unlikely to be exposed above the exposure action level.

111 The number of groups will vary from mine to mine, depending mainly on the number of working places and partly on the complexity of the ventilation arrangements.

112 For example for each mechanised longwall district in a large mine, there could be:

(a) a group representing the highest risk jobs (perhaps shearer drivers on a retreating face or return gate rippers on an advancing face);

(b) a group for the other face workers;

(c) there might need to be a third group for back-up workers in the return gate, unless the risk assessment demonstrates that they are at low risk, and can be grouped with others outbye.

113 In each mechanised development there will need to be:

(a) a group for people working at the face of the heading; and

(b) unless the auxiliary ventilation system exhausts the dust straight into the main return, another for back-up workers.

114 A small mine may just have one group; but a second would normally be needed if a mineral-cutting machine, such as an arc wall cutter, is used, unless the validation has demonstrated that samples based on a single group would be representative of the exposures for all workers at higher risk.

115 Where the risk assessment done in accordance with regulation 4 is based on occupational groups rather than individuals, the names of the individuals in each group need to be recorded. Then, appropriate people can be selected to wear samplers and information on exposure can be transferred to individuals' health records or to the individual's employer. If there are some people allocated to a group who may not experience the full range of likely exposures, for example longwall faceworkers who work mainly at the intake end of the face, they will need to be identified so they are not selected for a personal sample to represent the group. If there are several people fully representative of the group, select different people for personal sampling on successive months. Further technical guidance on methods for sampling and gravimetric analysis of respirable dust in coal mines is set out in Appendix 2.

Frequency of sampling

116 The sampling scheme must provide for at least one representative sample each month from:

(a) the occupational groups identified by the risk assessment as most exposed to dust from the operation of each mineral-cutting machine. Or, if no cutting machine is in use during that month, the person, or occupational group, identified by the risk assessment as most exposed to respirable dust in the mine; and

(b) any other occupational group which the risk assessment identifies as being exposed above the exposure action level.

117 At a mine with no mineral-cutting machines, if the results of three successive monthly samples are below the exposure action level, future samples can be taken at three monthly intervals. However, that mine must revert to monthly sampling if a three monthly sample result is above the exposure action level.

118 At mines with mineral-cutting machines, the minimum number of samples taken each month must at least equal the number of mineral-cutting machines in operation that month.

119 For any occupational group not associated with a mineral-cutting machine, but identified in the manager's sampling scheme as requiring monthly sampling, any decision to stop monthly sampling must be taken in the context of a full review of the risk assessment. If twelve successive monthly sample results for the

group were all below the exposure action level, the manager may specify sampling at three monthly intervals for at least one more year. In any case, where a group is being sampled on a three monthly basis, if a single sample result is above the exposure action level, sampling frequency must revert to monthly.

Ensuring samples are representative

120 The sampling scheme must also specify appropriate criteria for determining whether operations during the sampled shift were representative. In most cases a measure of coal production, or heading advance, at the place where sampling is undertaken would be an appropriate criterion. If the cause of reduced cutting is likely to reduce dust exposure, such as breakdown of cutting or conveying equipment, the criteria need to be set at levels not less than half of what is expected normally. It is essential that the criteria do not cause rejection of samples taken when cutting is reduced by geological disturbance likely to increase exposure to dust, particularly quartz, so long as the sample is representative of working through the disturbed conditions.

121 If a sample is discounted as unrepresentative by the sampling supervisor, another one needs to be taken on the next working day. If this continues until samples have been taken on five successive working days and all are deemed unrepresentative, the sample selected for the purposes of the statutory scheme must be the one taken on the shift when the cutting, or other dust-producing activity on which the criterion was based, was the greatest.

Training

122 It is essential that anyone responsible for taking samples, whether personal or fixed point samples and anyone who supervises them or inspects their place of work, is trained in the proper use of the sampling equipment (see regulation 12). This training needs to include awareness of abnormalities which would cast doubt on the validity of the sample result, such as the instrument being switched off unintentionally, being dropped or held upside down and the need to report such events to the person in charge of sampling. Anyone who wears a personal sampler must be trained in using sampling equipment. The training is the responsibility of the sampling supervisor who will also have to take appropriate steps to ensure the equipment is used properly and is not tampered with.

Regulation 9: Evaluation of samples

9. *—(1) The mine owner shall make arrangements to ensure that the respirable dust content and, unless it would be inappropriate, the quartz content of each sample required to be taken by these Regulations is determined at a suitable laboratory.*

(2)The mine owner shall make arrangements to ensure that—

(a) the mine manager is notified of the respirable dust content and, where appropriate, the quartz content of each sample determined in accordance with paragraph (1)—

(i) where an exposure control limit is exceeded, immediately, and

(ii) in all other cases, within 4 working days of the sample being taken; and

(b) a record is kept of each such determination.

(3) *As soon as is practicable, the mine owner shall provide the Executive with details of the arrangements required by paragraphs (1) and (2) and, thereafter, any significant revision to those arrangements.*

(4) *The manager shall ensure that a notice specifying every respirable dust content and quartz content notified to him under paragraph (2) is displayed in the covered accommodation for a period of 30 days commencing with the date of notification.*

(5) *The manager shall ensure that a suitable record of sampling carried out for the purpose of these Regulations is made and maintained and that that record or a suitable summary thereof is kept available for at least 5 years from the date of the last entry made in it.*

Owner's arrangements for analysing the samples

123 The owner must make the arrangements to ensure samples taken under the sampling scheme required by regulation 8 are suitably analysed and reported on. These arrangements need to cover:

(a) supplying enough suitably calibrated sampling equipment to the mine;

(b) the maintenance and calibration of the sampling equipment;

(c) the handling of samplers and samples after use, including arrangements for getting each sample to the laboratory securely;

(d) what information has to accompany the sample to the laboratory. This must include the time-weighted exposure control limits relevant to the sample or the information needed to calculate the limit;

(e) the reporting of unusual circumstances which might have a bearing on the results of the sample;

(f) the criteria for rejecting a sample as unrepresentative, or if it has been tampered with, and the consequential action to take;

(g) the arrangements for analysis of the samples; for example who does it, how quickly they do it, and how to notify the manager of results, especially adverse results;

(h) where there are people with an adverse health effect or dust-related disease, the special arrangements for them to carry on working at the mine with reduced dust exposure. These arrangements must reflect the advice of the doctor and prevent the person's identity being disclosed to anyone who does not need to know.

124 The owner will also have to make arrangements for the analysis and reporting of results from samples that are required by the regulations, but are outside the scope of the sampling scheme. For example the validation samples described in paragraphs 44-48, or the fixed point samples described in paragraphs 90-92. The arrangements made under this regulation can also cover these other samples.

Selecting a suitable laboratory

125 A suitable laboratory will be accredited by the United Kingdom Accreditation Service (UKAS) for the determination of both respirable airborne dust and quartz in coal mine dust on filter samples according to documented in-house methods.

126 The documented in-house methods must be based on Appendix 2 (*Sampling, gravimetric analysis and assessment of the quartz content of respirable dust exposure in coal mines*) and should take account of the appropriate Methods for the Determination of Hazardous Substances (MDHS), available from HSE books, particularly MDHS 101 *Crystalline silica in respirable airborne dusts*[10].

127 The owner and the laboratory will need to draw up an agreement to cover:

(a) retaining samples in case there is a need for reanalysis (normally for at least six months);

(b) reporting results, especially adverse results, to the mine manager; and

(c) maintaining and calibrating sampling equipment, including training of selected colliery staff, where appropriate.

Analysis for quartz

128 The laboratory will need to determine the respirable quartz content of any sample unless the total respirable dust in the sample is less than the time-weighted exposure control limit for quartz. However, it will be necessary to evaluate a representative proportion of the samples to determine whether the exposure action level is being exceeded. The owner's arrangements will need to specify the proportion.

Reporting arrangements for sampling results

129 The owner will need to specify the arrangements for evaluating the sampling results against the time-weighted exposure control limits and for alerting the manager (and the employer if the owner was not the employer of the person being sampled) if there is an adverse sampling result. This will include:

(a) who is responsible for checking against time-weighted exposure control limits, recording and reporting to the manager;

(b) how the time-weighted exposure control limits relevant to each sampled occupational group are notified to the laboratory;

(c) who at the laboratory is responsible for alerting the mine manager if there is an adverse sample reading and how this is done;

(d) what to do and who should take action if a sample appears to have been tampered with or otherwise appears invalid;

(e) reporting arrangements for sampling results where the time-weighted exposure control limits have not been exceeded.

Submission of arrangements to HSE

130 The mine owner must submit a copy of the arrangements made under this regulation to the appropriate HM Principal District Inspector of Mines. An owner of several mines can submit a single document as long as, taken with the relevant sampling scheme, all the arrangements relating to sampling required by these regulations are described adequately.

Suitable records

131 The manager must keep records of:

(a) the date samples were taken;

(b) the shift lengths worked, and where different, the sampling time relating to the respective samples taken;

(c) whether each sample was a personal sample or a fixed point sample;

(d) where fixed point samples were taken, the location of the sampler in the mine by reference to a place identifiable on the working plan of the mine;

(e) where personal samples were taken, the names of the people concerned, the area of the mine where they work, their occupational group and/or job; and

(f) in addition, where the person is a contractor's employee, their employer's name and address.

Recording sampling results

132 All the sampling results need to be recorded in sequence for each occupational group or fixed sampling point, so any trends are readily apparent. The results of the most recent round of sampling, identified only by occupational group in the case of personal sampling, must be posted in the covered accommodation provided in accordance with regulation 36 of the 1993 Regulations.

133 In any mine operating a mechanised longwall face, the results from the fixed sampling point 70 m from the face in the return gate road should also be posted in the covered accommodation and made available to safety representatives.

134 The full sampling records must be kept for at least five years from the date of the last entry. The records may be kept in electronic form, but it is essential that appropriate arrangements are made to safeguard against accidental loss. They could also be maintained centrally by the mine owner, laboratory or occupational health service provider, as long as up-to-date details relevant to a particular mine are readily available at the mine when required.

135 Mine owners will need to make suitable arrangements for the transfer of relevant exposure data to health records so that they, and any other employer who must maintain health records to comply with regulation 11(2), can comply with that regulation (see paragraphs 182-184). The results of samples taken to check the exposure of workers subject to any special arrangements because of diagnosed adverse health effect or identifiable disease must be entered on the person's health record even if they are not entered in other records to protect their identity.

Regulation 10: Action to be taken in the event of excessive dust

10. *—(1) Where a manager is notified that a sample determination made as part of the sampling scheme required by regulation 8(1) exceeds the exposure control limit for respirable dust or the exposure control limit for quartz, he shall—*

(a) determine the reason why the relevant exposure control limit was exceeded;

(b) take any appropriate remedial action; and

(c) within 15 working days of receipt of that notification, ensure that a further 5 samples have been taken on 5 representative working shifts in order to determine the state of compliance with the relevant exposure control limit; or

(d) if it is not practicable to comply with sub-paragraph (c) he shall—

(i) apply to the Executive in writing for consent to an extended period of time within which to complete the taking of the five samples as required in sub-paragraph (c), or

(ii) ensure that relevant operations are stopped in the affected part of the mine, leaving that part in a safe condition, and inform the Executive in writing accordingly.

(2) *If the average of the 5 sample determinations made in accordance with paragraph (1)(c) or (1)(d)(i) exceeds the exposure control limit for respirable dust or the exposure control limit for quartz, the manager shall—*

(a) ensure that relevant operations are stopped in the affected part of the mine as soon as this can be done consistently with leaving that part in a safe condition, and inform the Executive in writing accordingly; or

(b) permit relevant operations to continue in the affected part of the mine and provide justification for that decision to the Executive in writing forthwith.

(3) *If, in accordance with paragraph (2)(b), the manager has permitted relevant operations to continue, he shall ensure that a further 5 samples have been taken on 5 representative working shifts within 15 working days of receipt of the notification of the findings of the sample determinations referred to in paragraph (2).*

(4) *If the average of the 5 sample determinations made in accordance with paragraph (3) exceeds the exposure control limit for respirable dust or the exposure control limit for quartz, the manager shall ensure that relevant operations are stopped in the affected part of the mine and inform the Executive accordingly in writing.*

(5) *Where relevant operations have been stopped in accordance with paragraph (1)(d)(ii),(2)(a) or (4), the mine owner shall not permit relevant operations to be resumed until he—*

(a) is satisfied that all measures necessary to protect the health of workers at the mine have been taken;

(b) has provided sufficient justification to the Executive in writing which shall include—

(i) details of any change in the method of work or in the control measures, and

(ii) as assessment of the effect of these changes; and,

(c) subject to paragraph (6), has received the consent of the Executive to resume relevant operations, which shall be subject to such conditions as the Executive may impose.

(6) If the mine owner has not received a reply from the Executive within 7 working days of submitting his justification to resume relevant operations in accordance with paragraph (5)(b) then he may resume relevant operations without the consent required by paragraph (5)(c).

Action if a time-weighted exposure control limit is exceeded

136 If the sampling results indicate a time-weighted exposure control limit has been exceeded, the manager will need to:

(a) check the control measures to ensure they are working as intended and to any design specification set out in the dust control scheme made under regulation 5;

(b) discuss possible reasons for the rise in respirable dust concentration with appropriate colleagues (including other members of the management structure, safety representatives and employees, including contractors' employees where appropriate);

(c) devise and implement a programme of immediate action to reinforce the control measures and revise the regulation 5 dust control scheme as appropriate;

(d) consider whether there are workers, who may not previously have been required to wear suitable RPE, but need to do so temporarily until adequate control is re-established.

137 The managers will also need to arrange for further investigational samples if appropriate, and take the further series of five samples required by regulation 10(1)(c) to confirm remedial action to tighten control has been effective. The series of five has to be done within fifteen working days of the laboratory notifying that the exposure control limit had been exceeded. It is a good idea to carry out sampling in good time in case any resampling is required to collect a representative sample to replace one rejected because the level of activity was too low. If it is not possible to take five samples which meet the criteria in the sampling scheme to be considered representative (see paragraphs 120-121), they must either:

(a) apply in writing to HSE for extra time to carry out the series of five samples, setting out the reasons and how much extra time is needed. The Mines Inspectorate may agree to the request if it is satisfied the circumstances would not expose people above the control limit; or

(b) stop relevant operations and inform HSE in writing that they have done so.

138 If one or more of the five sample results is above the exposure action level, this suggests there is not adequate control in place and the assessment and controls need reviewing. In any case, if the average of the five samples exceeds either time-weighted exposure control limit, the manager must review the assessment and improve control measures unless the work causing excessive exposure in the affected part of the mine is stopped, and inform HSE in writing.

139 Regulation 10(2)(b) allows work to continue under certain conditions. For example, the manager might decide that working hours can be reduced, the method of working can be changed or further more effective engineering controls introduced. If this happens regulation 10(2)(b) requires the manager to notify HSE in writing, setting out the reasons for making these changes. A further series of five samples is then required to comply with regulation 10(3). The second series of five samples must be completed within fifteen working days of the laboratory notifying the result of the last of the series of five samples taken to comply with regulation 10(1)(c).

140 Where work has been stopped in accordance with regulation 10(1)(d)(ii), 10(2)(a) or 10(4) in spite of the manager making best use of available resources, the owner may allow relevant operations to resume providing the specific actions set out in regulation 10(5) are carried out. The duties in the regulation are placed on the owner; the manager will therefore need to liaise closely with the owner on whether or when work can restart.

Regulation 11: Health surveillance

11. *—(1) Every employer shall ensure that those of his employees who are, or who are liable to be, exposed to inhalable dust are placed under health surveillance by a doctor, unless that exposure is not significant.*

(2) *The employer shall ensure that a health record, containing particulars approved by the Executive, in respect of each of his employees to whom paragraph (1) applies is made and maintained and that that record or a copy thereof is kept available in a suitable form for at least 40 years from the date of the last entry made in it.*

(3) *The employer shall—*

(a) on reasonable notice being given, allow an employee access to his personal health record;

(b) provide the Executive with copies of such health records as the Executive may require; and

(c) if he ceases to trade, notify the Executive forthwith in writing and make available to the Executive all health records kept by him.

(4) *Health surveillance arranged by an employer in order to comply with his duty under paragraph (1) shall be at the cost of that employer and shall take place during the working hours of the employee or at a time agreed with the employee.*

(5) *An employee who is the subject of health surveillance shall furnish the doctor with such information concerning his health as the doctor may reasonably require.*

(6) *Where, as a result of health surveillance, an employee is found to have an identifiable disease or adverse health effect which is considered by a doctor to be the result of exposure to inhalable dust—*

(a) the manager shall—

(i) review the risk assessment, and

(ii) review any measure taken to comply with regulation 5, taking into account any advice given by a doctor or by the Executive; and

(b) the employer of that employee shall—

(i) ensure that a doctor informs the employee accordingly and provides the employee with information and advice regarding further health surveillance,

(ii) consider assigning the employee to alternative work where there is either a lower exposure to inhalable dust or no such exposure, taking into account any advice given by a doctor, and

(iii) provide for a review of the health of any other employee who has been similarly exposed, including a medical examination where such an examination is recommended by a doctor or by the Executive.

(7) *Where, for the purpose of carrying out his functions under these Regulations, a doctor requires to inspect any workplace or any record kept for the purposes of these Regulations, the employer or the owner as the case may be shall permit him to do so.*

The following section starts by discussing the objectives of health surveillance and goes on to cover:

- the duties of employers and employees;
- who should undergo health surveillance and who does not need to;
- continuing health surveillance after exposure has ceased;
- the medical examination;
- X-ray examinations;
- confidentiality of medical records;
- information to employees and employers;
- employers' and managers' action on detection of an adverse health effect or identifiable disease; and
- the keeping of health records.

The objectives of health surveillance

141 The objectives of health surveillance are to:

(a) protect the health of individual employees by detecting as early as possible, adverse changes which may be caused by exposure to inhalable dust;

(b) help evaluate the measures taken to control exposure; and

(c) collect, keep up-to-date and use data and information for determining and evaluating hazards to health.

Employers' duties

142 This regulation places duties on any employer whose employees work below ground in a coal mine and may be exposed to inhalable dust. This will include mine owners and contractors whose employees regularly work below ground at mines.

143 Regulation 4(2) of the 1993 Regulations requires such employers to co-operate with one another, by the exchange of information or otherwise, to enable each to comply with the law. Mine owners will need to draw the attention of the contractors they engage to these requirements.

144 It is existing industry practice for mine owners to allow contractors employees to take part in medical examinations held at collieries. Such arrangements have benefits for both contractors and mine owners. However, contractors retain the

responsibility for ensuring that their employees are examined at appropriate intervals, and this may require them to arrange for additional medical examinations independently from mine owners.

145 Health surveillance arrangements made by employers must be carried out by, or under the direct supervision of, a doctor competent in occupational health. It is strongly recommended that clinical assessment, including communication and follow-up to the individual and employer, is performed by a doctor with a minimum of Associateship of the Faculty of Occupational medicine (AFOM) and appropriate experience of carrying out health surveillance of workers exposed to occupational lung disease.

146 The employer's duties do not end with organising the medical examinations. Employers also need to:

(a) identify those who need to receive a medical examination;

(b) ensure that they are offered an examination at an appropriate time with paid attendance and at no cost;

(c) identify those at risk who have not received a medical examination and take appropriate follow-up action such as offering those who are unable to attend when the doctor visits the mine the option of attending in working hours and at the employer's expense at another venue;

(d) maintain records to enable exposure over time to be monitored; and

(e) obtain information on an individual's past employment history, in particular, the date of the last medical examination.

Employees' duties

147 Employees have a duty under section 7(b) of the 1974 Act to co-operate with their employers so far as necessary to enable them to comply with the law. An employee will need to participate in health surveillance if identified by the employer as having significant exposure.

148 If an employee chooses not to co-operate in this way, the only other way the employer can comply with regulation 11(1) is by removing the employee from the work giving rise to the significant exposure.

Who should undergo health surveillance?

149 All employees working regularly at coal mines who have had, or have, exposure to mineral dust underground should have periodic medical examinations. These should normally be at four-yearly intervals, unless the doctor responsible for the health surveillance advises otherwise. There may be a need for more frequent examinations, depending on the results of previous medical examinations or employment history. If a change made since the last examination suggested that an occupational group or a person was at greater risk, for example those who may have been exposed to higher levels of quartz dust when cutting through sandstone, the employer should seek the doctor's advice on whether to reduce the interval between medical examinations.

150 Employers need to make sure that new employees and existing employees transferring from other mines do not go for longer than four years without an examination. Alternatively, where an employee has had a medical examination

within the previous two years, they are not subject to an unnecessary further chest X-ray.

151 The arrangements for health surveillance made to comply with these regulations may also be used to comply with COSHH requirements for employees exposed to dust on the surface, for example in a coal preparation plant, or for the COSHH requirements relating to exposure to gasses or fumes below ground.

Who does not need to undergo health surveillance?

152 The duty to provide health surveillance is qualified by 'unless that exposure is not significant'. The health risks from exposure to inhalable dust are cumulative. So people working in coal mines occasionally and for short periods will not have significant exposures, unless they have already accumulated five years or more exposure to inhalable dust from their current or previous employment.

Continuing health surveillance after exposure has ceased

153 Since pneumoconiosis is a disease where an adverse effect on health may be anticipated after a latent period, and it can be reliably detected at a sufficiently early stage, it may be appropriate for an employer to continue health surveillance of his employees (at least while they remain his employees) after exposure to inhalable dust has ceased. Where an employee has been redeployed to the surface on medical grounds, due to a respiratory condition, they will already need to be subject to more frequent medical examinations irrespective of their exposure in the current work location.

The medical examination

154 The medical examination procedure will need to include:

(a) completing an appropriate questionnaire on respiratory symptoms and smoking history, designed to identify chronic bronchitis and other respiratory diseases such as asthma;

(b) spirometry to measure forced expiration volume in one second (FEV_1) and forced vital capacity (FVC). Results from spirometry need to be interpreted with reference to the guidelines from the National Institute for Clinical Excellence (NICE) on the management of chronic obstructive pulmonary disease in adults in primary and secondary care[11];

(c) a chest X-ray, unless the doctor decides this is not justified in an individual case.

X-ray examinations

155 The medical examination will normally include a chest X-ray examination. However, employers and doctors will need to be aware of the requirements of the Ionising Radiation (Medical Exposure) Regulations 2000[12]. These require doctors to satisfy themselves that the health benefit to the individual X-rayed will outweigh the potential negative effects from the radiation exposure. This will normally be the case for:

(a) mine owners' employees who work wholly or mainly underground; and

(b) contractors' employees whose jobs involve frequent exposure to mineral dust in a mine;

(c) but, there will be cases where an X-ray will not be appropriate for these workers; for example when an X-ray has been taken within the last four years.

156 New recruits do not need to be X-rayed, unless they are re-entrants with a previous employment history suggesting significant exposure to inhalable dust, or other parts of the pre-employment medical examination give a clinical justification for an X-ray. However, the doctor will need to look at the totality of new entrants' occupational history before starting at the mine, to make sure they have not had significant exposure to inhalable dust working in another industry.

157 The employer must provide the Occupational Health Service (OHS) provider with the information about each employee's job which the doctor will need to decide whether an X-ray is justified. The job history and exposure sampling record kept by the employer as part of the employee's health record (see paragraphs 180-181) will usually be enough for this purpose if it covers the entire period since the previous medical examination. Otherwise, the employer must provide whatever information is available about the employee's employment history relevant to exposure to inhalable dust, in particular whether the employee has been on face or development work in mines or other activity potentially involving high levels of exposure to dust (for example tunnelling or quarrying).

158 The OHS provider will need to identify those people whose last X-ray was less than four years ago. This can be done from existing health surveillance records and checks with the person concerned. It is strongly advised that no one is X-rayed who has been X-rayed in the previous two years, but there will be some cases where the doctor may consider it advisable to carry out X-rays at intervals of two years or less, for example in cases where there has been rapid progression of a dust-related disease.

159 Those whose last X-ray was more than two years ago and who are, or have been, engaged in work potentially involving high levels of exposure since their last X-ray may be offered another X-ray at the current medical examination. Arrangements need to be made for those whose last chest X-ray was more than two years ago, but less than four years, but who have been engaged in potentially less dusty work, to be recalled for X-ray examination after a further interval of not more than two years. The maximum interval between chest X-rays for any regular underground worker will be no more than six years.

160 The responsible doctor will need to individually assess any employees whose past exposure to dust is significant (see paragraph 155) but current exposure is only occasional, before deciding if an X-ray is justified. The OHS provider should identify such employees when the list of names of employees to be examined is drawn up in conjunction with the employer, using their knowledge of the person's job and occupational history.

161 At the time of the X-ray examination, the radiographer will need to check that the person is one of those for whom an x-ray is deemed appropriate. The radiographer will also need to check with the person if the information from the employer, on which the doctor's decision was based, is complete. In cases of uncertainty, the radiographer should refer to the responsible doctor for a decision.

162 It is essential that the X-ray is a full-sized posterior-anterior chest X-ray taken in accordance with 2000 International Labour Organisation (ILO) guidelines[13]. This must be read and reported on in accordance with ILO classifications by suitably qualified and experienced doctors. The following would be suitably qualified and experienced:

(a) a consultant radiologist with an expertise in occupational lung disease;

(b) a consultant respiratory physician with an expertise in occupational lung disease; or

(c) an occupational physician with at least two years experience of carrying out health surveillance of workers exposed to fibrogenic dusts.

163 There needs to be a suitable scheme of quality assurance designed to minimise intra and inter observer variation.

Confidentiality of Medical Records

164 Clinical details relating to identifiable individuals need to be treated as confidential medical records. Employers engaging an occupational health service provider can require their doctors to pass information to them or their mine managers but that information must be restricted to what they need to know to carry out their health and safety duties. In general this means that doctors need to express the results of health surveillance in terms of the individual's fitness for work if this is to be passed to employers.

165 If a disease reportable under RIDDOR is diagnosed, the doctor should encourage the individual to agree to his name and the name of that disease, but not necessarily its severity, being passed to the person responsible for reporting it to HSE, generally the mine manager. Such details can be given by the doctor directly to an HSE Inspector or the individual's general practitioner if the individual does not want the manager or employer to have more details than fitness for work.

166 Collected data on the overall results of health surveillance can be presented with whatever level of clinical detail would help monitor employees' health so long as individuals are not identified.

Information to employees

167 Where an employee is found to have an adverse health effect or identifiable disease which a doctor considers to be the result of exposure to inhalable dust, the employer must make sure the employee concerned is interviewed and told by a doctor of the arrangements which will be put in place for continuing health surveillance.

168 Taking into account any advice received from the HSE Medical or Mines Inspector and/or the OHS doctor, the employer must also ensure that the employee is advised by the mine manager or another suitably qualified person of:

(a) the arrangements, if any, to transfer the employee to alternative work in a less dusty place; and

(b) any changes to dust control measures affecting the employee resulting from reviews required by regulation 11(6)(a).

169 The doctor carrying out the medical examination will need to contact the employee's general practitioner to report the ill-health condition so that the GP

is aware of the work the employee does, and the adverse health effect which has resulted from exposure to dust.

Information to employers

170 As well as informing the employer if the medical examination reveals any adverse health effect or identifiable disease attributable to exposure to inhalable dust, the doctor will need to consider whether the results suggest the condition has developed rapidly and the manager may need to review the protection measures or the risk assessment. If appropriate, the doctor will also need to advise the manager to notify HSE of a case of pneumoconiosis as required by the Reporting of Injuries Diseases and Dangerous Occurrences Regulations 1995.

171 The doctor will also need to advise the employer if the diagnosis of a dust-related adverse health effect or identifiable disease means considering whether the individual should be reassigned to other work where there will be lower exposure to inhalable dust or no such exposure. Such a diagnosis is not, in itself reason for reassignment. The severity of the condition and its rate of progression need to be taken into account. Reasonable protection and reduced exposure may halt or slow the progress of the disease. The course of action should preferably be agreed with the employee once they have received information and advice from the doctor or occupational health professional.

172 If the employee has experienced high personal levels of exposure to inhalable dust, the employer should also be advised to check on other employees in the same occupational group. This could be done by further personal sampling of exposure, or health surveillance, or both.

Employers' action on detection of an adverse health effect or identifiable disease

173 The employer will need to consult the doctor to consider:

(a) whether a further medical examination of the employee concerned needs to be arranged and if so, who will carry it out;

(b) if a medical examination is necessary, whether other employees who have been exposed in a similar way to the affected employee also need to be medically examined;

(c) if necessary, the further health surveillance facilities which need to be provided and the arrangements which need to be made;

(d) whether the employee should wear RPE, while remaining at the same place of work and job;

(e) whether to transfer the employee to other work where there is no or minimal exposure to inhalable dust;

(f) whether to transfer employees to other work where there is less exposure to inhalable dust or to reduce their working hours. In this case, the employer will need to consider what maximum exposure level is appropriate and how often this should be checked by personal sampling. This should be no more than the exposure action levels and checked by sampling at least once a year, unless the doctor recommends tighter control; and

(g) whether more frequent health surveillance is needed.

174 If contractors receive notification that any of their employees has been diagnosed with pneumoconiosis or any other dust-related disease, and they are currently working at the mine, they must notify the manager of the mine so that they can fulfil their duties to report the occurrence under the requirements of RIDDOR, and the actions required under regulation 11(6)(a). Contractors must also inform the mine owner if advised by the doctor that any adverse health effects or identifiable disease may have resulted from exposure to inhalable dust in circumstances which suggest that other workers at the mine may be at particular risk.

Manager's action on detection of an adverse health effect or identifiable disease

175 If any adverse health effects or identifiable diseases resulting from exposure to inhalable dust is detected, the manager will need to:

(a) review the risk assessment of the work in accordance with regulation 11(6)(a)(i); and

(b) where necessary, review and revise the control measures required by regulation 5 to prevent a recurrence of the ill-health effect or disease.

176 The extent of such a review must take account of advice from the doctor. Information available to the doctor, for example on progression of the condition over time, may suggest whether exposure during previous employment was more significant than in current employment.

Health records

177 Employers must keep an up-to-date health record for every employee placed under health surveillance (see paragraphs 152-155). It will need to contain at least the following particulars, approved by HSE:

(a) surname;

(b) forenames;

(c) gender;

(d) date of birth;

(e) permanent address and postcode;

(f) National Insurance number;

(g) date when present employment started;

(h) a history of the jobs, giving the periods of time in this employment (and with previous employers if available), involving exposure to inhalable dust; and

(i) results of health surveillance procedures and the date on which and by whom they were carried out. The conclusions should relate only to the employee's fitness for work and must not include confidential clinical data.

178 Individual health records for regular mineworkers assessed as medium or higher risk of exposure will need to include:

(a) a job history, set out using the same occupational group or job descriptions as used in the risk assessment, giving the time period for each job;

(b) a summary of any sampling results for respirable dust and quartz for the occupational group or groups the person has been a member of, and how long they were a member for. The summary should normally include the average of these results, as well as the results for any months where the time-weighted exposure control limit was exceeded;

(c) the sample results from any personal sampler worn by mineworker covered by the individual health record concerned.

179 The record of sampling results in a person's health record needs to indicate clearly which results reflect a representative exposure of the occupational group and which are derived from personal samplers actually worn by the individual.

180 Exposure sampling data may be held on a separate database, for example one kept to comply with regulation 9(5), as long as an individual record can be extracted with reasonable notice on request at any time and is included with the rest of the health record when employment ends. However, bear in mind that health records need to be kept for 40 years, so any relevant exposure data on the individual, or summary of that data, will need to be kept for the same length of time.

181 The health record will also need to include, if available to the current employer, the dates of any previous employment involving significant exposure to inhalable dust and any related exposure sampling or non-confidential health surveillance records.

182 The aim of including exposure sampling data in the health record is to provide the doctor carrying out the medical examination with an indication of a person's exposure pattern. If such data would not be representative, for example for an employee who does not work underground regularly, but health surveillance is required because of significant past exposure, the employer should record the typical number of days worked underground in each year covered by the health record.

183 It is each employer's duty to keep and maintain the records relevant to their own employees required by this regulation, but co-operation will be needed to allow this. In particular, mine owners will have to provide this information on people who are not their employees, to other employers, when required.

184 Employers other than the owner must make health records available, on request, to the mine owner, manager or another employer if needed, for example to review control measures or when employees change employment (regulation 4 of the 1993 Regulations.)

185 The employer may keep the records on paper or in electronic form, providing the information is readily retrievable at any reasonable time and in an easily understood form. It is essential that appropriate arrangements be made to safeguard against accidental loss. It is particularly important that the employer also keeps the information in a form that will help those responsible for health surveillance to compare the results of monitoring exposure with any health effects that are detected.

186 So, where an employer keeps an employee's personal exposure data and health records on separate electronic databases, the system will need to be

capable of retrieving both sets of employee information so they can be read and considered together.

187 Health records must be kept for 40 years. If the employer stops trading, the health records must be offered to HSE. HSE will either retain the record itself or make arrangements for them to be kept by another body that can better meet these aims.

Regulation 12: Information, instruction and training for persons who may be exposed to inhalable dust

12. *—(1) Where an employer undertakes work which is liable to expose an employee to inhalable dust, he shall provide that employee with suitable and sufficient information, instruction and training.*

(2) *Without prejudice to the generality of paragraph (1), the information, instruction and training provided under that paragraph shall include—*

(a) the risk which exposure to inhalable dust presents to health;

(b) the relevant exposure control limits;

(c) the significant findings of the risk assessment;

(d) the appropriate precautions and actions to be taken by the employee in order to safeguard himself and other employees at the workplace;

(e) if the exposure control limit for respirable dust or the exposure control limit for quartz is exceeded, provision forthwith of all relevant sampling results to the employee or his representative; and

(f) the collective results of any health surveillance undertaken in accordance with regulation 11 in a form calculated to prevent those results from being identified as relating to a particular person.

(3) *The information, instruction and training required by paragraph (1) shall be—*

(a) adapted to take account of significant changes in the type of work carried out or methods of work used by the employer; and

(b) provided in a manner appropriate to the level, type and duration of exposure identified by the risk assessment.

(4) *The employer shall ensure that any person (whether or not his employee) who carries out work in connection with the employer's duties under these Regulations has suitable and sufficient information, instruction and training.*

Information

188 In addition to the information, instruction and training required to be provided to employees under regulation 12(2), it is recommended that this information also includes as appropriate;

(a) the purpose of health surveillance, the benefits from regular attendance at periodic health screening and the arrangements for employees to have access to their individual health records;

(b) any further relevant information resulting from a review of the risk assessment, why it has been done and how any changes will affect the way employees do the work in the future.

189 Providing information, instruction and training is not a one–off exercise: the information, instruction and training will need to be reviewed and updated whenever significant changes are made to the method of work, in particular if operators need to know about changes to control measures on the equipment they operate. Further information and training following a review of the risk assessment needs to cover why the assessment was reviewed, any changes to the way the work is to be done and the precautions employees need to take to protect themselves and others. Periodic refresher instruction and training will also be appropriate.

190 Where contractors' employees might need this information, managers need to provide it directly or alert their employers so they can make relevant information available to employees or safety representatives.

191 Employers have a duty to make all relevant information available to employees or their representatives in accordance with Health and Safety (Consultation with Employees) Regulations 1996[14], and the Safety Representatives and Safety Committees Regulations 1977[15].

Instruction and training

192 The instruction and training will need to ensure that people at work in the mine do not put themselves or others at risk through exposure to inhalable dust. In particular, the instruction and training need to be sufficient and suitable for them to know;

(a) which occupational group their particular job is assigned to;

(b) how and when to use the control measures;

(c) how to use RPE; and

(d) where appropriate, the cleaning, storage and disposal of RPE.

193 The employer must ensure that the person or people any work is delegated to are qualified and competent to undertake it.

194 If the nature of the workplace and the activity are such that workers may need ready access to this information, it must be posted in the district or the covered accommodation.

195 Employers have a duty under the Management of Health and Safety at Work Regulations 1999[16] to make sure the information they provide is comprehensible. So, they will need to consider all the various ways of providing information, instruction and training and select those most appropriate to their own circumstances.

196 The range of options includes class or group tuition, individual tuition, written instructions including leaflets, courses etc. Employers will also need to decide how much time is needed to provide suitable and sufficient training etc. for their employees to comply fully with the detailed requirements of the regulations.

Regulation 13: Exemption certificates

13. —(1) Subject to paragraph (2) the Executive may, by a certificate in writing, exempt any person or class of persons or any substance or class of substances from all or any of the requirements or prohibitions imposed by regulations 4(5), 5(4), 6, 7, 8(2), 9(2) to (4). 10(2) to (6), and 11(4), (5) and (7), and any such exemption may be

granted subject to conditions and to a limit of time and may be revoked by a certificate in writing at any time.

(2) *The Executive shall not grant any such exemption unless having regard to the circumstances of the case, and, in particular, to—*

(a) the conditions, if any, which it proposes to attach to the exemption;

(b) any requirements imposed by or under any enactments which apply to the case,

it is satisfied that the health and safety of persons who are likely to be affected by the exemption will not be prejudiced in consequence of it.

Regulation 14:Repeal, revocations and saving

14. *—(1) In section 74 of the 1954 Act—*

(a) at the end of sub-paragraph (a) of paragraph (1) the word "and";

(b) sub-paragraph (b) of paragraph (1); and

(c) in paragraph (2), the words "or in the case of a mine of coal, dust of such character and in such quantity as to be likely to be injurious to the persons employed",

are repealed.

(3) *The Coal Mines (Respirable Dust) Regulations 1975(**1**), the Coal Mines (Respirable Dust) (Amendment) Regulations 1978(**2**), and the Mines (Substances Hazardous to Health) Regulations 1996(**3**) are revoked.*

(4) *In Schedule 2 to the Personal Protective Equipment at Work Regulations 1992(**4**) delete Part IV.*

(5) *In regulation 5(1)(a)(i) of the Control of Substances Hazardous to Health Regulations*

*2002(**5**) replace the words "the Coal Mines (Respirable Dust) Regulations 1975" with the words "the Coal Mines (Control of Inhalable Dust) Regulations 2007".*

(6) *Any record or register required to be kept under the Coal Mines (Respirable Dust) Regulations 1975 shall, notwithstanding the revocation of those Regulations by paragraph (2), be kept in the same manner and for the same period as specified in those Regulations as if these Regulations had not been made, except that the Executive may approve the keeping of records at a place or in a form, other than at the place where, or in the form in which, records were required to be kept under those Regulations.*

(**1**) S.I. 1975/1433.
(**2**) S.I. 1978/807.
(**3**) S.I. 1996/2001.
(**4**) S.I. 1992/2966, to which there are amendments not relevant to these Regulations.
(**5**) S.I. 2002/2677, to which there are amendments not relevant to these Regulations.

Appendix 1

Approved exposure control limits and time-weighting calculation method with regard to the specified reference periods.

Status

197 The limits and calculation method reproduced in this appendix are legally binding because they have been approved by the Health and Safety Commission.

Notice of Approval

198 The Health and Safety Commission has on [date] approved the exposure control limits and methods of calculation set out in the Schedule to this Notice for the purpose of the exposure control limit for respirable dust and the exposure control limit for quartz specified in Regulation 2(1) of the Coal Mines (Control of Inhalable Dust) Regulations 2007.

Signed

Secretary to the Health and Safety Commission

[Date]

Schedule

Part 1 Exposure Control limits

1 The exposure control limits in the table below are given in mg.m-^{3} and refer to concentrations of respirable dust, as defined by BS EN 481 1993, in the air in the workplace that people can breathe averaged over a reference period of a working week of 40 hours.

2 They apply to a working week of any number of hours accumulated on successive working shifts until there is a rest period of at least 24 hours with no occupational exposure to inhalable dust, when adjusted by the time-weighting calculations set out in Part 2 of this schedule.

	Exposure control limit (ECL)
Respirable Dust	3.0 mg.m^{-3}
Quartz	0.3 mg.m^{-3}

Part 2 Time-weighting calculations

3 The working weeks of occupational groups may be shorter or longer than the 40-hour reference period used for the approved exposure control limits. Where this is the case, the exposure control limits must be adjusted as follows:

$$ECL_{tw} = \frac{ECL \times 40}{Hsw}$$

where ECL_{tw} is the time-weighted exposure control limit to be compared with representative sample determinations, ECL is the appropriate approved exposure control limit from the table in part 1 of this schedule and H_{sw} is the standard hours in the working week.

4 The standard hours in the working week, $H_{sw,}$ is the greater of 30 hours or the number of hours the occupational group is expected to work in the mine on successive shifts (including regular overtime) until there is a rest period of at least 24 hours with no occupational exposure to inhalable dust.

5 Where an occupational group works a regular rota of weeks of different hours, the standard hours used in this calculation can be the average hours calculated from totalling the number of hours in the successive weeks in the rota and dividing by the number of weeks in the rota. Otherwise, the longest week expected between successive sampling weeks must be used if an irregular pattern is planned.

6 If any occupational group's standard hours include periods of work in the mine exceeding 12 hours in any 24 hours, the following additional adjustment must be made:

$$ECL_{tw} = ECLtww \times \frac{12}{Hsd}$$

where ECL_{tww} is whichever has the lesser value of a) the approved exposure control limit or b) the exposure control limit time-weighted for the working week as set out in paragraph 3 above, and H_{sd} is the maximum standard hours worked in the mine in any 24 hour period if this is more than 12.

7 The following examples illustrate these calculations using the approved control limit value of 3 $mg.m^{-3}$ for respirable dust. In each case, the same calculations would be required to time weight the limits for quartz.

Example 1 - operation of the time-weighted exposure control limit.
A development team has a working week of six 8-hour shifts followed by one day off. Measured average exposure on one of these shifts is 2.7 $mg.m^{-3}$

Standard weekly hours, H_{sw} = 6 x 8 = 48 hours

$\therefore$ time-weighted exposure control limit ECLtw $= \frac{3 \times 40}{48}$

$= 2.5\ mg.m^{-3}$

With 2.7 $mg.m^{-3}$ determined as the measured exposure averaged over the sampling period, the time-weighted exposure control limit was exceeded.

Example 2 - operation of time-weighting for shifts over 12 hours.
The back-up team in the same development has a working week of three 14 hour shifts followed by four days off. Measured average exposure during one of these shifts is 2.7 $mg.m^{-3}$.

Standard weekly hours, H_{sw} = (3 x 14) = 42 hours
Maximum standard daily hours, H_{sd} = 14 hours

$\therefore$ time-weighted exposure control limit ECLtw $= \frac{3 \times 40}{42} \times \frac{12}{14}$

$= 2.45\ mg.m^{-3}$

With 2.7 $mg.m^{-3}$determined as the average exposure over the sampling period, the time-weighted exposure control limit has been exceeded.

Example 3 - shift patterns with unequal numbers of hours
A production team works a rota of one week of five 8 hour dayshifts; one week of backshifts of 12 hours for four days but 8 hours on the Friday; and one week of five 8 hour night shifts. The manager's dust control scheme allows for 8 hours planned overtime on Saturday morning for each team when it is on dayshift. The average exposure determined from a sample taken on Tuesday backshift is 2.7 $mg.m^{-3}$.

Hours in the rota $= (5 \times 8) + (4 \times 12 + 1 \times 8) + (5 \times 8) + (1 \times 8)$ = 144
Weeks in the rota = 3
$\therefore$ Standard weekly hours, H_{sw} $= \frac{144}{3}$ = 48 hours

$\therefore$ time-weighted exposure control limit ECLtw $= \frac{3 \times 40}{48}$

$= 2.5\ mg.m^{-3}$.

With 2.7 $mg.m^{-3}$determined as the average exposure over the sampling period, the time-weighted exposure control limit has been exceeded. Note: since the longest day worked in the rota equals 12, no further adjustment is required.

Example 4 – number of days without a break

A team of contractors works a week of six 8-hour shifts and 8 hours planned overtime on the Sunday. They have a week off every fifth week. Measured exposure on one shift is 1.5 $mg.m^{-3}$.

This case amounts to 28 days with exposure every day before there is a full day with no exposure.

$\therefore$ the standard weekly hours, $H_{sw} = (28 \times 8) = 224$ hours

$\therefore$ time-weighted exposure control limit ECLtw $= \dfrac{3 \times 40}{224} = 0.54\ mg.m^{-3}$

With 1.5 $mg.m^{-3}$ determined as the average exposure over the sampling period, the exposure control limit has been exceeded.

Appendix 2

SAMPLING, GRAVIMETRIC ANALYSIS AND ASSESSMENT OF THE QUARTZ CONTENT OF RESPIRABLE DUST EXPOSURE IN COAL MINES

Introduction

1 This document presents the recommended methodology for the measurement of the personal exposure of miners to the mass concentrations of respirable dust and respirable crystalline silica in the air in underground coal mines.

2 The analytical work in this Annex should be carried out in accordance with UKAS accredited methods based on relevant HSE guidance and the laboratory should participate in appropriate proficiency testing schemes.

Respirable dust

3 Respirable dust approximates to the fraction of airborne material that penetrates to the gas exchange region of the lung. The respirable fraction varies for different individuals, however it is possible to define a target specification for sampling instruments that approximates to the respirable fraction for the average person. The target specification given by ISO and CEN and published in the UK as part of BS EN 481:1993 (*Workplace atmospheres. Size fraction definitions for measurement of airborne particles*[17]*)* has been adopted in the UK.

Method performance

4 The sampling methods for respirable dust described in this document have been evaluated both in the laboratory and in underground coal mines to determine their performance with respect to the BS EN481 target specifications and to assess their robustness for the arduous conditions found in coal mines.

Detection limits

5 The lower limit of detection of gravimetric analysis is determined primarily by the length of the sampling period, the sensitivity of the balance, and the weight stability of the substrate (e.g. filter) used to collect and weigh the sample. These factors should be chosen to ensure whenever possible that the lower limit of detection is an order of magnitude lower than the appropriate exposure limit. Useful information on how to determine and reduce gravimetric detection limits can be found in BS ISO 15767:2003 (*Workplace atmospheres. Controlling and characterizing errors in weighing collected aerosols*[18]*).*

6 The lower limit of detection of the direct-on-filter quartz analysis methods is dependent upon: a) the analysis equipment used, b) the type of filter, c) the analytical parameters, and d) the presence of interfering minerals in the sample. For X-ray diffraction, a lower limit of detection of 3 µg has been obtained on the primary quartz line, and approximately 10 µg on the strongest secondary lines. For the Fourier transform infrared method a lower limit of detection of 3 µg has been obtained based on analysis of pure quartz samples.

PRINCIPLE

7 A measured volume of air is drawn through a filter mounted in an aluminium cassette in a cowled personal cyclone sampler (see paragraph 10).

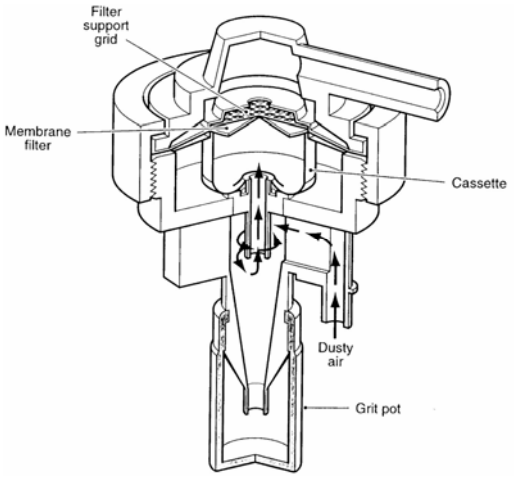
8 The mass of respirable dust collected is determined by weighing the filter cassette before and after sampling following the procedures outlined in paragraph 26.

9 The mass of quartz contained in the respirable dust sample is determined by two alternative direct-on-filter methods. The Fourier Transform Infra-red method (FTIR) and the X-ray diffraction method (XRD) are referred to in paragraph 27.

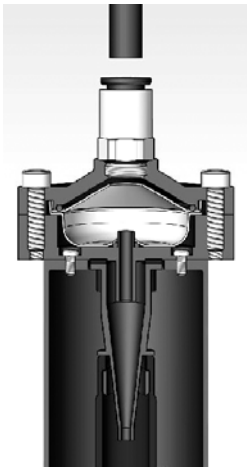
DUST SAMPLING EQUIPMENT

Personal samplers

10 The respirable dust sample is collected using a cyclone sampler with a penetration that matches the respirable dust convention given in BS EN 481. A cut-away diagram of a typical cyclone sampler is given in Figure 1a.



a) exploded



b) showing cowl [19]

Figure 1: Cyclone personal sampler:

It comprises a conducting plastic cyclone particle size selector and a filter holder incorporating an aluminium filter cassette. A cylindrical conducting cowl is fitted around the body of the cyclone to reduce the windspeed that the cyclone inlet is exposed to, especially the high windspeeds found on some coal faces (see Figure 1b).

11 The sampler is attached to the miner within his breathing zone (defined in HSG 173 as within 20 to 30 cm of the person's nose and mouth), and the sampling pump is connected to it by a length of flexible tubing. The use of a harness, with belt and braces, to fix the position of the sampler and to carry the sampling pump is recommended. Alternatively, especially for seated machine drivers, a specially modified reflective jacket to carry both sampler and pump can be used.

Static sampling of respirable dust

12 The personal cowled cyclone sampler system can also be used to measure the dust concentration at the 70 m point in the return roadway of coal faces or any other location underground. The sampler should be mounted at approximately head height, using a rigid bracket to prevent the sampler swinging in the air flow. In the case of all static samples the sampling pump should be switched on and off at the underground sampling point and not in the lamproom. The results from these static samples should

not be compared with the personal exposure limits. However they can be used to determine the effectiveness of any engineering controls.

Filters

13 In addition to having a high particulate collection efficiency, the filter must have minimal absorption of moisture and must be compatible with the subsequent direct method chosen for quartz analysis. For both FTIR and XRD membrane filters made of PVC or a PVC-acrylonitrile copolymer, with a pore size of 5 µm, are suitable. The filter is held within an aluminium cassette that is intended to be weighed along with the filter. This is to ensure that any dust dislodged from the filter surface during use is included in the mass of dust assessed. Aluminium cassettes are used because plastic cassettes, which are currently available for use with cyclones, do not have the required weight stability.

Sampling pumps

14 The sampling pump must be approved for use in potentially explosive atmospheres in mines, and must be capable of maintaining smooth flow of 2.2 ± 0.1 l min^{-1} throughout a sampling period of at least 12 hours. It should have the following features:

(a) an automatic flow control which keeps the volumetric flow rate constant in the case of changing back pressure;

(b) either a malfunction indicator, which following the completion of sampling indicates that the air flow has been reduced or interrupted during sampling; or an automatic cut-out, which stops the pump if the flow is reduced or interrupted;

(c) an electronic timer to record the duration of the sampling period

(d) a facility for adjustment of the flow rate such that it can only be actuated with the aid of a tool (e.g. a screw driver) or requires special knowledge for operation (e.g. software), so as to prevent inadvertent adjustment of the flow rate during use.

(e) the flow must be pulsation damped using an internal pulsation damper

In addition, compliance with the requirements of BS EN 1232:1997 (Workplace atmospheres. Pumps for personal sampling of chemical agents. Requirements and test methods[20]) is recommended.

Flow measurement

15 A portable flow meter should be used. It should be capable of measuring the desired volumetric flow rate to within 0.1 l min^{-1}, with an accuracy that is traceable to national standards. A suitable practical flow meter would be a calibrated rotameter.

Sample Transport

16 A transport box should be used that has specially designed fixing points that enable the samplers to be kept upright and fastened during the journey from the mine to the laboratory. The box should be designed to minimise the possibility of the accidental transfer of large particles from the grit pot to the filter.

DUST SAMPLING PROCEDURE

Preparation of cyclone sampling head in the laboratory

17 At the laboratory, clean the samplers before use. Disassemble parts that come into contact with dust, soak in detergent solution, rinse thoroughly with water and allow to dry before reassembly.

18 In a clean, dust-free environment, load the samplers with pre-weighed cassettes, label each sampler so that it can be uniquely identified. Ensure that the securing screw on the cyclone back plate is tight such that the cyclone cannot be inadvertently opened underground.

Preparation of sampling pump at the colliery

19 A person appointed by the colliery manager (Appointed Person) should set the volumetric flow rate in a clean area (e.g. lamp room or safety office). Connect each loaded sampler to a sampling pump, ensuring that no leaks can occur, following the schematic diagram supplied by the laboratory. Switch on the sampling pump, attach the calibrated flow meter so that it measures the flow through the cyclone inlet. Allow the pump to stabilise before measuring and adjusting the flow. Set the flow rate to 2.2 $\pm$ 0.1 l min^{-1} and switch off the pump.

Deployment of samplers

20 Attach the cowled cyclone to the miner using the harness or specially modified reflective vest such that the sampler is close to the collar bone. Attach the pump to the belt of the harness so that it causes minimum inconvenience to the worker, and safely secure tubing used to connect the sampler and pump into loops on the harness braces. For the vest, place the pump in the pocket provided and secure tubing as above. Ensure that the harness or reflective vest is on the outermost layer of clothing at all times.

21 Samplers will normally be deployed from and returned to the lamproom although each colliery is free to choose a location suitable for its own requirements. Before the miner being sampled leaves the lamproom, an Appointed Person should switch on the pump and record the time and volumetric flow rate at the beginning of the sampling period. If the pump is fitted with an integral timer, ensure that this is reset to zero. When in use underground, the person wearing the sampler should check it periodically during sampling to ensure that the pump is still running and that the tubing is not squashed and is still connected to the sampler and pump. This should also be checked by the district official when they encounter a person wearing a sampler.

Procedure when sampler returns to lamproom

22 When the person being sampled returns to the lamproom, an Appointed Person should carefully remove the sampling equipment from the miner without subjecting it to mechanical shocks. Remove the cowl and keep the sampler upright to minimise particle movement. Measure the volumetric flow rate to an accuracy of 0.1 l min^{-1} using the calibrated flow meter. Record the flow rate and the sampling time, and calculate the duration of the sampling period. If the pump is fitted with an integral timer, check that the indicated period agrees with the calculated period. The sample should be considered as invalid if the two sampling times differ

by more than 5%, since this indicates that the pump did not operate for the entire period.

23 Carefully record the sample identity and all relevant sampling data. Consider the sample to be invalid if the two measured flow rates differ by more than 0.1 litre/min or 5% (whichever is larger).

24 Remove the cyclone sampler from the tubing and fix it in to the transport box for transport to the laboratory. The samplers should be transported by laboratory transport or courier rather than normal parcel post to ensure that they arrive intact and on time. The report pro forma should accompany the sample.

Procedure when cyclone returns to laboratory

25 On arrival in the laboratory, remove the cassette from each sampler and place in the balance room for conditioning for at least twelve hours. Ensure that the numbering systems of the cassette and the sampler are consistent so that the correct result is assigned to the right person.

GRAVIMETRIC ANALYSIS EQUIPMENT AND PROCEDURE

26 Detailed procedures for the gravimetric analysis of the samples and calculation of the respirable dust concentrations are given in MDHS 14/3 (*General methods for sampling and gravimetric analysis of respirable and inhalable dust*[21]). Up-to-date information on how to control and characterise errors in weighing the collected dust is given BS ISO 15767.

QUARTZ ANALYSIS EQUIPMENT AND PROCEDURE

27 Detailed procedures for the analysis of the collected dust samples for their quartz content are given in MDHS 101 Crystalline silica in respirable airborne dusts[22] describing both the Fourier Transform Infrared spectroscopy (FTIR) and the X-ray Diffraction (XRD) methods of analysis. This gives information on how to calculate the quartz concentration of the samples and estimates of the uncertainty of the methods.

Endnotes

1 Control of Substances Hazardous to Health Regulations 2002 SI 2002/2677 The Stationery Office 2002 ISBN 0 1104 2919 2

2 Control of Substances Hazardous to Health (Amendment) Regulations 2004 SI 2004/3386 The Stationery Office 2004 ISBN 0 1105 4076

3 Control of Asbestos at Work Regulations 2002 SI 2002/2675 The Stationery Office 2002 ISBN 0 1104 2918 4

4 Control of Lead at Work Regulations 2002 SI 2002/2676 The Stationery Office 2002 ISBN 0 1104 2917 6

5 Health and Safety (Consultation with Employees) Regulations 1996 SI 1996/1513 The Stationery Office 1996 ISBN 0 1105 4839 6

6 Safety Representatives and Safety Committees Regulations 1977 SI 1977/500 The Stationery Office 1977 ISBN 0 1107 0500 9

7 BS EN 149:2001 Respiratory protective devices. Filtering half masks to protect against particles British Standards Institution 2001 ISBN 0 5803 7517X

8 Respiratory Protective Equipment at Work: A Practical Guide HSG 53 (Third edition) HSE Books 2004 ISBN 0 7176 2904 X)

9 HSE Operational circular 282/28 available at http://www.hse.gov.uk/pubns/fittesting.pdf

10 Methods for the Determination of Hazardous Substances available at http://www.hse.gov.uk/pubns/mdhs/index.htm

11 ‚Chronic obstructive pulmonary disease. Management of chronic obstructive pulmonary disease in adults in primary and secondary care.', National Institute for Clinical Excellence; Clinical Guideline 12, February 2004„

12 The Ionising Radiation (Medical Exposure) Regulations 2000 SI 20001059 The Stationery Office ISBN 0 11 099131 1

13 Guidelines for the Use of the ILO International Classification of Radiographs of Pneumoconioses, Revised Edition 2000 (Occupational Safety and Health Series, No. 22). International Labour Office: Geneva, 2002

14 Health and Safety (Consultation with Employees) Regulations 1996 SI 1996/1513 The Stationery Office 1996 ISBN 0 1105 4839 6

15 Safety Representatives and Safety Committees Regulations 1977 SI 1977/500 The Stationery Office 1977 ISBN 0 1107 0500 9

16 The management of Health and Safety at Work Regulations 1999 SI 1999/3242 The Stationery Office 1999 ISBN 0 1108 5625 2

17 British Standards Institution 1993 ISBN 0 580 22140 7

18 British Standards Institution 2003 ISBN 0 580 42103

19 Photo courtesy SKC limited

20 British Standards Institution 1997 ISBN 0 580 28328 3

21 HSE Books 2000. ISBN 0 7176 1749 1. Also available at http://www.hse.gov.uk/pubns/mdhs/pdfs/mdhs14-3.pdf

22 HSE Books 2005 ISBN 0 7176 2897 3. Also available at http://www.hse.gov.uk/pubns/mdhs/pdfs/mdhs101.pdf