**MODEL COURSE ATON**

**LEVEL 2 – TECHNICIAN**

**Maintenance of Mercury Rotating Optics**



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**PART A - COURSE OVERVIEW**

**Section 1 - Introduction**

**Purpose of the Model Course**

The purpose of the model course is to assist training institutes and their teaching staff in organizing and introducing new training courses, or in enhancing, updating, or supplementing existing training material where the quality and effectiveness of the training courses may thereby be improved.

It is not the intention of the model course to present instructors with a rigid teaching package which they are expected to follow blindly. For teaching purposes, the subjects may be grouped and re-arranged where that is considered an advantage. The knowledge, skills, and dedication of the instructor are key components in the transfer of knowledge and skills to those being trained through this model course.

The required standard of competence is considered to be the level of proficiency that should be achieved for the proper performance of the duties carried out by the technician in his or her organization.

**Use of the Model Course**

This course is intended to cover the knowledge and practical competence required for a technician to properly service and maintain Mercury Rotating Optics used on Lighthouses. The complete course comprises 6 modules, each of which deals with a specific subject representing an aspect of Mercury Rotating Optics servicing and maintenance. Each module begins by stating its scope and aims, and then provides a teaching syllabus.

**Presentation and Lesson Plans**

This is a practical, job-centered course designed to provide trainees with a realistic, hands-on educational experience. The modular presentation enables the instructor to adjust the course content to suit the trainee intake and provide any revisions to the learning objectives as required. Where no adjustment has been found necessary in the learning objectives, the lesson plans may simply consist of the syllabus with keywords or other reminders added to assist the instructor in making their presentation of the material.

**Evaluation or Assessment of Trainee Progress**

Trainees will be evaluated on their understanding of the material and their ability to carry out the tasks associated with each module of the course. Additional guidance is provided in Section 5 of this Course Overview.

**Implementation**

For the course to run smoothly and effectively, considerable attention must be paid to the availability and use of:

 Qualified instructors

 Support staff

 Rooms and other spaces  Training equipment

 Safety equipment

 Reference material

Thorough preparation is the key to successful implementation of the course.

**Validation**

The information contained in this document has been validated by a group of subject matter experts drawn from the IALA membership. Validation in the context of this document means that the group has found no grounds to object to its contents.

**Section 2 - Course Framework**

**Scope**

This course is intended to provide technicians with the practical training necessary to become efficient and competent in the servicing and maintenance of Mercury rotating optics.

**Objective**

Upon successful completion of this course, trainees will have acquired sufficient knowledge and skill to service and maintain ATON Mercury rotating optics on the job within their organizations.

**Entry Standard**

The Competent Authority may prescribe minimum standards for education or work experience for prospective trainees to enter this course. In preparing this course, it has been assumed that trainees would have the minimum physical ability and educational background necessary to successfully carry out the function of servicing and maintaining ATON Mercury rotating optics. This will include a basic education in Navigation Lights and Health and Safety at work.

**Requirements for Certification**

Every candidate for certification should:

 Be not less than 18 years of age.

 Satisfy the Competent Authority that they possess the theoretical and practical knowledge necessary to carry out the responsibility of servicing and maintaining Mercury Rotating Optics.

**Course Intake Limitations**

Class sizes my be limited at the discretion of the Competent Authority in order to allow the instructor to give adequate attention to individual trainees. In general, it is recommended that a maximum of 6 students be the upper limit that a single instructor can be expected to train satisfactorily to the level of competence required.

**Training Staff Requirements**

All instructors, supervisors, and assessors should be appropriately qualified in the subject matter covered by this course. In addition to technical expertise in the subject matter, accredited training programs should ensure that all members of the teaching staff have appropriate training in instructional techniques and assessment methods. As well as instructors, supervisors, and assessors, additional staff may be required for the maintenance of equipment and the preparation of materials, supplies, and work areas.

**Teaching Facilities and Equipment**

This course involves both classroom instruction and practical visit in a work area. Classrooms should be equipped with blackboards, whiteboards, and overhead projectors to enable presentation of the subject matter. An alternative to classroom instruction would be to provide the lecture material to students at a distance via the Internet or other electronic means (i.e., "e-learning"). In that case, students would need access to computers and related equipment, and should be provided with a means of interacting with instructors for discussion and to answer questions.

**Teaching Aids**

Trainees should have access to the types of equipment that they will be expected to work with on the job. This would include such things as samples of equipment in use, PPE, photographs etc.

**Reference**

In addition to any specific references required by the Competent Authority, the following material is relevant to this course:

 IALA Guideline

 IALA Guideline

Technical documentation from equipment manufacturers would be another useful source of information.

**Section 3 – Course Outline**

The complete course comprises of nine modules, each of which deals with a specific aspect of Mercury rotating optics, servicing and maintenance.

The topics of these five modules are to be considered as a minimum requirement for developing the Level 2 Course. However, the lesson content can be adapted or expanded to meet the specific requirements of the Competent Authority.

**Section 4 - Guidelines for Instructors**

|  |  |  |
| --- | --- | --- |
| **Module title** | **Time in hours** | **Overview** |
| Overview and history of Mercury floating bath optics | 1.5 | This module describes the history behind the Mercury bath rotating optic |
| Mercury the substance | 1.5 | This module describes the chemical Mercury (Hg) its properties and its hazards |
| Legislation and Mercury | 1.5 | This module describes the legislative framework within which mercury must be used, handled and disposed of and will vary from one country to another. |
| Application in a floating optic bath | 2.0 | This module describes how Mercury is used, maintenance and general information on its application in a  rotating optic |
| Mercury removal and replacement | 2.0 | This module describes the procedures and safety requirements for removing and draining Mercury from a rotating optic |
| Site visit | 8.0 | To visit a Mercury Rotating Optic for familiarisation |
| Evaluation | 1 |  |
| **Total Hours:** | 17.5 |  |

**Introduction**

The intent of this course is to enable students to return to their jobs prepared to service and maintain Mercury rotating optics found in a typical Aid to Navigation. Particular emphasis should be placed on proper safety procedures, both through lecture and--most importantly--the instructor's personal example.

**Curriculum**

Although the learning objectives are set out here in a certain order, instructors are not obliged to teach them in this order. Instead, the instructor should treat them in the order which they consider to be the most effective for their trainees and circumstances.

The recommended hours for the module durations are intended to be used as approximate guidelines for planning purposes. The hours should be adjusted as necessary to suit local circumstances or based on experience with similar courses. It is also quite usual for different trainees to require different lengths of time to cover the same work. The course should therefore be implemented with some flexibility to allow for adjustments during its running. Using the time estimates, modified as appropriate, a timetable should be drawn up to suit the normal working day and terms of the training institute.

The success of the course will depend to a large extent upon coordination of the individual subjects into a coherent teaching scheme. It is important that an experienced instructor act as course coordinator to plan and supervise the implementation of the course. The course coordinator should then monitor the running of the course, and conduct regular discussions with the teaching staff concerning the progress of trainees and any problems that have become apparent. At the conclusion of the course, a discussion should be held to determine whether changes should be made to improve future courses**.**

**Section 5 - Evaluation or Assessment**

To evaluate trainee progress, regular assessments must be undertaken. The nature of these assessments and the evaluation criteria used will depend on the needs of the Competent Authority, the style of training used, and the requirements of the training institute. However, the subject matter of this course would lend itself primarily to short written exams.

**PART B - COURSE MODULES**

Module 1 – Overview and history of Mercury floating bath optics

**Scope**

This module describes the history behind the Mercury bath rotating optic

**Learning Objective**

To understand why Mercury was used and where it is used now.

Lesson 1 – History of the floating optic

1. Developments in the rotating optic
2. The early mercury baths

Lesson 2 – Where they are used

1. Locations within the competent authority where Mercury is used
2. Future plans for mercury use

Module 2 – Mercury the Substance

**Scope**

This module describes the chemical Mercury (Hg) its properties and its hazards

**Learning Objective**

To be aware of the properties and hazards of Mercury

Lesson 1 – Physical properties

1. Chemical background
2. Mass
3. Liquid state
4. Boiling point
5. Uses

Lesson 2 – Hazards to Health

1. Results of mercury poisoning
2. Ingestion by mouth
3. Inhalation by air
   1. Safe working limits
4. Absorption through skin
5. Air monitoring
6. Treatment for those contaminated
7. Blood & urine testing

Lesson 3 – Environmental Hazards

1. Pollution to land
2. Marine pollution

Module 3 – Legislation and Mercury

**Scope**

This module describes the legislative framework within which mercury must be used, handled and disposed of and will vary from one country to another.

**Learning Objective**

To understand the law and approved codes of practice for both the country of operation and the competent authority.

Lesson 1 – Legislation

1. Legislation pertaining to Mercury
2. Previous legislation and legislation developments
3. Approved codes of practice for handling Mercury

Lesson 2 – Internal Instructions

1. Competent Authority instructions
   1. See appendix 1 - Model safe work instruction
   2. See appendix 2 - Precautions during the removal of optic mercury bath in lanterns
   3. See appendix 3 - Precautions when handling small quantities of mercury (hg)
2. Storage
3. Handling
4. Transport
5. Disposal

Module 4 – Application in a floating optic bath

**Scope**

This module describes how Mercury is used, maintenance and general information on its application in a

rotating optic

**Learning Objective**

To understand how to safely operate, maintain and fault find on a mercury bath optic

Lesson 1 – Overview

1. Principles of operation
2. Quantities inuse
3. Side bearings
4. Shims

Lesson 2 - Routine maintenance

1. Run down times & start up times
2. Longevity
3. Overview of draining down & topping up
4. Cleaning & varnishing of iron surfaces
5. Viscosity changes / dirt impregnation.
6. Lubrication
7. Longevity

Lesson 2 – Drive systems

1. Stepper motor drives
2. Geared variable speed drives
3. Geared fixed speed drives

Module 5 – Mercury Removal and Replacement

**Scope**

This module describes the procedures and safety requirements for removing and draining Mercury from a rotating optic

**Learning Objective**

To enable the student to safely undertake the removal and replacement of mercury from a rotating optic

**Syllabus**

See Appendix 1, 2 and 3 for a model method statement of these works

Lesson 1- Equipment required

1. Temporary storage containers & transfer pipes
2. Jacks
3. Paper & tape for masking
4. Filtering gauze

Lesson 2 - Safety equipment

1. PPE
   1. Breathing masks
   2. Overalls
   3. Overshoes
   4. Gloves
   5. Goggles
2. Air monitoring
3. Sheeting
4. Clean / dirty areas
5. Flowers of Sulphur
6. Written method statement
7. Disposal method statements
8. Personal hygiene
9. Medical surveillance

Lesson 3 – Draining & re filling

1. When to work - Length of day Vs ambient temperature
2. Sheeting up
3. Filtering
4. Re filling
5. Spillage procedures
6. Cleaning up and disposal of contaminated items

Module 6 – Visit to a Mercury rotating optic

**Scope**

To visit a Mercury Rotating Optic for familiarisation

**Learning Objective**

To consolidate knowledge in the field

**Syllabus**

**APPENDIX 1**

**MODEL SAFE WORK INSTRUCTION**

**Mercury (Hg) in Rotating Optics**

**1. Purpose**

These procedures detail the minimum arrangements for the protection of employees and contractors, or any other person that may be exposed to Mercury. It includes the procedures to be followed and health surveillance standards, including the requirements for urine testing of those that will be potentially exposed before and after working with Mercury.

The safe working procedures noted in this Instruction deals only with the handling and use of Mercury and therefore can only form part of the safe working procedure for the task. It is the responsibility of management and supervision to follow the procedures in Appendix 1 or 2. Any deviation from this work instruction will require a specific Risk Assessment to be completed.

**2. Scope**

Mercury exposure falls within the scope of The “Local legislative standards”

These procedures apply to all work with Mercury and contaminated Mercury equipment, substances or bi-products.

**3 INTRODUCTION**

Mercury is a silvery white metal and is the only pure metal which is liquid at ordinary temperatures.

Mercury evaporates, even at ordinary room temperatures and the concentration of vapour produced

in a closed unventilated room can exceed the recommended exposure limit of 0.025 milligrams per 8

hour period per cubic metre by many times. Mercury vapour is highly toxic and precautions must

always be taken to avoid the inhalation of vapours and direct skin contact with the metal.

**4 MERCURY VAPOUR IN LANTERNS**

The concentration of mercury vapour in any closed area, such as a Lighthouse lantern, is dependant

upon three factors:

(a) The surface area of the exposed mercury;

(b) The room temperature; and

(c) Movement of the mercury mass.

Previous tests carried in Laboratories have shown that under normal working conditions, the extent of airborne mercury contamination within a lantern containing a 1st Order Optic, was negligible and was well below the exposure limit. Further tests at another lighthouse showed that under normal day-to-day conditions, the mercury vapour contamination was within safe limits. However, this condition alters considerably during mercury bath removal and cleaning, and then airborne contamination greatly exceeds the permitted levels. The safe working procedure relating to the removal of the mercury bath is the subject of Appendix 1 attached.

**5 THE MEDICAL EFFECTS OF MERCURY**

Mercury vapour has no smell and can only be detected by elaborate measuring equipment. Acute mercury poisoning is very rare in industry and is usually the outcome of accidental ingestion. However, symptoms of mercury poisoning are a metallic taste in the mouth, nausea, vomiting, thirst, a burning sensation in the throat and in severe cases, chronic diarrhoea. Mercury poisoning may be a notifiable industrial disease under local regulation.

6 **FIRST AID**

There is limited scope for first aid treatment for mercury poisoning. In cases where such a condition is suspected, medical advice should be sought immediately.

**7 PROTECTIVE CLOTHING**

Protective clothing, including disposable overalls with hoods; disposable overshoes; close fitting rubber gloves and Respiratory Protection Equipment (RPE), are to be used for any work involving the handling or transfer of mercury at Lighthouse Stations.

The approved breathing apparatus is a full face respiratory mask with the relevant Hg rated filter. Forced air full face respiratory masks are recommended for prolonged work as this reduces respiratory stress for the wearers.

Rubber/plastic masks must be maintained in a clean condition and in good repair. After use the mask is to be washed in warm soapy water and thoroughly dried and lightly dusted with French chalk before returning to store. The contaminated filters must be removed and disposed of as "special waste".

**8**  **PREVENTATIVE MEASURES**

Throughout any process or work with mercury it is essential that maximum ventilation be maintained and air extraction/blower units must be used if there is room to accommodate them. This will prevent the build-up of vapours and help to keep the area cool. The mercury should be stored in closed containers, which can be sealed, thus preventing the mercury vaporising freely into the atmosphere. Open buckets are **not** to be used. Special closed canisters are provided and these should be used as instructed.

If any spillage occurs the mercury should be picked up as soon as possible using a rubber suction ball, or the mini vacuum cleaner, which is part of the special equipment provided.

If the mercury is allowed to be broken up into smaller droplets, this has the effect of increasing the surface area and the contamination level rises.

**9** **DECONTAMINATION OF CONTAMINATED AREAS**

The decontamination process is carried out using a wash comprising of ***equal parts of slaked lime and flowers of sulphur mixed together with water to form a thin paste***. Be aware flowers of sulphur may cause irritation of the eyes if it is mixed away from contaminated areas. it is therefore recommended that safety goggles without vents be worn. The yellow wash should be applied to the affected containers or areas by persons wearing full protective clothing and respiratory protection concerned and allowed to dry. The wash should then be removed with clean water and again allowed to dry. The mixture converts the metallic mercury into mercury sulphide and, therefore, removes the danger of further vaporisation, but must be treated as “Special Waste”.

**10 EQUIPMENT CLEANING**

On completion of the operation, and prior to returning the equipment to stores, all visible mercury droplets must be collected, which is normally best done using a small paint brush to “move” the droplet into a transportation container.

Note: It is impossible to totally clean this equipment of mercury dust or droplets, therefore it will always, to some degree, be contaminated and must be treated as such, being handled only when wearing the correct PPE. All waste is to be collected and disposed of as “Special Waste”, and not in any form disposed of down a drain, or in the sea. Each transportation box, containing Mercury cleaning equipment is to carry the warning notice as shown.

**11 PERSONAL HYGIENE**

A high standard of cleanliness must be observed when working with mercury. Personnel must remove overalls, gloves and other items, which may have been in contact with mercury, before entering any area where food and drink is prepared. Also the hands and face must be thoroughly washed before meals are taken. As the contaminated dust settles on the head, the hair must be washed on completion of the operation.

**12 STORAGE**

Generally, mercury is to be stored in a cast iron flask fitted with a screwed plug. The plug must be screwed down tight.

Quantities of mercury are up to one third of a pint (approximate weight 4 Kg) are supplied by the manufacturers in heavy-duty polythene bottles. All storage containers **must** be fitted with a tight fitting cap or stopper and on no account should any mercury be stored in containers open to the atmosphere. It should be noted that a polythene bottle full of mercury will break open if dropped onto a hard surface. Care must be taken when handling stored mercury since the specific gravity is very high and even small quantities are comparatively heavy. The storage of mercury on a station is allowed, at the discretion of local management.

All mercury waste is to be placed in a sealed container, or double bagged with labels attached denoting the contents, before delivery to a Trinity House Store for onward delivery to a Special Waste Contractor for disposal.

**13**  **MEDICAL SURVEILLANCE**

Because of the known medical condition excessive exposure to mercury by inhalation or contact can cause, the following rules will apply:

(a) All mercury urine tests will be controlled by the Health & Safety Manager.

(b) Requests for sample bottles are to be made to the Health & Safety Department

(c) All samples will be tested by one laboratory, to give ease of comparison.

(d) All persons who may be involved in mercury operations are to have urine tests prior to the operations

(e) Any person with a "mercury in urine" dosage of 15 nmol/mmol Creatinine or more will not be allowed to participate in future mercury cleaning operations until their Mercury urine levels have reduced (Occupational Exposure Limit = 20 n mol/mmmol Creatinine).

(f) When possible and within 24 hours of completion of mercury cleaning operations all persons involved are to submit second urine samples. If this is not possible, then on return to the depot whichever is the sooner

(g) Results will be collated by the Health & Safety Manager and reported to the individual as soon as possible after they have been received

(h) A record of exposure/urine test results will also be maintained on the employee’s personal file.

(I) If the Urine Mercury result exceeds 15 nmol/mmol in Creatinine. (Maximum dosage 20 nmol/mmol Creatinine) then the Health & Safety Manager will liaise with the Occupational Health Service as necessary and instruct an immediate retest.

Note: To standardise records, the second urine sample should be taken at, or as near to 4pm, the day after the operation, as is possible.

**14 PACKAGING**

Once Urine samples have been carried out they need to be sent to an approved laboratory for testing

**APPENDIX 2**

**PRECAUTIONS DURING THE REMOVAL OF OPTIC MERCURY**

**BATH IN LANTERNS**

1 **INTRODUCTION**

During the removal of the mercury from the optic bath it can be predicted with certainty that the level of airborne mercury contamination will exceed the accepted safe level. A safe working procedure must be maintained to reduce so far as is practicable the extent of the contamination. It will be necessary for all personnel within the lantern area to wear protective clothing as listed in paragraph 4 of this Safety Instruction and air extraction units should be considered also. All other personnel not employed in the optic bath cleaning must be instructed not to enter the area at any time, unless adequately protected.

2 **EQUIPMENT**

The following equipment will be provided to enable the safe working procedure to be implemented:

Plastic tubing with a sealed screwed connector

Tube clips

One rubber suction bulb

One enamel jug

One litre proprietary brand mixed shellac (Anti-Knotting)



Various grades sand paper

Four 2" paintbrushes

Drain/Filler filter unit

Quantity mutton cloth

Four Protector half masks,

Ten Protector filters,

Four pairs rubber gloves

Eight disposable overalls (2 days work)

12 Pairs of Elasticated PVC overshoes

Ten plastic bags (large)

Ten SDS labels denoting “Mercury Waste” (Available from the Health & Safety Manager- Risk Assessment software)

Quantity flowers of sulphur

Quantity slaked lime

Four pair of safety goggles - Vistamax VNC21

Seventeen GRP storage pots

A Jerome 431 Mercury Analyser and recording laptop must be present in the Lantern room during all mercury bath changes and de-contamination process as this may result in at least one team member being trained in its use, advanced notice must be given to the Health & Safety Department to arrange this.

3 **PROCEDURE**

Prior to leaving Depot, check that all the equipment is available, ensuring that the overalls are big enough for the people involved, and a Risk Assessment has been completed.

**Day One**

N.B. Note the height of the optic above the vertical rollers before commencing any work

(a) Check contents of boxes. Mix Shellac Crystals and allow maximum time for them to dissolve (if used). Check that the Mercury filter has clean mutton cloth in it. (Ensure that you are wearing protective clothing and correct mask).

(b) Locate jacks and jack handles. Ensure jacks are useable. Take jacks to lantern room.

(c) Locate jack pad hole covers, remove the covers and ensure that the area underneath is clear and that the jacks can drop the required distance.

(d) Remove all unnecessary loose equipment from under the optic.

(e) Ensure any items located on the bath supports are removed if possible or loosened prior to removal on the day. (For example the manual winding gear or any electrical equipment).

(f) Place jacks in position and take the weight of the bath without actually lifting the bath. Use special adaptors if available.

(g) Check the area the bath is going to be lowered into; at certain stations the handrails have to be removed to allow the bath to be lowered. Either remove the obstruction or loosen any fixings as necessary to allow speedy removal on day two.

(h) Loosen off, but do not remove, the bath support cradle nuts and bolts, removing accumulations of old paint as needed.

(i) Prepare the filter with four layers of mutton cloth.

(j) Lay out as much equipment for the following day as is convenient and safe. Do not create a hazardous situation in doing so. Extractor fans must not be slung overnight where they will obstruct the optic light beam.

**Day Two**

(a) Commence as early as possible.

(b) Isolate both optic- drive motors and verify isolation. Observe all electrical safety precautions.

(c) All persons not involved in the task to remain clear of the area.

(d) All persons involved are to be correctly dressed.

(e) Switch "on" the air extractors.

(f) Remove all equipment from under the bath as previously identified. Take care with the optic drive shafts etc. Drive shafts may be slid back out of mesh.

(g) Identify the Mercury drain point and attach the drainpipe with in-line filter to it. Drain the Mercury into the special containers.

(h) Taking great care and with one man calling out the timing on the jacks, lower the bath to a suitable working height.

(i) Carefully remove all traces of Mercury from the bottom of the bath, through the filter into the container, using the paintbrushes provided.

(j) Clean the bath and float using glass paper. Remove all traces of dust and debris into "Mercury" waste bag. Wipe over bath and float with methylated spirits. Allow to dry.

(k) Inspect bath and float for corrosion, pin holes etc.

(l) Apply Shellac to bath and float. Allow to dry for at least one hour and apply second coat. Allow to dry thoroughly before raising bath. The coats should be as thin as possible as too thick a mix is liable to flaking at a later date.

(m) Raise the bath in a controlled manner, again one man calling the timing on the jacks.

(n) Replace the bath supports etc. and tighten nuts fully.

(o) Prepare the filter with a single layer of mutton cloth.

(p) Pour the Mercury back into the bath, using a tube from the glass fibre containers into the filling point in a controlled manner, until all the Mercury is back in the bath. Compare the height of the optic above the vertical rollers; add Mercury only if necessary to clear the rollers.

(q) Remove jacks, replace all equipment previously removed.

(r) Place all equipment for disposal into the correct waste bags and label with SDS labels for “Mercury”. Remove to TH Store or arrange collection for disposal by a licensed Special Waste disposal firm.

(s) Re-time the light, adjusting the optic drive as needed.

**Day Three**

Clean all equipment

Decontaminate any contaminated areas

Re-pack and remove equipment from station.

**APPENDIX 3**

**PRECAUTIONS WHEN HANDLING SMALL QUANTITIES OF MERCURY (Hg)**

1 **INTRODUCTION**

There are occasions when small quantities of metallic mercury are required to be handled e.g. slip-ring troughs on PRB lantern assemblies. Although the quantity of mercury is relatively small, adequate precautions with regard to personal safety must be observed.

2 **AIRBORNE CONTAMINATION**

As stated in the Instruction, the amount of mercury vapour produced is directly proportionate to:

(a) The surface area of the mercury; and

(b) The surrounding air temperature.

It is, therefore, essential that during the work as described in paragraph 1 above that spillage must be reduced to a minimum and also that the working area must be ventilated to the maximum obtainable level. If a spillage does occur the free mercury must be contained and recovered using a suction bulb. Mercury must always be stored in a closed stone jar or cast iron bottle fitted with a screwed plug. The suction bulb can also be used to transfer small quantities of mercury from the trough to the storage jar.

3 **PROTECTIVE CLOTHING**

Despite the fact that only small quantities of mercury are to be handled, dangerous levels of mercury vapour may be present. Therefore, all personnel who are undertaking the work must be provided with the same standard of equipment for a major cleaning operation, namely:

(a) Disposable overalls;

(b) Tight fitting rubber gloves;

(c) Mask with filter

Eye protection

(e) Elasticated PVC overshoes