

PETRONAS TECHNICAL STANDARDS

HEALTH, SAFETY AND ENVIRONMENT

GUIDELINE

CHEMICAL MANAGEMENT PROGRAM

PTS 60.1502

DECEMBER 2010



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This revision of PTS 60.1502 – CHEMICAL MANAGEMENT PROGRAM (DECEMBER 2010, Revision 2) has been updated to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. All updates in the document are highlighted in *italic font*.

The previous version of this PTS 60.1002 CHEMICAL HEALTH HAZARDS (JUNE 2005) will be removed from PTS binder / e-repository from herein onwards.

The custodian of this PTS is: Manager - HSE MS, Standards & Regulations, GHSED.

Please direct any questions regarding this PTS to the above-mentioned.

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PREFACE

PETRONAS Technical Standards (PTS) publications reflect the views, at the time of publication, of PETRONAS OPU/Divisions.

They are based on the experience acquired during the involvement with the design, construction, operation and maintenance of processing units and facilities. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPU in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

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1.0 INTRODUCTION

This publication on 'Chemical Management Guideline' provides advice on assessing risks to health arising from chemical hazards in the workplace as well as implementing an effective Chemical Management in OPU/JVs.

1.1 WHAT IS CHEMICAL?

A chemical substance is any material with a definite chemical composition. For example, a sample of water has the same properties and the same ratio of hydrogen to oxygen whether the sample came from a river or was made in a laboratory. A pure substance cannot be separated into other substances by any mechanical process. Generally, substances exist as solid, liquid, or gas, and may change between these phases of matter when there is a change in temperature or pressure.

1.2 OBJECTIVE

The specific objectives of this Guide are:

1. To protect workers/employees from the health effects arising from the exposure to the chemicals handled in workplaces
2. To state the requirement in meeting PETRONAS standards as well as most legal framework with respect to chemicals
3. To specify the methodology to carry out chemical health risk assessment
4. To outline the steps involved in identifying, applying and maintaining the controls which keeps the exposure to ALARP and in any event, below PEL

1.3 LEGAL REQUIREMENT

There are various legislations or legal framework that governs the management of chemicals across the world. Most of them provide the requirement for a chemical facility to perform the following:

- Preparing a chemical register/inventory
- Provision and availability of safety data sheet (SDS)
- Adequate labeling/relabeling
- Performing risk assessment on the use of the chemicals
- Conduct chemical exposure monitoring
- Institute health surveillance program
- Inspection and maintenance of controls equipment, including personal protective equipment (PPE)
- Provision of information instruction & training

The requirement outlined in this PTS may be used, unless it is otherwise specified by the local country regulations. For Malaysia operations, two main regulations that specify the requirement on chemical management are:

- Occupational Safety & Health (OSH) Use and Standards Exposure of Chemicals Hazardous to Health Regulations (USECHH) 2000;
- Occupational Safety & Health (OSH) Classification, Packaging & labeling of Hazardous Chemicals Regulations 1997 – (CPL)

Some of the available legislations for various countries are as follows:

- Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation 2007 (REACH) – European Union
- Control of Substances Hazardous to Health Regulations 2002 (COSHH) – United Kingdom
- National Model Regulations for the Control of Workplace Hazardous Substances 1994 – NOHSC, Australia .
- Part 1990 – Identification, Classification, and Regulation of Potential Occupational Carcinogens, OSHA, USA
- Occupational Health and Safety Act 85 of 199 - Regulations for Hazardous Chemical Substances, 1995 (RHCS) – South Africa
- Globally Harmonised System of classification and labelling of chemicals (GHS) South African National Standard SANS 10234:2007 – South Africa
- Transport of dangerous goods – Packaging and large packaging for road and rail transport SANS 10229-1:2005 - South Africa

All requirements established in this document shall be applicable to all employees of PETRONAS worldwide. In locations where local statutory requirements are more stringent, such requirements shall take precedent.

1.4 OPUs/JVs GENERAL RESPONSIBILITIES:

Group Health, Safety and Environment Division (GHSED) is the custodian of this document and shall be responsible to periodically review and revise the contents of this document and to distribute them.

OPUs/JVs HSE Department shall be responsible to:

1. Review the requirement of this PTS with respect to other applicable local country requirement and adopt the necessary standards
2. Prepare and distribute OPU-specific procedures and customized to the requirement of this PTS
3. Identify/develop relevant resources to implement the program
4. Ensure the implementation of the requirements of this document by line managers.

1.5 ELEMENTS OF CHEMICAL MANAGEMENT PROGRAM

The elements of chemical management program are not limited to the following:

1. Chemical Inventory/ Register
2. Controls of Chemicals Use Onsite
3. Risk Assessment
4. Exposure Monitoring
5. Health Surveillance Program
6. Local exhaust ventilation (LEV) System
7. Provision of PPE
8. Provision of CSDS
9. Labeling & Relabeling
10. Chemical Waste Management
11. Warning Sign
12. Information Instruction & Training

1.6 PRODUCT STEWARDSHIP PROGRAM

Product Stewardship is one of the seven key areas identified in PETRONAS Corporate Sustainability Framework and one of the Management Codes under the Responsible Care Program (RCP). It relates to the practice of making health, safety and environment protection as an integral part of the product development, manufacture, handling and usage.

As a manufacturer of various chemicals, OPU/JVs may be required to conduct an evaluation of their products to assure that these products deliver their intended benefits, while protecting public health and the environment. These evaluations include characterization of any risks associated with the use of the product and how they are communicated with the stakeholders.

A communication system to facilitate public knowledge of their products, including relevant safety, health and management information is necessary. Detailed requirement may be referred to PETRONAS Group HSE Division.

2.0 CHEMICAL INVENTORY/REGISTER

Create an inventory of all chemicals stored/used/produced in each work area and obtain health hazard information for each chemical. This is termed as Chemical Register/Inventory. Setting up an inventory of chemicals is a key requirement under the Malaysia's Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazardous to Health) Regulations 2000 (USECHH) Regulations.

The Chemical Register shall contain the following information;

- i. List of all chemicals hazardous to health that are stored/used/produced in the workplace.
- ii. Current Safety Data Sheet (SDS*) of each of the chemicals hazardous to health.
- iii. The average monthly or yearly amount of each chemicals hazardous to health are produced or processed in the unit process
- iv. The average monthly or yearly amount of chemicals hazardous to health are handled, stored, transport, disposal or treatment at the work area
- v. The name, address and contact number of the local or foreign suppliers of each of the chemicals hazardous to health.

** SDS is similar to Chemical Safety Data Sheet (CSDS) or Material Safety Data Sheet (MSDS). It will be referred as SDS in this publication.*

The Chemical Register is maintained in good order and condition and up-dated from time to time. PETRONAS Datakimia also provides the platform for OPU/JVs to maintain an online Chemical Inventory. The proposed format of the Chemical Register/Inventory is as per Appendix A.

3.0 CONTROLS OF CHEMICALS USE ONSITE

OPUs/JVs shall ensure that only approved chemicals are used onsite. A mechanism to approve the use of chemicals shall be established and this may be triggered by the OPUs/JVs Management of Change (MOC) procedures or equivalent.

The purpose of this controls are to ensure, chemicals used onsite are:

- Furnished with appropriate SDS
- Labeled adequately
- Registered/inventoried part of the Chemical Register/Inventory
- Assessed on their use and risk to health for the chemical handlers
- Used with adequate control measures to minimize its risk to health

This also applies to the chemicals brought in/used by the Contractors as well as substitutions of existing chemicals.

4.0 RISK ASSESSMENT

The methodology outlined in PTS 60.1400.01 - Health Risk Assessment (Standard) - (HRA) (PETRONAS, 2007) is also used for the chemical health risk assessment. For Malaysia operations, Occupational Safety & Health (OSH) Use and Standards Exposure of Chemicals Hazardous to Health Regulations (USECHH) 2000, specifies the requirement to conduct Chemical Health Risk Assessment (CHRA). Methodology outlined in CHRA Manual (Department of Safety & Health, Malaysia, 2000) may be referred.

The chemical health risk assessment involves the following steps and this section describes the methodology to carry out the risk assessment.

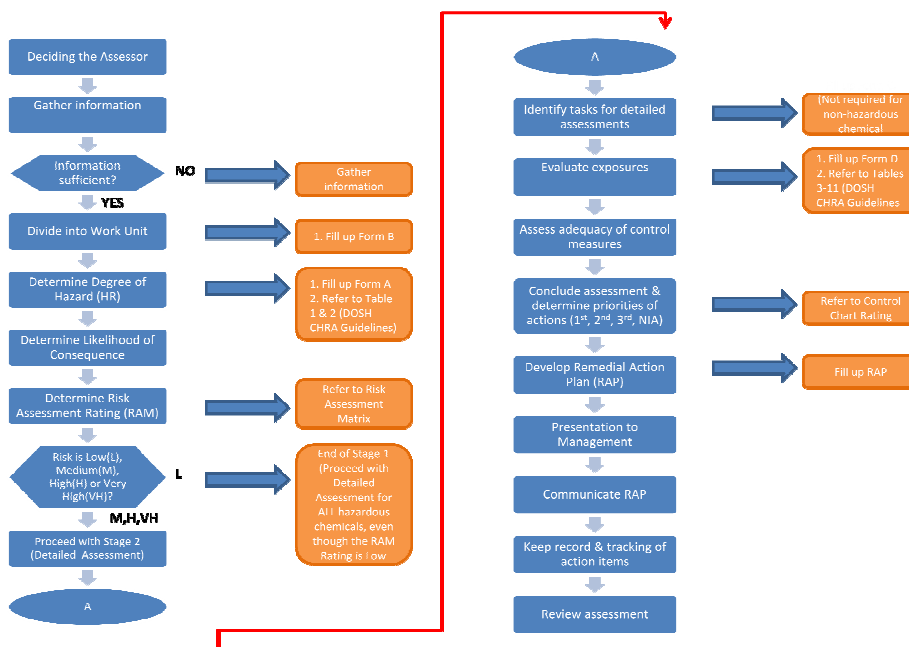


Figure 1 The Chemical Health Risk Assessment Flowchart

OPUs/JVs may opt to conduct the assessment using the online tool (customized iHSE) or proceed with the normal Microsoft Office tools.

4.1 IDENTIFICATION OF WORK UNITS & CHEMICAL HAZARDS

The first step to assess the chemical health risk is to identify the group of workers that is handling the chemicals and the chemicals they handle.

4.1.1 Selection of Work Units

Employees and other workers should be assigned to Job Types based on similar tasks and thus having similar potential for exposure. This is referred as Work Unit. OPU/JVs Organization Chart and Job Descriptions can be used to categorize the Work Units.

Ensure that all potential exposures to hazardous chemical have been identified for assessment by reviewing:-

- pregnant women and nursing mothers;
- untrained or inexperienced persons (e.g. new recruits, temporary workers);
- persons working in confined or poorly ventilated spaces;
- persons with pre-existing conditions (e.g. bronchitis, sensitised to the chemical concerned, asthmatics);
- persons receiving medications which might increase their susceptibility to toxic effects;
- persons suffering from malnutrition or a chronic infection or medical condition;
- smokers, who may be at increased risk due to additive or synergistic effects.

4.1.2 Identification of Chemical Hazards

Maintain an updated register of manufacturer's/suppliers SDS. The preparation of Chemical Register/Inventory is as per Section 2.

To ensure that the list is comprehensive, consider:-

- feedstocks and additives;
- intermediates and by-products;
- final products;
- ancillary chemicals used in the process, e.g. catalysts, vessel flushing agents, solvents, acids and alkalis used for pH adjustment, drilling mud chemicals, biocides, surfactants;
- waste products, e.g. residues, gaseous emissions, dirty rags, empty contaminated containers;
- proprietary products e.g. cleaning agents, oils and greases, paints, degreasing agents, glues;
- building, plant and equipment construction materials e.g. insulation and fire retarding materials, paints, gaskets and packing materials;
- chemical agents produced as a result of tasks or processes, e.g. welding fumes and gases, oil mist, vehicle exhausts.

4.1.3 Information on hazard

Understanding toxicology is essential to gather background information on the hazards of chemical. An introduction to toxicology and a list of common toxicity terms is given in

1. APPENDIX A: SAMPLE OF CHEMICAL INVENTORY/REGISTER
2. APPENDIX B: AN OUTLINE OF TOXICOLOGY AND COMMON TERMS

Sources of information on the health effects, routes of exposure and physio-chemical properties of chemicals are given below.

a) Sources of information

Information may be obtained from, for example:-

- manufacturer's and supplier's SDS, labels on containers or manuals of products;
- databases or published texts (e.g. PETRONAS Datakimia);
- OPU/JVs guidance material;
- Or advice may be obtained from occupational health advisers/physicians, occupational hygienists, toxicologists, organisations with knowledge and experience of the activity or operation, e.g. industry associations, government health and safety advisory bodies.

b) Routes of exposure

Exposure can occur via three routes:-

- Inhalation (via the lungs);
- Skin contact, either directly or from contaminated surfaces or clothing. Some chemicals are able to enter the body through intact skin, e.g. benzene, xylene, toluene, phenol, mercury, hydrofluoric acid. In addition, tasks involving high pressure equipment may result in injection of chemicals through the skin, e.g. paint spraying, grease injection, or by contact with sharp objects which are themselves contaminated;
- Ingestion (via the mouth), either directly or by consuming contaminated food or drink. Smokers are vulnerable to transferring chemical agents on their hands to their mouth if they have not ensured their hands are clean before smoking a cigarette, as are nail biters. Injection (penetration into the skin))

Discussions on the effect of physical and chemical properties on its intrinsic hazard or the potential for an increase in the exposure level are presented in APPENDIX C: EFFECTS OF CHEMICAL & PHYSICAL CHARACTERISTICS.

A set of HRA Forms that may be used for this assessment is attached in APPENDIX D: HRA ASSESSMENT FORM.

4.2 ASSESSING EXPOSURE

Once the Work Unit and inventory of chemicals have been identified, there is a need to evaluate the exposure to assess the potential of chemicals entering the body through the various routes of entry.

Important considerations in the assessment of chemicals exposure in the workplace are:

- Frequency of exposure (Daily/Weekly/Monthly/Yearly)
- Duration of exposure (% of work/ minutes/hours)
- Intensity or magnitude of exposure
- Methods of handling

The intensity or magnitude of exposure may be evaluated quantitatively or qualitatively. The results from the past personal or area exposure monitoring gathered may be used to estimate the exposure to chemicals. Direct reading instruments available for specific chemicals may also be used for the estimation. On the other hand, qualitative estimates of exposure depend on the degree of chemical release or presence and the degree of chemical being absorbed. The information gathered from the exposure evaluation is recorded in Form D of Appendix D.

In addition to routine work, also consider activities such as one-off maintenance jobs, plant startup, shutdowns, commissioning, turnarounds, as well as unplanned but reasonably expected events such as leaks, spills and release etc.

4.3 ASSESSING CONTROL MEASURES

Evaluation of the existing control measures includes going through the hierarchy of controls which the details are explained in Section 7.

The risk level is based on the Hazard Rating (HR) and Exposure Rating (ER) as shown in (Figure 2 Control Chart Rating to Determine the Chemical Risk Level) below.

Hazard Rating ↓	Exposure Rating →				
	Very Low (a)	Low (b)	Medium (c)	High (d)	Very High (e)
1	No	Immediate	Third	Second	
2	Action	Required	Priority	Priority	
3				First Priority	
4		Third	Second	for	
5		Priority	Priority	Action	
Exposure Band*	< 0.1xOEL ⁺	0.1xOEL-0.5xOEL	0.5xOEL-1xOEL	>OEL	>>OEL

Figure 2 Control Chart Rating to Determine the Chemical Risk Level

The risk level achieved determines the actions to be taken to manage the risk to chemicals.

Exposure should be controlled to a level 'as low as reasonably practicable' (ALARP) and should, in any case, be less than the permissible exposure limit (PEL) for the chemical in question. In addition, the recommended measures to achieve a level ALARP for the chemicals should be specified.

The PEL and specifications for control are known as screening (compliance) and performance criteria. These criteria may be in place prior to the HRA commencing, or may be introduced as a result of an unsatisfactory level of control identified during the HRA.

Definitions of PELs for chemical hazards are given below.

a) PEL: Personal exposure - air measurement

Many countries have identified PEL or Occupational Exposure Limits (OELs) for various chemical agents - units are in parts per million (for gases and vapours), milligrams per cubic metre (for all except fibrous dusts) or fibres per millilitre of air (for fibrous dusts). In general, the limits comprise:-

- Time-Weighted Average (TWA) exposure: the TWA concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect;
- Short Term Exposure Limit (STEL): this is applied to chemicals with acute effects and, in general, is a maximum allowable exposure over a 15 minute period; and, in some cases,
- Ceiling Limit: the concentration that should not be exceeded during any part of the working exposure.

Where a country has no PEL for a substance, PETRONAS Companies are recommended to refer either to:

- Schedule I of the Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazardous to Health) Regulation 2000 (Department of Safety & Health, Malaysia, 2000) or
- The documentation and Threshold Limit Values (TLV®) list published annually by the American Conference of Governmental Industrial Hygienists (American Conference of Governmental Industrial Hygienists, 2009).

Other reference sources are the European Union Indicative Limit Values (ILVs - these are currently draft limits), individual country's limits such as the United Kingdom's Occupational Exposure Standards (OESs) and Maximum Exposure Limits (MELs), the Netherlands' MAC warden, the German Maximale Arbeitsplatzkonzentrationen (MAKs) and Technical Exposure Limits (TRKs).

If no PEL exists for a particular substance its supplier should be requested to provide a working limit, together with evidence to support that limit. Alternatively, a request for an advised limit may be made to Occupational Health Advisers in the OPUs.

By exception, PETRONAS Occupational Health Advisers may recommend PEL lower (i.e. more stringent) than other published limits for a substance where the lower limit is readily achievable, or evidence exists to justify it.

b) PEL: Personal Exposure - Biological Monitoring

Biological Limit Values (BLVs) are guidance values for assessing biological monitoring results. (American Conference of Governmental Industrial Hygienists, 2009) has set the Biological Exposure Indices (BEIs®) for a number of chemicals. BEIs® represents the levels of determinants that are most likely to be observed in specimens collected from healthy workers who have been exposed to chemicals to the same extent as workers with inhalation exposure at the TLV®.

The BLV determinant can be the chemical itself (eg. Cadmium in urine and/or in blood for Cadmium), one or more metabolites (e.g. S-phenylmercapturic acid (SPMA) in urine for Benzene); or a characteristics, reversible biochemical change induced by the chemical (e.g. Cholinesterase activity in red cells for Parathion). Most of the specimens used is urine, blood or exhaled air.

Where the need for additional control measures is identified to reduce the risk, a systematic review of all control options should be made with a view to controlling exposures to ALARP.

5.0 EXPOSURE MONITORING

Exposure monitoring shall be conducted based on the following:

- As per the recommendation of Chemical Health Risk Assessment (CHRA)
- As part of investigation
- As directed by the Authority/PETRONAS Health Advisors

Exposure Monitoring must be carried out by a Company Approved personnel. For Malaysia operations, Hygiene Technician registered (with DOSH) shall carry out the exposure monitoring in accordance with an approved monitoring and analytical protocols by DOSH (i.e. US-NIOSH Manual of Analytical Methods/OSHA Method). (NIOSH USA, 2009); (US OSHA, 2009)

Exposure monitoring results are compared to the Ceiling Limit and Permissible Exposure Limits (PELs) as listed in Schedule I of the USECHH Regulations 2000, or other DOSH accepted references (i.e. ACGIH TLV Booklet). The detailed of monitoring protocols may be referred to Guidelines on 'Monitoring Airborne Contaminants for Chemicals Hazardous to Health (Department of Safety & Health, Malaysia, 2002).

5.1 EXPOSURE MONITORING EQUIPMENT

Exposure monitoring is preferably carried out using active sampling and the typical equipment used for that purpose is as follows:

- Personal sampling pumps for active sampling
- Sampling media (i.e.: for benzene: coconut charcoal tubes, for mercury: hopcalite/carulite tubes)
- Pump primary calibrator for calibration of sampling pumps (i.e.: soap film flow meter/bubble meter/drycellmeter)
- Hygrometer for temperature & humidity readings
- Wind velocity monitor

Under certain circumstances, passive samplers, with adequate validation may be used.

Note: All equipment must be Intrinsically Safe, or would otherwise need a Hot Work Permit to Work (PTW) from location for use.

5.2 CALIBRATION

Sampling pumps are calibrated using a primary pump calibrator before and after monitoring to ensure the correct flow rate is set on the sampling pumps (prior) and flow rate remains constant (after). An average flow rate is calculated to later determine total volume collected. A post flow rate difference of $\pm 10\%$ indicates inconsistent flow, hence deems the sample void and unacceptable.

All calibrators are to be sent to suppliers for calibration and maintenance at least once a year (calibration/maintenance certificate to be included in the report). Sampling pumps should be sent to supplier for maintenance at a frequency relevant to its use.

5.3 SAMPLING STRATEGY

There are three types of sampling strategies:

- Ambient exposure monitoring – monitoring equipment is set up and placed at high-risk areas/locations as per recommended of CHRA or as advised by an Industrial Hygienist (IH).
- Task-based personal exposure monitoring – for short-term (task-based) exposure monitoring, equipment (sampling pumps) are attached to the worker at the beginning of the identified task and removed at the end of task for as long as the task is carried out.
- 8-hour/full-shift personal exposure monitoring – for PEL exposure monitoring, monitoring equipment (sampling pumps) are attached to worker at the beginning of shift and removed at the end of shift.

NOTE: Wind velocity, temperature & humidity – readings should be taken at locations of exposure monitoring being carried out, periodically throughout the sampling day, to account for wind direction and change in ambient humidity.

Flowchart showing the exposure assessment strategy is as per APPENDIX E OVERVIEW OF EXPOSURE MEASUREMENT STRATEGY

5.3.1 Selection of Worker

Workers for task-based or 8-hour/full-shift exposure monitoring are chosen at random for a representative amount of workers and or with advice from an IH taking into consideration the following criteria:

- Nearest to source
- With the most duration and frequency of exposure
- Nature of work/work practice
- Availability of control measure

5.3.2 Field Blank

A field blank is subjected to the same handling procedures as the other samples minus the actual sampling time. This quality control step is to detect any contamination introduced during handling of samples and/or background contamination. The number of field blanks necessary is two per 10 samples with a maximum of 10 per sample set.

5.3.3 Transportation Blank

One tube is broken and sealed prior to packaging and sending sampling tubes to laboratory for analysis. This is to determine any contamination of sampling tubes occurring during transportation of samples to laboratory. The number of transportation blanks necessary is one per sample shipment/transportation.

5.4 Personal Exposure and Ambient (area) Monitoring

Monitoring shall be conducted for work units or tasks identified in the CHRA or if advised by an Industrial Hygienist (IH) or PETRONAS Health Advisors. Sampling pumps or badge monitors (if accepted) are attached to employees for the duration of their shift or task with the sampling media attached within the employees' breathing zone (approx 30cm radius from nose - collar/lapel). This exercise should be repeated on at least 3 consecutive workdays of the same work unit or task for a representative assessment of personal chemical exposure. For ambient (area) monitoring, a sampling pump shall be located at the identified high-risk area and shall follow an 8-hr/full-shift basis of exposure. This should be repeated on at least 3 consecutive workdays at the same high-risk area for a representative assessment of ambient exposure levels.

5.5 SAMPLE ANALYSIS

Sampling media shall be packed and sent to laboratories in a manner as per required by receiving lab (typical is below 4°C) to determine amount of contaminant collected. US-NMAM or US-OSHA Sampling and Analytical Methods (or approved DOSH analytical methods) are to be used as a guideline for laboratories to accurately determine the contaminant content on the sampling media.

Selection of laboratory should be on the basis of:

- I. Analytical accuracy
- II. Convenience
- III. Turnaround Time
- IV. Cost

List of recommended laboratories to carry out the analytical testing shall be confirmed with PETRONAS Industrial Hygienists.

5.5.1 Exposure Calculations

Exposure calculations shall include the following:

- Calculating the 8-hour/full-shift continuous exposure calculation from the laboratory results as follows:

Calculation of 8-hour /Full-shift/15-mins Continuous Chemical Exposure Level

$$\text{Exposure Level} = \frac{T_1 (C_1) + T_2 (C_2) + T_3 (C_3) + T_4 (C_4) + \dots + T_n (C_n)}{\text{Total Time}}$$

T_n - duration of sampling n in minutes

C_1 - amount in ppm of contaminant collected during sampling n

Total time - total time sampled, $T_1 + T_2 + T_3 + T_4 + \dots + T_n$

For 8-hour continuous exposure level, Total Time = 480 minutes

For 15-mins exposure level, Total Time = 15 minutes

If Total Time is < 480 minutes, and an 8-hour exposure level is desired:

- a) assume remaining time has no exposure

Regard total time as 480 minutes

- b) assume remaining time has continuous similar exposure

Regard exposure level for full duration of monitoring to equal the 8-hour continuous exposure level.

- Using average flow-rate value for volume calculation as well as the corrected Volume value (should temperature vary +/-14C from standard temperature of 25C).

Correction of Volume Air Sampled

$$\text{Exposure Level} = \frac{\text{Ave Flow Rate} \times t}{1000} \times \frac{T}{T_s}$$

Ave Flow Rate - average flow rate during sampling (cc/min)

t - duration of sampling in minutes

T_s - Standard Temperature (25C / 298.15K)

T - Temperature at time of measurement taken.

- Should respiratory protection equipment (RPE) be worn during monitoring of personnel, the Assigned Protection Factor (APF) of the RPE should be factored into the exposed value for purpose of determining compliance to the PEL and tabled in the final report.