

**GUIDELINES ON SAMPLING STRATEGY
AND SUBMISSION OF AIR MONITORING /
SAMPLE ANALYSIS REPORT**

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(I) SAMPLING STRATEGIES

1. When conducting hygiene monitoring or measurements, the following sampling strategies shall as far as possible be followed:-
 - (a) The atmosphere of any workplace in which toxic airborne contaminants are given off shall be monitored at sufficient intervals.
 - (b) Occupations with the highest expected exposure shall be monitored first. Representative subjects shall be selected for sampling.
 - (b) All monitoring shall represent the personal exposure unless otherwise specified. The monitoring device should be attached as close as possible to the worker's breathing zone. Note the periods when exposure may be high due to specific activities or process cycles. Change the sample collection medium when conditions show signs of overloading due to excessive airborne contaminants.
 - (c) If area monitoring is conducted, the monitoring device or sampling medium shall be positioned at about 1.2 to 1.8 metre (3 to 4 feet) from the floor. Make sure that the sample collection medium is not in direct contact with, or placed too close to any settled dust or spilled chemical.
 - (d) Samples representing a full-shift exposure shall be collected for evaluating or assessing the time-weighted average (TWA) concentration.
 - (e) Before conducting the air monitoring, the air monitoring service provider shall obtain from the factory occupier or his representative the information on the work process to be monitored. The information shall be recorded in Part C of the Hygiene Air Monitoring Report -Information on Work Process.
 - (f) A minimum of 6 hours of sampling is required to evaluate exposure over a full 8-hour shift, or 8 hours of sampling for a full 12-hour shift. However, this is only applicable to work processes with small concentration variations. Otherwise, a full shift (8 or 12 hours) sampling is required.

If the worker is exposed to contaminants for less than 6 hours, a partial-period sampling could be conducted covering the period of exposure. In this case, the period, which was not sampled, could be assumed to have zero exposure. [An example of the calculation of TWA_{6hr} concentration is in appendix 1].

2. All sampling and monitoring shall be carried out in accordance with the recommended procedures. Ensure that all active monitoring devices are calibrated. Before use, check the batteries of the devices for charge and the expiring date of the sampling medium. In addition, make sure that the following are carried out: -
 - (a) Sample collection medium (membrane filter) for monitoring of total particulate shall be desiccated for at least 24 hours prior to weighing. If a vacuum dessiccator is used, desiccation of filter can be reduced to 30 minutes.
 - (b) Sorbent tube used for monitoring of gases or vapours shall be positioned vertically to avoid “channelling” (i.e. the adsorbent shifts and forms a channel within the tube) during sample collection. After sampling, the sorbent tube shall be capped at both ends and stored at <4°C prior to analysis in order to prevent sample loss.

3. All equipment and instruments used for sampling shall be calibrated in accordance with standard calibration methods before and after sampling. The persons carrying out the air monitoring must ensure that the sampling equipment used are reliable and accurately calibrated.

4. The person carrying out the monitoring shall as far as possible remain at the workplace until all the samples are collected. He should ensure that the monitoring devices are not tampered with. He should also check the flowrate of the monitoring devices after the first 15-30 minutes and at intervals of about two hours thereafter.

5. The sample size should be at least 3 to 5 samples per job-classification/group, or from 25% to 50% of those in the group for groups of 10 or more.

6. The frequency of air monitoring depends on the exposure level: -

< 10 % of the PEL	:	* No air monitoring is required.
10 – 50% of the PEL	:	At least once a year.
> 50 -100% of the PEL:		At least once every <u>six months</u>.

> PEL : At least once every three months, until the exposure is reduced to below the PEL by appropriate control measures.

* A re-assessment should be carried out if there is any change in the process.

Note:

Exposure level of 50% PEL is known as the “action level” and shall as far as possible be reduced to less than 50% PEL.

7. If it is not possible to conduct a full-shift sampling, a series of “grab” or “spot” samples can be taken randomly throughout the workshift using detector-tubes or other appropriate instruments. The acceptable number of samples is 4 to 7.

Note: Refer to the Factories (Permissible *Exposure Levels* of Toxic Substances) Notification for the PEL values.

(II) AIR MONITORING AND SAMPLE ANALYSIS REPORT

1. Analytical results of air samples should be submitted to the customer within 3 weeks from the date of receipt of samples from the customer, if the air monitoring is not conducted by the same organisation that analyses the samples.
2. Air monitoring results should be submitted in the attached hygiene monitoring report form to the customer by the air monitoring service provider within 3 weeks from the date of receipt of analytical results from the laboratory. A copy of the analysis results from the laboratory should be attached with the hygiene monitoring report. (Note: Air samples shall be sent to the analytical laboratory for analysis as early as possible after sampling.)
3. Air monitoring results should be submitted in the attached hygiene monitoring report form to the customer within 6 weeks from the date of air monitoring, if both air monitoring and sample analysis are conducted by the same organisation.
4. Air monitoring results should be submitted by the factory occupier to the Occupational Health Department, Ministry of Manpower, within 2 weeks from the date of receipt of the results from the air monitoring service provider or the analytical laboratory.
5. All analytical laboratories shall use methods, which are sensitive enough to detect or measure the concentration below 10% of the permissible exposure level (PEL) of each chemical being analysed. Report of result of "< PEL" is not acceptable.
6. The particulars of the subjects monitored, including their full names, NRIC (for Singaporeans) or FIN numbers (for foreigners) must be recorded in the hygiene monitoring report form. DO NOT record the work permit, passport or employee numbers. A sample of the completed form is in Appendix 1.
7. A layout plan indicating the location(s) of sampling point(s) should be attached to the hygiene monitoring report. For personal sampling of a subject who is stationed at a specific location for the whole workshift, the personal sample's location should be indicated in the map. However, if the personal sample is taken from a subject who moves around, the work-area of the subject should as far as possible to be indicated on the map. If the work area is too large to be indicated, the department or section where the subject works should be stated in the "Remarks" column of the hygiene monitoring report form. A sample of a layout plan is in Appendix 2.

If the TWA concentration exceeds 50% PEL, the air monitoring service provider has to confirm that he has provided appropriate recommendation(s) to the factory occupier to control or limit the exposure. This information should be given in Part E – Findings and Recommendation of the report form. A sample of this is attached in Appendix 3.

SAMPLE REPORT

Apendix 1

HYGIENE CHEMICAL AIR MONITORING REPORT

Part A. COMPETENT PERSON

Name _____

NRIC/FIN No.

Organisation Conducting the Assessment__

Part B. FACTORY MONITORED

Name of Company/Business

Factory Registration Number

Address

Tel _____

Fax _____

Date of Monitoring

Name of factory representative

(present during monitoring)

Part C: INFORMATION ON WORK PROCESS

(NOTE: *Before* conducting the air monitoring, this part shall be completed by the factory representative and given to the air monitoring service provider for process information.)

Process, Work or Operation	Type Of Workshift (eg. 8hr or 12hr)	Frequency/Duration of Process, Work or Operation
Vapour Degreasing	} 12-hr shift	Continuously throughout the whole shift.
General housekeeping - manual cleaning		5-7 times per shift; 30–45 min each time.
Degreasing- Manual Parts Handling		Once every hour; <10 min each time.
Electroplating	8-hr shift	Continuously throughout the whole shift.
Assembly - stacking	2 hr	2 hr process for the entire shift.

Part D: HYGIENE MONITORING REPORT FORM

Factory Registration Number: _____

Date of Assessment: _____

Factory Name: _____

Factory Address: _____

A copy of the factory layout plan is attached to this form]

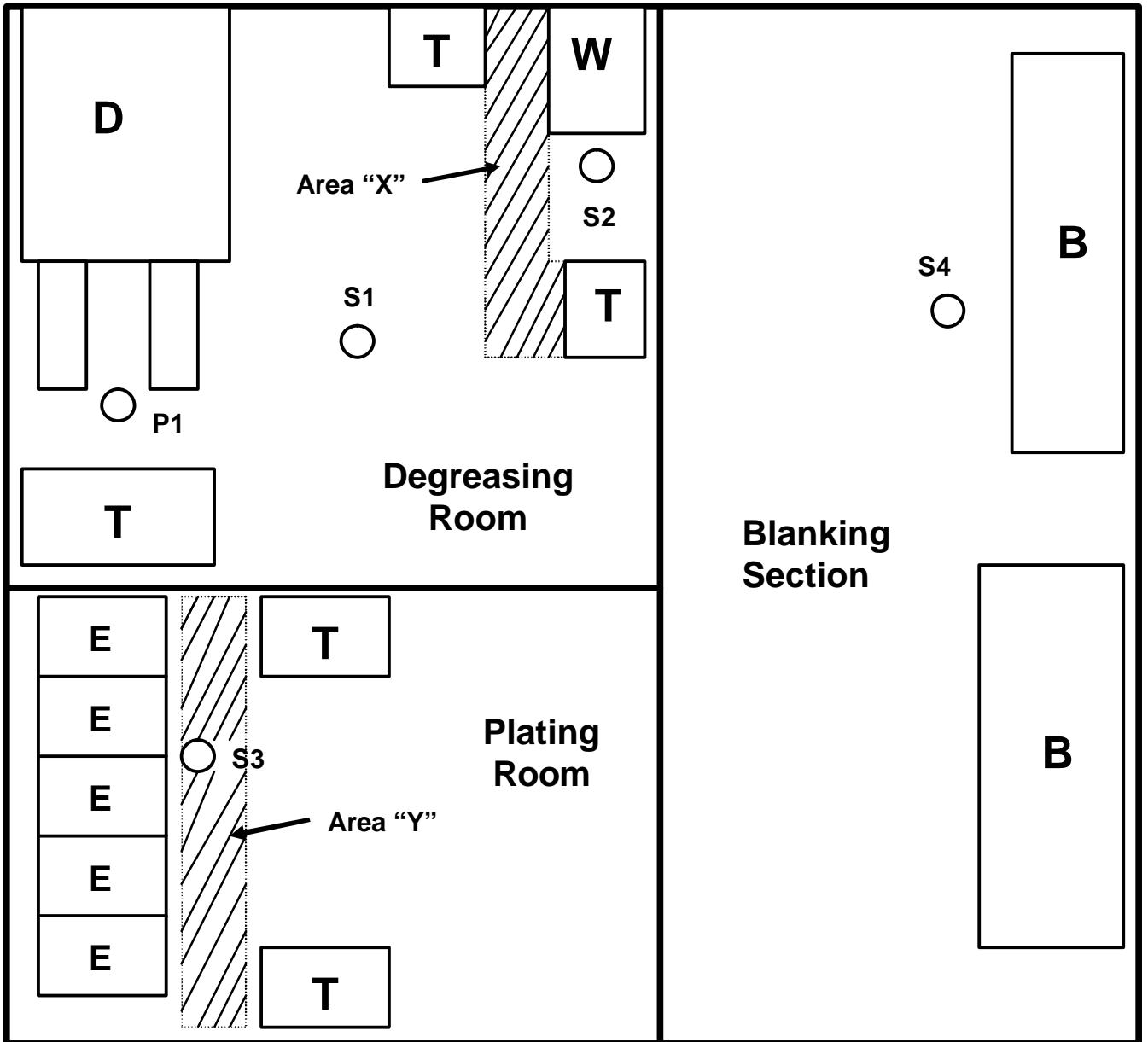
Chemical Monitored	1 Total Number of Workers Exposed	Type of Sample (P-personal S-static)		2 Monitoring Method	3 Process	4 Existing Control Measures	Monitoring Time & Duration [min]	5 Concentration measured or TWA _{8hr} concentration [mg/m ³]		Name and 6 ID of Person Monitored		Location of monitoring (demarcate on the layout plan attached)
		Conc.	TWA _{8hr}					Name	ID			
Trichloroethylene	3	P	Badge	Degreasing -vapour degreasing	LEV, Partial Enclosure	0900 hrs - 1900 hrs (800 min)	50	50	Lim Ah Teck	S12345678A	Degreaser. (Sample P1)	
		S	Sorbent Tube				75	75	-	-	1m away from machine. (Sample S1)	
	2	P	Badge	General Housekeeping- Manual Cleaning	No Control		150	150	Ershad Khan	F9087456H	Cleaner. Did cleaning 6 times during monitoring period. (Working in area "X")	
		S	Sorbent Tube				300	300	-	-	Beside Washing Tank. (Sample S2)	
	3	P	Badge	Degreasing - Manual Parts Handling	No Control		5	5	Mok Ah Beng	G0981234E	General worker. Manually convey parts from blanking section to degreasing room.	
Chromium	5	P	Filtration	Electro plating	Mist Suppression Tablets	1000 hrs - 1500 hrs (360 min)	0.01	0.01	Mohd Yusof bin Hassan	S0288567J	Electroplater. (Working in area "Y")	
		S					0.02	0.02	-	-	Beside Chromium Tank (Sample S3)	
Lead	2	S	F	Assembly – Stacking	LEV	0900 hrs - 1000hr (120 min)	0.01	0.002	-	-	In Blanking room (Sample S4)	

Important Notes for Completing Part D:

- ¹ Total Number of Persons Exposed: refers to *all* the people who are exposed to the chemical over *all* workshifts.
- ² Monitoring Method: eg. Filtration, Badges, Sorbent Tubes, Impinger, etc.
- ³ Process: choose one process below that best describes the work performed.

Abrasive Blasting	Electroplating	Metal / Injection Molding	Solvent cleaning / Degreasing
Acid / Alkali Cleaning	Extrusion / Drawing	Metal Punching	Sterilization
Assembly of Parts	Forging	Metal Stamping	Storage / Warehouse
Blending / Mixing	Foundry Operation	Packing	Surface Mounting technology
Brazing	General Housekeeping	Painting (brush)	Wafer Fabrication
Buffing / Polishing	Glueing (brush)	Painting (spray)	Weighing
Car Maintenance	Glueing (spray)	Plastic Injection Molding	Welding
Casting	Grinding	Powder Coating	Woodworking
Chemical plant / refinery	Heat Treatment	Printing	Others – please specify
Cutting / Sawing	Laboratory	Quarrying	-
Drumming / Refilling	Masking	Silk Screen Printing	-
Dry cleaning	Melting/ Smelting	Soldering (wave /hand)	-

- ⁴ Existing control measures: eg. Total Enclosure, Partial Enclosure, Local Exhaust Ventilation or No Control.



LEGENDS:

- | | | |
|---|------------------------------------|-----------------------|
| ○ | Sampling Points (S: Static sample | P: Personal sample) |
| ▨ | Work Area of Mobile Worker | |
| D | Conveyorised Degreasing Machine | E Electroplating Tank |
| W | Washing Tank | B Blanking Machine |
| | | T Table |

I confirm that:

- The instruments used were calibrated before and after conducting the air monitoring.
- Recognized sampling and analytical methods were adopted, such as those recommended by the US National Institute of Occupational Safety & Health and Occupational Safety & Health Administration.

Part E: FINDINGS AND RECOMMENDATIONS

I have evaluated the results of the air monitoring and informed the factory occupier of the process (es) where the TWA concentration exceeded 50% PEL. I have advised the factory occupier to look into control measures to reduce the exposure.

Finding(s)	Recommendation(s)
General Housekeeping Results of TCE in air: 56% PEL and 112% PEL	<ol style="list-style-type: none"> 1. Substitution of TCE with a safe solvent substitute; or install a local exhaust ventilation system for manual cleaning of parts. 2. Workers have to wear organic vapour cartridge respirators and personal protective equipment. 3. Workers are required to undergo Statutory Medical Examinations for TCE.

I confirm that:

- The instruments used were calibrated before and after conducting the air monitoring.
- Recognized sampling and analytical methods were adopted, such as those recommended by the US National Institute of Occupational Safety & Health and Occupational Safety & Health Administration.

Part E: FINDINGS AND RECOMMENDATIONS

I have evaluated the results of the air monitoring and informed the factory occupier of the process (es) where the TWA concentration exceeded 50% PEL. I have advised the factory occupier to look into control measures to reduce the exposure.

Finding(s)	Recommendation(s)