WORKING ENVIRONMENT MEASUREMENT (WEM)

Technical Guidebook

CRL Calabarquez Corporation
LIIP Admin. Bldg., Mamplasan, Biñan, Laguna
Tel: (632) 552-5020; (6349) 539-0205
Web: www.crllabs.com
Email: info@crllabs.com

Introduction

CRL Calabarquez Corporation is a full environmental Air Quality Monitoring company. Its services include working environment measurement (WEM), indoor air quality monitoring (IAQ), stationary source emission testing (stack testing), ambient air quality and noise monitoring (ambient), cylinder gas audit (CGA), relative accuracy audit (RAA) and relative accuracy test audit (RATA).

CRL Calabarquez Corporation is part of the CRL Environmental Corporation group, a full service environmental analytical testing laboratory. CRL features advanced instrumentation, backed by proven technical competence and quality assurance in the laboratory and in the field.

CRL is pleased to present our Working Environment Measurement Technical Guidebook. It is intended to provide our customers and concerned individuals with a convenient source of information and a useful guide on the measurement of the different and most common safety and health hazards (parameters) in the working environment. This guidebook provides the rules and regulations, sampling and analysis methods and instruments as well as standards to compare the results of the measurements with.

The parameters provided herein are grouped into four categories; (1) **Physical**, (2) **Ventilation**, (3) **Chemical** and (4) **Biological**.

For clarifications and inquiries on other parameters not provided herein, kindly communicate with us through the contact information provided on the cover page or on the back page of this guidebook. For further information, one may refer to the below references used in this guidebook.

Institutions and references:

ACGIH – American Conference of Governmental Industrial Hygienists
ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers
DOLE – Department of Labor and Employment, PH
MASA – Methods of Air Sampling and Analysis, 3rd Edition by James P. Lodge
NIOSH – National Institute for Occupational Safety and Health, US
OSHA – Occupational Safety and Health Administration, US
OHSC – Occupational Safety and Health Center, PH
OSHS – Occupational Safety and Health Standards, PH
USEPA – United States Environmental Protection Agency

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Rules and Regulations

The conduct of Working Environment Measurement (WEM) is primarily for the purpose of promoting and maintaining the safety and health of workers by the evaluation of the magnitude of hazards through quantitative measurement of physical and chemical agents (among others) in the working environment. The Philippine government through its Department of Labor and Employment (DOLE) enacts and executes rules and regulations for the proper implementation of safety and health measures in the working industry and thus requires the conduct of WEM for the monitoring of its effectiveness. These rules and regulations are briefly discussed below.

CHAPTER VII (Industrial Hygiene)

PRESIDENTIAL DECREE 856(Sanitation Code of the Philippines)

Rule V, Section 2 of the Chapter VII (Industrial Hygiene) of the Sanitation Code of the Philippines laid down the "Environment Control" which is one of the requirements in the operation of industrial establishments. These "environment controls" guide the safety and health practitioners and other concerned individuals on the existing effective controls in reducing, if not completely eliminating, the working environment hazards. These "environment controls", as well, presented the respective standards, limits and guideline values that should be followed and be complied with—this is the predecessor of the Occupational Safety and Health Standards (OSH Standards).

WORKPLACE ENVIRONMENT ASSESSMENT

DOLE Memorandum Circular No. 01 series of 2000

This DOLE MC is the implementing guidelines for the conduct of workplace environment assessment in hazardous establishments and work processes. This is carried out by the DOLE inspectorate.

RULE1070 (Occupational Health and Environmental Control)

Occupational Safety and Health Standards (as amended, 1989) [Yellow Book]

Rule 1070 establishes the threshold limit values (TLV*) for toxic and carcinogenic substances and physical agents. Under this rule are the different updated standards and limits [from PD 856, Chapter VII] for physical (noise, illumination, general ventilation, and temperature and relative humidity) and airborne contaminants. This rule stipulates the conduct of WEM to be complied with by employers periodically as may be necessary but no longer than annually.

*Threshold Limit Valuesrefer to airborne concentration of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed daily [at 40 hours a week; 8 hours a day and 5 days a week]without adverse effect.

Table 1. Physical Parameters

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
Heat Stress	Direct Readout (Heat Sensing)	Heat stress meter	**ACGIH:** Variable standards, *see ACGIH Screening Criteria for Heat Stress Exposure (2011)*
Illumination	Direct Readout (Light Sensing)	Light meter	**OSHS (Rule 1075):** Variable standards*, see OSHS Rule 1075.03 to Rule 1075.04 or Rule 1075.06,Table 8c: Illumination Levels*
Noise	Direct Readout (Noise Sensing)	Noise meter	**OSHS (Rule 1074):** 90dB(A) for 8-hr work-day or see Rule 1074.02, Table 8b for other work durations **ACGIH and NIOSH:** 85dB(A) for 8-hr work-day
Relative Humidity	Direct Readout (Humidity Sensing)	Digital hygrometer	**ASHRAE (Standard 62.1-2010):** Relative humidity less than 65% (RH < 65%)
Temperature	Direct Readout (Temperature Sensing)	Digital thermometer	**ASHRAE (Standard 55-2010):** Between 19.4 and 28.8℃ (67 – 82 ℉)

Table 2. Ventilation Parameters

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
General Ventilation [as Air Supply]	Direct Readout (Flow Sensing)	Anemometer	**OSHS (Rule 1076.02):** 20 to 40 cubic meters an hour per worker
General Ventilation [as Air Change]	Direct Readout (Flow Sensing)	Anemometer	**OSHS (Rule 1076.02):** From 4 ACH for sedentary workers to 8 ACH for active workers *(Note: this standard does not cater the type of area nor the type of work performed, other references may be consulted)*
General Ventilation [as Air Velocity]	Direct Readout (Velocity Sensing)	Anemometer	**OSHS (Rule 1076.04):** Less than 15 meters per minute (m/min) [50 fpm] during rainy season and 45 m/min (150 fpm) during summer season **ACGIH (Industrial Ventilation: A Manual of Recommended Practices):** For air-conditioned areas, 15-22 m/min (50-70 fpm) while for non-air-conditioned areas, 23-38 m/min (75-125 fpm)
Local Ventilation [as Face Velocity]	Direct Readout (Velocity Sensing)	Anemometer	**OSHA(Federal Register):** 60 – 100 fpm **NFPA 45:** 80 – 120 fpm **Prudent Practices:** 80 – 100 fpm (with exceptions, see Prudent Practices) **SEFA 1.2:** 60 – 100 fpm

Table 3. Chemical Parameters

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
DUSTS / PARTICULATE MATTERS					
Asbestos	NIOSH 7400 (Air Filtration)	Mini pump, filter	NIOSH 7400 (Phase Contrast Microscopy, PCM)	PCM	**OSHA TLV:** 0.1 asbestos fibers (>5 µm long)/cc **NIOSH TLV:** 0.1 fibers/cc (fibers > 5 µm long)/400L
Particulate Matter 2.5	SKC IP-10A Method (Air Filtration)	Mini pump, PEM 2.5, filter	SKC IP-10A (Gravimetric)	Microbalance	--
Particulate Matter 10	SKC IP-10A Method (Air Filtration)	Mini pump, PEM 10, filter	SKC IP-10A (Gravimetric)	Microbalance	--
Silica Dust	NIOSH 7601 (Air Filtration)	Mini pump, cyclone, filter	Colorimetry	Ultra Violet – Visible Spectrophoto-meter (UV-Vis)	**NIOSH TLV:** 50 µg/m^3(Ca)
Total Nuisance Dust (TND)	NIOSH 0500 (Air Filtration)	Mini pump, filter	NIOSH 0500 (Gravimetric)	0.001 mg sensitivity balance	**OSHS (Rule 1073, Table 8a: Mineral Dusts):** 10,000 µg/m^3 (TLV)
Total Respirable Dust (TRD)	NIOSH 0600 (Air Filtration)	Mini pump, cyclone, filter	NIOSH 0600 (Gravimetric)	0.001 mg sensitivity balance	**OSHS (Rule 1073, Table 8a: Mineral Dusts):** 5,000 µg/m^3 (TLV)
Sodium Hydroxide, NaOH	NIOSH 7401 (Air Filtration)	Mini pump, filter	NIOSH 7401 (Acid-base titration)	Laboratory glass wares	**OSHS (Rule 1073, Table 8a: Mineral Dusts):** 2,000 µg/m^3 (TLV)

TLV – Threshold Limit Value; C – Ceiling Value; Ca – Carcinogenic

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
METALS (Particulates)					
Metals [scan]	NIOSH 7300 (Air Filtration)	Mini pump, filter	NIOSH 7300 (ICP)	Inductively Coupled Argon Plasma Spectroscopy (ICP)	*Note:* Metals scan provide concentrations of Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Mo, Ni, K, P, Se, Ag, Na, Sr, Tl, Sn, Ti, V and Zn
Aluminum, Al (total dust)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHA TLV:** 10,000 µg/m^3 (TLV)
Arsenic (As) and compounds (as Arsenic)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Hydride AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 500 µg/m^3 (TLV)
Cadmium, Cd (metal dust and soluble salt)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 200 µg/m^3 (TLV)
Chromium, Cr(metallic and insoluble salts)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 1,000 µg/m^3 (TLV)
Copper, Cu (dusts and mists)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 1,000 µg/m^3 (TLV)
Iron (Fe) Oxide Fume (as Iron)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 10,000 µg/m^3 (TLV)

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
Lead, Pb (inorganic compounds, fumes, dusts)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 150 µg/m^3 (TLV)
Manganese, Mn	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 5,000 µg/m^3 (C)
Mercury, Hg	(Air Filtration)	Mini pump, filter	Cold Vapor AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 50 µg/m^3 (TLV) (all forms except Alkyl)
Nickel, Ni (metal and soluble compounds)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 1,000 µg/m^3 (TLV)
Silver, Ag (metal and soluble compounds)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 10 µg/m^3 (TLV)
Zinc, Zn	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 5,000 µg/m^3 (TLV)
Zinc Oxide (ZnO) Fume (as Zinc)	NIOSH 7300 (Air Filtration)	Mini pump, filter	Flame AAS	Atomic Absorption Spectrophoto-meter (AAS)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 5,000 µg/m^3 (TLV)

TLV – Threshold Limit Value; C – Ceiling Value; Ca – Carcinogenic

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
GASES					
Carbon Monoxide, CO	Direct Readout (Gas Sensing)	CO electrochemical analyzer	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 50 ppm (TLV)
	Grab Sampling (Containment in Tedlar bags)	Tedlar bags, aspirator	USEPA Method 10	Non-Dispersive Infra-Red (NDIR)	
Carbon Dioxide, CO_2	Direct Readout (Gas Sensing)	CO_2 electrochemical analyzer	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 5,000 ppm (TLV)
	Grab Sampling (Containment in Tedlar bags)	Tedlar bags, aspirator	Direct Readout	CO_2 Electrochemical Analyzer	
Chlorine (Cl_2) Gas	MASA Method 202 (Liquid Absorption)	Mini pump, absorbing solution	MASA Method 202 (Methyl Orange Method)	Ultra Violet – Visible Spectrophoto-meter (UV-Vis)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 3,000 µg/m^3 (TLV)
Nitrogen Dioxide, NO_2	MASA Method 406 (Liquid Absorption)	Mini pump, absorbing solution	MASA Method 406 (Griess-Saltzman Method)	Ultra Violet – Visible Spectrophoto-meter (UV-Vis)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 9,000 µg/m^3 (C)
Sulfur Dioxide, SO_2	MASA Method 704A (Liquid Absorption)	Mini pump, absorbing solution	MASA Method 704A (Pararosaniline Method)	Ultra Violet – Visible Spectrophoto-meter (UV-Vis)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 13,000 µg/m^3 (TLV)

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
ACIDS (vapors)					
Acids [scan]	NIOSH 7903 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 7903 (Ion Chromatography)	Ion Chromatograph	*Note:* Acids scan provide concentrations of HBr, HCl, HF, HNO_3,H_3PO_4 and H_2SO_4
Acetic Acid	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 10 ppm (TLV)
Hydrochloric Acid, HCl (Hydrogen Chloride)	NIOSH 7903 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 7903 (Ion Chromatography)	Ion Chromatograph	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 7,000 µg/m^3 (C)
Phosphoric Acid	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 1,000 µg/m^3 (TLV)
Sulfuric Acid, H_2SO_4 (as Sulfate)	MASA Method 720D (Liquid Absorption)	Mini pump, absorbing solution	MASA Method 720D (Barium Sulfate Turbidimetry)	Ultra Violet – Visible Spectrophoto-meter (UV-Vis)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 1,000 µg/m^3 (TLV)

TLV – Threshold Limit Value; C – Ceiling Value; Ca – Carcinogenic

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
VOLATILES,ORGANICS AND OTHER COMPOUNDS					
Volatiles [scan]	OSHA 7 GC 24 (Sorbent Adsorption)	Mini pump, sorbent tube	OSHA 7 GC 24-Compound Scan (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	*Note:* Communicate with CRL for complete list of volatiles.
Total Volatile Organic Compounds (TVOC)	Direct Readout (Gas Sensing)	Photo Ionization Detector (PID)	--	--	--
	Grab Sampling (Containment in Tedlar bags)	Tedlar bags, aspirator	Direct Readout	Photo Ionization Detector (PID)	--
BTEX (Benzene, Toluene, Ethylbenzene, Xylene)	OSHA 7 GC 24 (Sorbent Adsorption)	Mini pump, sorbent tube	OSHA 7 GC 24-Compound Scan (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	*Note: Refer to respective chemicals for their standards*
Acetone	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 2,400 mg/m^3 (TLV)
Ammonia, NH_3	MASA Method 401 (Liquid Absorption)	Mini pump, absorbing solution	MASA Method 401 (Indophenol Method)	Ultra Violet – Visible Spectrophoto-meter (UV-Vis)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 30,000 µg/m^3 (TLV)

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
Benzene	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 25 ppm (C)
	NIOSH 1501 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 1501 / OSHA 7 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 80,000 µg/m^3 (C)
Chloroform	NIOSH 1003 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 1003 / OSHA 7 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 240,000 µg/m^3 (C)
Chloroformates	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	--
Cyclohexanone	NIOSH 1003 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 1003 / OSHA 7 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 200,000 µg/m^3 (TLV)

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
Ethyl acetate	NIOSH 1457 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 1457 / OSHA 7 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 1,400 mg/m^3 (TLV)
Ethylbenzene	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 100 ppm (C)
	NIOSH 1501 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 1501 / OSHA 7 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 435,000 µg/m^3 (C)
Formaldehyde	MASA Method 116 (Liquid Absorption)	Mini pump, absorbing solution	MASA Method 116 (Colorimetric Method)	Ultra Violet – Visible Spectrophoto-meter (UV-Vis)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 6,000 µg/m^3 (C)
Hexavalent Chromium	NIOSH 7600 (Air Filtration)	Mini pump, filter	NIOSH 7600 (UV-VIS)	Ultra Violet – Visible Spectrophoto-meter (UV-Vis)	**ACGIH TLV:** 50 µg/m^3 (TLV) (as Chromium, soluble)
Hydrogen Peroxide	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 1.0 ppm (TLV) (Hydrogen Peroxide, 90%)

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
Hydrogen Sulfide	MASA Method 701 (Liquid Absorption)	Mini pump, absorbing solution	MASA Method 701 (Methylene Blue Method)	Ultra Violet – Visible Spectrophoto-meter (UV-Vis)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 15,000 µg/m^3(TLV)
Isopropyl Alcohol	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 400 ppm (TLV)
Methanol	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 200 ppm (TLV)
Methyl Ethyl Ketone (2-Butanone)	NIOSH 2500 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 2500 / OSHA 7 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 590,000 µg/m^3 (TLV)
Methylene Chloride	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 500 ppm (TLV)
n-Butanol (Butyl Alcohol)	NIOSH 1405 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 1405 / OSHA 7 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 300,000 µg/m^3 (TLV)

TLV – Threshold Limit Value; C – Ceiling Value; Ca – Carcinogenic

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
n-Hexane	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**ACGIH TLV:** 50 ppm (TLV)
Oil Mist (Mineral)	(Air Filtration)	Mini pump, filter	Gravimetry	Microbalance	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 5,000 mg/m^3 (TLV)
Ozone, O_3	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 0.1 ppm (TLV)
Petroleum Ether (Naphta, Petroleum Distillates)	NIOSH 1550 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 1550 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 2,000 mg/m^3 (TLV)
Phenols	MASA Method 121 (Liquid Absorption)	Mini pump, absorbing solution	4-Aminoantipy-rene	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1076.04, Table 8: TLV for Airborne Contaminants):** 10,000 µg/m^3 (TLV)
Phthalic Anhydride	OSHA 90 (Air Filtration)	Mini pump, treated filter	OSHA 90 (HPLC/UV)	High-Performance Liquid Chromatograph (using UV)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 12,000 µg/m^3

Table 3, continued.

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
Toluene	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 100 ppm (C)
	NIOSH 1501 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 1501 / OSHA 7 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 375,000 µg/m^3 (C)
Xylene (Xylol)	Drager (Sorbent Adsorption)	Drager pump and tube	--	--	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 100 ppm (TLV)
	NIOSH 1501 (Sorbent Adsorption)	Mini pump, sorbent tube	NIOSH 1501 / OSHA 7 (GC-FID)	Gas Chromatograph-Flame Ionization Detector (GC-FID)	**OSHS (Rule 1073, Table 8: TLV for Airborne Contaminants):** 435,000 µg/m^3 (TLV)

TLV – Threshold Limit Value; C – Ceiling Value; Ca – Carcinogenic

Table 4. Biological Parameters

PARAMETER	TEST REFERENCE (SAMPLING OR MEASUREMENT METHOD)	SAMPLING OR MEASURING INSTRUMENT	ANALYSIS REFERENCE (ANALYSIS METHOD)	ANALYSIS INSTRUMENT	INSTITUTION/REFERENCES: STANDARDS
Total Bacteria	NIOSH 0800/01 (Air impaction)	Biostage impactor	Pour Plate Method	Colony Counter	--
Total Fungi (as yeasts and molds)	NIOSH 0800/01 (Air impaction)	Biostage impactor	Spread Plate Method	Colony Counter	--
Legionella *(from cooling towers, etc.)*	Culture Based Method	Sterile sampling bottle	Aerobic incubation	Colony Counter	--

CRL Calabarquez Corporation

Clark Headquarters
Bldg. 2, Berthaphil Compound 1
Berthaphil Inc. Industrial Park
Jose Abad Santos Ave., CFZ
Clarkfield, Pampanga
Philippines 2010
Tel: (6345) 599-3943; (6345) 499-6529
(632) 299-5826
Fax: (6345) 599-3963

Laguna Office
LIIP Admin. Bdg., Laguna Int'l Ind'l Park
Mamplasan, Biñan, Laguna
Philippines 4024
Telefax: (632) 552-5020
(6349) 539-0205

Makati Office
Unit 609 Cityland 10 Tower 1
6815 H.V. dela Costa, Ayala Ave., North
Makati City, Philippines 1226
Tel: (632) 840-4071; (632) 817-5307
(632) 893-9700
Fax: (632) 816-0329

Web: www.crllabs.com
Email: info@crllabs.com