TECHNICAL ANNEX 1

VOC Monitoring Exercise

TABLE OF CONTENTS

List of Tables

List of Figures

1. BACKGROUND

1.1.1 In the monitoring exercise, all sampling equipment used was properly calibrated and all methodologies employed were traceable to locally or internationally recognised standards.

1.1.2 The sampling and analysis of VOC Ozone precursors in the Region followed the methodologies that were either adopted by the HKSAR Government Environmental Protection Department (EPD) for similar works or published by United States Environmental Protection Agency (USEPA). Otherwise the monitoring procedures were referenced to other widely accepted methods with modifications where necessary to suit local constraints.

1.1.3 The USEPA *"Technical Assessment Document for Sampling and Analysis of Ozone Precursors* {USEPA ref: EPA/600-R-98/161 dated September 1999}" provides detailed guidelines and method descriptions to establish a Photochemical Assessment Monitoring Stations (PAMS) for measuring VOC ozone precursors. The sampling and analysis of VOC for this study has closely followed this guidance paper.

1.1.4 An independent audit exercise had been performed by LAM Geotechnics Limited for all the site sampling and laboratory analysis procedures prior to and during the actual sampling exercise. Any non-compliance observed by the independent auditor had been incorporated into the actual monitoring exercise as far as technically feasible.

1.1.5 The monitoring exercise was divided into two phases in PRDEZ. The purpose of the second phase monitoring was to supplement the first phase in terms of area coverage. Wider geographical coverage of the original programmed are thus provided and enhanced the representation of the air quality monitoring results. The data from elevated stations has added value for studying the long-range transportation of pollutants across PRDEZ. Besides, Phase II monitoring was performed on discrete days and locations not covered in Phase I monitoring.

1.1.6 In general, the sampling results to be presented in subsequent sections correspond to monitoring site characteristics where industrial areas with more emission sources had been found to have higher pollutant concentrations compared to rural areas.

2. FIELD SAMPLING METHODOLOGY

2.1 Location of Sampling Points

2.1.1 There were 17 different locations in HKSAR and PRDEZ as marked on Figure 2-1.

2.1.2 In Phase I VOC monitoring exercise, there were eight and two monitoring stations distributed in the PRDEZ and HKSAR respectively. Figure 2-1 identified the ten monitoring stations. The pollutants detected from these stations were presumably sourced from industrial, urban, motor vehicle, or rural emissions as listed in 2.1.5 with reference to the characteristics of each station. Profiles for individual sampling locations are presented in Table 2-1.

2.1.3 In Phase II VOC monitoring exercise, there were nine sampling locations in PRDEZ. There were two commons locations in Phase I and Phase II monitoring, namely Guangzhou City Tianhe District, Guangzhou City Conghua City.

2.1.4 For security and accessibility purposes, sampling locations of the monitoring exercise were collocated as far as practicable with the existing air quality monitoring stations operated by the Guangdong Environmental Protection Bureau, given the stations met the monitoring requirements of this Study.

2.1.5 Sampling locations were inspected prior to the actual monitoring exercise to confirm their suitability for the Study. The following section provides a brief description of the selected sites:

PRDEZ

S1. Shenzhen City Nanshan District 深圳市南山區 – Industrial

Nanshan District is located at approximately 17 km west of Shenzhen City and is an industrial area in the PRDEZ. Industrial operations of different scales such as power generation, quarrying and domestic electric product manufacturing can be found in this area. The monitoring station was set up at 11 Guangwan Road.

S2. Dongguan City Changping Town 東莞市常平鎮 – Industrial

Changping Town is located at approximately 25 km east of Dongguan City. Major industries found were bleaching and dyeing, and textiles, both of which involve heat treatment. There are a total of 36 management districts scattering around the urban area of Changping Town. All industrial facilities were evenly distributed in these management districts. The VOC monitoring station was located at the rooftop of the City Government Building situated in the centre of this town.

S3. Guangzhou City Huangpu District 廣州市黃埔區 – Industrial

Huangpu Industrial Area is due east of Guangzhou City. The area is a suburban area designated for industrial development. Huangpu Port and a number of large-scale heavy industries including Guangzhou Petrochemical Factory and Guangzhou Ethene Factory are found in the area. Rooftop of the City Municipal Building located at the heart of the Huang Pu Industrial Area was chosen as the VOC monitoring location.

S4. Guangzhou City Guang-Shen Highway Shahe Section 廣州市北環高速公路 (沙河路段) – Mobile

Guang-Shen Highway is a major access connecting Guangzhou City and other cities in the Pearl River Delta Region. Located at the sub-rural area of Guangzhou, the Guang-Shen Highway Shahe section merges with another high traffic flow road network, Guang-Shan Highway. The VOC sampling result at this interchange reflected the characteristic of typical mobile emission sources in the PRDEZ.

S5. Guangzhou City Tianhe District 廣州市天河區 – Urban

Tianhe District is the most recently developed business area in the heart of Guangzhou City with modern high rise Grade A office building mixed with existing low rise residential blocks. Good urbanised transportation network was implemented in conjunction with the newly operated underground system. The VOC monitoring station at Tianhe Nan Yi Road is where office and residential met with busy road traffic nearby.

S6. Guangzhou City Conghua City 廣州市從化市 – Rural

Conghua city is located at the far north of Guangzhou City of approximately 74 km and is remote from urbanised areas in the PRDEZ. Given its geographic nature of unpolluted environment, the city is selected for the rural VOC monitoring.

S7. Jiangmen City Fengjiang District 江門市蓬江區 – Industrial

Jiangmen City is due west of the Pearl River Delta Region. Industries in Jiangmen City are mainly light industries such as papermaking, sugar production, chemical and food. Nearly all industries are located in the suburb close to Jiangmen River. There is an existing monitoring station at Beijie operated by Jiangmen EPB for industrial emission sampling.

S8. Zhuhai/Zhongshan City Guang-Zhu Highway (Sanxiang Section) 珠海/中山市廣珠高速公路 (三鄉鎮路段) – Mobile

Apart from Guang-Shen Highway, Guang-Zhu Highway is another major highway in the Pearl River Delta Region identified for VOC sampling. A new section of the Guang-Zhu Highway has recently been completed for additional traffic capacity to Zhuhai. The new section of the highway merges with the old Guang-Zhu Highways at Sanxiang, where the peak traffic flow is expected.

HKSAR

S9. Hong Kong Tsing Yi Island 香港青衣島– Mobile

The sampling point was located at the entrance portal of Cheung Tsing Tunnel towards Chek Lap Kok direction, Tsing Ma Control Area at Tsing Yi Island for investigating the concentration and source profile of vehicular emissions. The sampling point was at the intersection of the several major highways including Tsing Long Highway, Tsing Tsuen Road, and Tuen Mun Road.

S10. Hong Kong Tai Po 香港大埔 – Industrial

The sampling point was located at the Tai Po Waterfront Park where emission profile of industrial processes generated from Tai Po Industrial Estate could be monitored.

Sampling sites for Phase Two VOC monitoring

2.1.6 Apart from the 2 common sampling sites (S5 & S6) in Phase I monitoring, Phase II monitoring has included the following sites.

T1. Guangzhou City Panyu City 廣州市番禺市 – Rural

Xinken Town is a rural area located at the southeast corner of Panyu City, Guangzhou City. The monitoring station is set up at about ~15m above ground. In the close proximity of the monitoring stations, only farmlands can be found. The Lingding Sea is situated at the southeast of Xinken which brings northwest winds to Xinken in summer.

T2. Guangzhou City Huadu City 廣州市花都市– Residential

Huadu city is located at the northwest edge of Guangzhou city. The monitoring station is set up at the roof (~20m) of an existing Guangdong Province automatic air quality monitoring station in Huadu. The whole area is a newly developed residential area of medium dense population.

T3. Guangzhou City Lianhuashan 廣州市蓮花山 – Rural

Lianhuashan is a small hill located at the east of Panyu city, Guangzhou City. The monitoring station is set up at the roof (~15m) of a structure. Lianhuashan is one of the famous spot scenes in Guangzhou and no industrial area is found in its close vicinity.

T4. Shenzhen City Baoan District 深圳寶安區 – Mixed commercial/residential

The station locates at Xixiang in Baoan District which is at the west side of Shenzhen City. The monitoring station is set up at the radar control centre for Shenzhen Huangtian Airport. The control centre is at the peak of a hill of 100m high. The Lingding Sea is situated at the west of the station, while 107 National Highway and Guang-Shen Highway are found in its east direction. In the north and south direction, some light industries such as electronics and textile etc. are found.

T5. Guangzhou City Baiyunshan 廣州市白雲山 – Rural

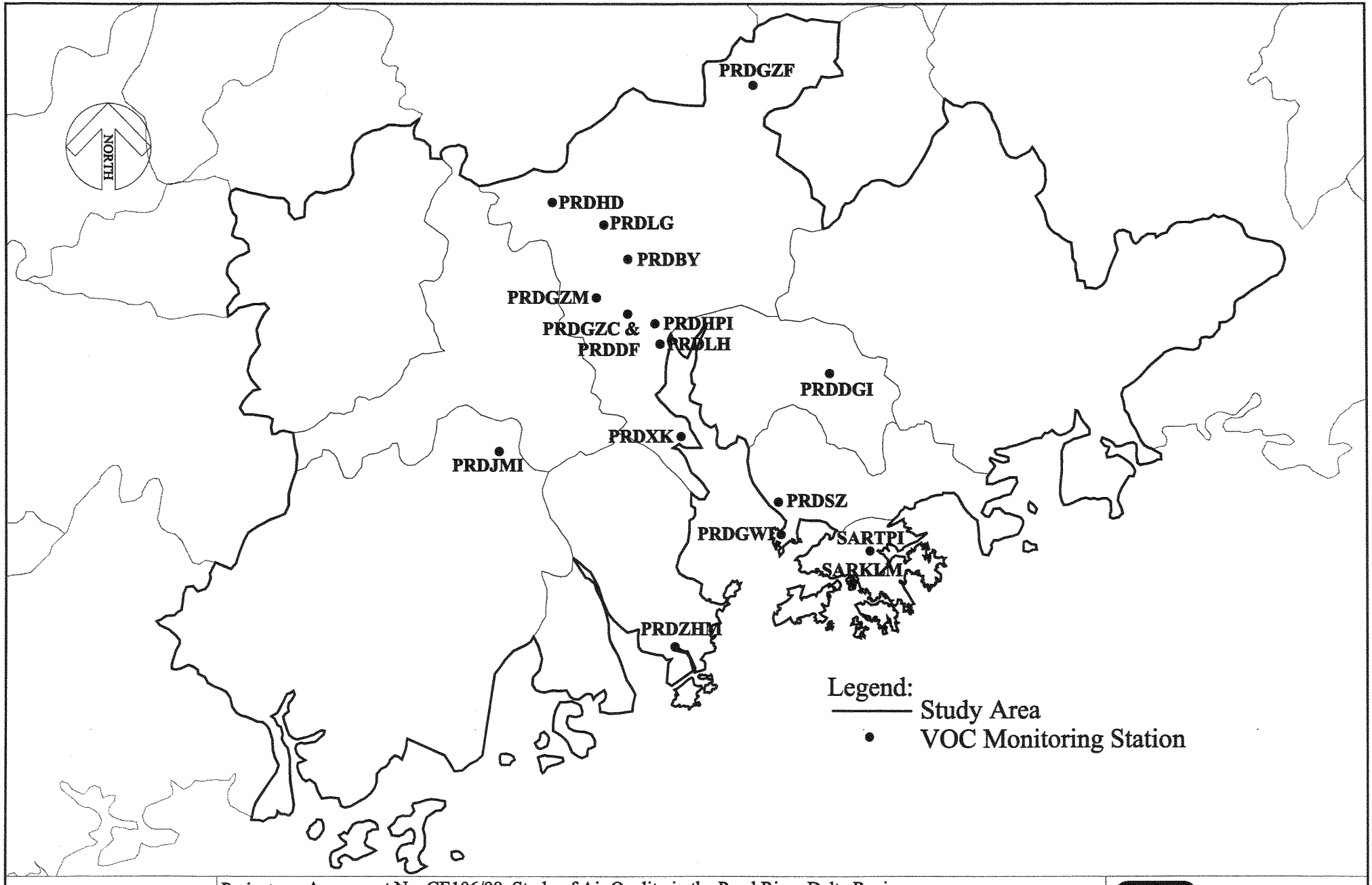
Baiyunshan has a height of 372 m and is due north of the Guangzhou city. The monitoring location is set up in a country park near the top of the hill that captures the air quality information at high level.

T6. Guangzhou City Baiyun District 廣州市白雲區 – Rural

The station is at Longgui, which is about 10 km away from Guangdong city. It is located in the suburb. Agriculture lands are found in the proximity of the monitoring station.

T7. Guangzhou City Yuexiu District 廣州市越秀區 – Mixed

Dong Feng Zhong Road is a major road in the city centre of Guangzhou which provides East-West transportation access. It is one of the busiest roads in Guangzhou city and has six lanes across. The monitoring station is located at the rooftop of the Guangdong Provincial Environmental Protection Bureau building on the road in Yuexiu district.



CH2M HILL (China) Limited	Project:	Agreement No. CE106/98 Study of Air Quality in the Pearl River Delta Region		Environmental Protection Department
	Title:	Locations of the VOC Monitoring Stations in the Pearl River Delta Region		
	Figure: 2-1	Scale: NTS	Page No: 4	

Table 2-1 Location of VOC Monitoring Stations

No.	Sample Label	City/ Town	Monitoring Station	Site Characteristics	Distance from Source (m)	Probe Sampling Height (above ground level)
S1	PRDGWI	Shenzhen City Nanshan District 深圳市南山區 (工業源)	11 Guangwan Road	Industrial: Mixed industrial/ residential	NA	~ 20 m
S2	PRDDGI	Dongguan City Changping Town 東莞市常平鎮 (工業源)	City Government Building	Industrial: Mixed industrial/ residential	NA	~ 16 m
S3	PRDHPI	Guangzhou City Huangpu District 廣州市黃埔區(工業源)	District Government Building	Industrial: Mixed industrial/ residential	NA	~18m
S4	PRDGZM	Guangzhou City Guang-shen Highway 廣州市北環高速公路沙河路段 (交通源)	Building close to Guang-Shen Highway Shahe Section	Mobile: Residential	~5m	~ 18 m
S5b	PRDGZC	Guangzhou City Tianhe District 廣州市天河區 (城市源)	Roof level of 24Tianhe Nan Yi Road	Urban: Mixed commercial/residential	NA	~ 20 m
S6	PRDGZF	Guangzhou City Conghua City 廣州市從化市 (郊區)	Upper reservoir dam of Chu Nen Power Station	Rural : Background	NA	~ 5 m
S7	PRDJMI	Jiangmen City Fengjiang District 江門市蓬江區 (工業源)	EPB monitoring station	Industrial: Mixed industrial/residential	NA	~ 9 m
S8	PRDZHM	Zhuhai/Zhongshan City Guangzhu Highway 珠海/中山市廣珠高速公路 (交通源)	Building close to Guang-Zhu Highway Sanxiang Section	Mobile: Residential	~10m	~ 15 m
T1	PRDXK	Guangzhou City Panyu City 廣州市番禺市	Xinken County	Rural	NA	~ 5 m
T2	PRDHD	Guangzhou City Huadu City 廣州市花都市	Guangdong Provincial automatic air quality monitoring station	Residential	NA	~ 5 m
T3	PRDLH	Guangzhou City Lianhuashan 廣州市蓮花山	Lianhuashan	Rural	NA	~ 15 m
T4	PRDSZ	Shenzhen City Baoan District 深圳寶安區	Xixiang, Raider Control Center at the Shenzhen Huangtian Airport	Mixed industrial/residential	NA	~20 m
T5	PRDBY	Guangzhou City Baiyunshan 廣州市白雲山	Country park at Baiyunshan	Rural	NA	~100 m
T6	PRDLG	Guangzhou City Baiyun District 廣州市白雲區	Longgui County	Rural	NA	~20 m
T7	PRDDF	Guangzhou City Yuexiu District 廣州市越秀區	335 Dong Feng Zhong Road	Mixed commercial/residential	NA	~30 m
S9	SARKLM	Hong Kong Tsing Yi Island 香港青衣島	Tsing Ma Control Area - Entrance Portal of Cheung Tsing Tunnel	Mobile	~5m	~ 1.2 m
S10	SARTPI	Hong Kong Tai Po 香港大埔	Tai Po Waterfront Park	Industrial	NA	~ 15 m

Note: PRDEZ sites: S1-S8, T1-T7; HKSAR sites: S9, S10.
Sites T1-T7 were not close to any specific emission sources as they were used to monitor the regional movement of air pollutants.

2.2 VOC Sampling Period

2.2.1 Two months were allowed for the organisation of monitoring team and the selection of suitable monitoring locations after studying available air quality data for the PRD region.

2.2.2 The VOC precursor samples were generally collected 3 times a day simultaneously for all sampling locations with a 1 in 8-day cycle. The 3 sampling times were 6:00-9:00, 11:00-14:00, and 15:00-18:00 of the day. Parallel samples were also taken for precision check.

2.2.3 As mentioned in Section 1.1.5, Phase II monitoring results from discrete days and locations are available for VOC (speciated). Two-hour samples were taken from Guangzhou City Conghua City at 7:00-9:00, 10:00-12:00, 13:00-15:00, and 16:00-18:00 of the day. For all other locations, 3-hour samples were taken at 6:00-9:00, 9:00-12:00, 12:00-15:00, and 15:00-18:00 of the day.

2.2.4 PRDEZ and HKSAR have slight deviations in their sampling schedules for Phase I monitoring, which are illustrated in Table 2-2. Reasons for the deviations include weather condition, work procedures, and public holiday in different areas. The schedule for Phase II monitoring was also included in the table. Table 2-3 presents the number of samples taken in the VOC Monitoring Exercise.

Table 2-2 Sampling Schedule of the VOC Monitoring Exercise

Date	PRDEZ Phase I	PRDEZ Phase II	HKSAR
May-30-2000	*		•
June-7-2000	*		•
Field & Laboratory Pre-Audit			
July-1-2000	•		•
July-15-2000		•	
July-22-2000		•	
Aug-2-2000	•		•
Aug-10-2000	•		•
Field & Laboratory Audit			
Aug-18-2000	•		•
Aug-26-2000	•		
Sep-3-2000	•		
Sep-11-2000	•		•
Sep-19-2000	•		•
Sep-27-2000	•		•
Oct-12-2000		•	
Oct-19-2000		•	
Oct-24-2000		•	
Nov-3-2000			•
Nov-6-2000			•
Nov-10-2000			•
Dec-11-2000		•	
Dec-20-2000		•	
Dec-21-2000		•	
Dec-25-2000		•	
*pilot test		• samples taken	

Table 2-3 Number of Samples Taken in the VOC Monitoring Exercise

	Speciated VOC	TNMOC	Carbonyl
PRDEZ (Phase I)	216	216	216
PRDEZ (Phase II)	41	-	-
HKSAR	72	72	72
Total	329	288	288

2.3 Field Sampling Methodology and Procedures

2.3.1 All sampling and analytical equipment used in the monitoring exercise were properly calibrated. All methodologies employed were traceable to locally or internationally recognised standards. These include methods used by the EPD, and those published by the USEPA.

2.3.2 It was important that the sampling equipment was correctly positioned. Throughout the field sampling exercise, the sampling probe was positioned at least 3 to 15 m above ground and 1 m from any structure vertically and horizontally, except for Tsing Yi Island. As the Tsing Yi location, the equipment was placed on ground level during sampling where is very close to the traffic flow for there was difficulty in acquiring a higher position due to constraints in the surrounding. There was unrestricted airflow in an arc of at least 270 degrees for all locations. The distance between any obstacles and the sampling inlet was at least twice the height between obstacles and the sampler. The sampling inlet was kept away from suspected sources of VOC, such as chimney and excessive planting.

Volatile Organic Compound Ozone Precursors

2.3.3 The measurement methodologies followed the USEPA standard method Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition. Compendium Method TO-15. *Determination of Volatile Organic Compounds in Ambient Air Using Specially Prepared Canisters with Subsequently Analysis by Gas Chromatography.* {USEPA reference No: EPA/625/R-96/01b dated January 1997}.

2.3.4 All canisters were cleaned and certified contaminant-free at the laboratory before sampling. Air sample was drawn into pre-cleaned and pre-evacuated 6-litre SUMMA® passivated stainless steel canisters by a calibrated flow controller at a uniform flow rate of 20ml/min±10% for 3 hours.

2.3.5 Pressure was checked before sampling. The filled canister was then delivered to the laboratory for analysis. The pressure was checked again once the canister arrived at the laboratory to ensure the canister was airtight and the samples were not contaminated during delivery.

Total Non-methane Organic Compounds (TNMOC)

2.3.6 The collection of TNMOC followed the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. Compendium Method TO-12. *Compendium Method TO-12. Method for the Determination of Non-methane Organic Compound (NMOC) in Ambient Air Using Cryogenic Preconcentration and Direct Flame Ionisation Detection.* {USEPA reference No: EPA-600/4-89/017}.

2.3.7 Air sample collected in the 6-litre canister for the analysis of VOC ozone precursors was also used for the analysis of the total non-methane hydrocarbons.

Carbonyl (Formaldehyde, Acetone & Acetaldehyde)

2.3.8 The collection and analysis of carbonyl followed two compendium methods (TO11A & TO5):

- Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. Compendium Method TO-11A. *Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge followed by Performance Liquid Chromatography (HPLC).* {USEPA reference No: EPA-625/R-96/01b}; and
- Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. Compendium Method TO-5. *Method for Determination of Aldehydes and Ketones in Ambient Air Using High Performance Liquid Chromatography.*
- TO-11A was modified based on TO-5 with the use of silica gel as the coated absorbent. Both methodologies used the 2, 4-dinitrophenylhydrazine (DNPH) as the derivative reagent in incorporating HPLC as the analytical method.

2.3.9 The commercially available cartridges contained two sections of DNPH-coated silica gel and were sealed. The seals were broken just prior to sampling.

2.3.10 Exposure of the DNPH cartridge to direct sunlight was avoided during the sampling. The cartridges were kept individually in a glass culture tube wrapped with aluminium foil. The cartridge was capped with polypropylene caps before and after sampling. Handling of the cartridge was performed using polyethylene gloves and cartridge was kept at low temperature (~4°C) as far as practicable after the sampling.

2.3.11 A known volume of ambient air was collected through the cartridge with a manual single-port carbonyl sampler. Sampling rate was 1L/min±10% for a 3-hour period through a calibrated flow controller.

2.4 Field Sampling Quality Control Procedures

2.4.1 The following section presents the quality control and assurance programme for the sampling of VOC. The programme is comparable with quality procedures currently used by EPD and USEPA, with necessary modifications to account for site-specific constraints.

2.4.2 A field data sheet was filled out at each sampling site during the fieldwork was performed. The sheets recorded general information such as date, time, and location of the air sample. Other information on the site environs and weather conditions could be included, such as ambient pressure and temperature.

2.4.3 All samples were tagged with a unique identification code that indicated monitoring location, target pollutant, and sampling date and time.

Volatile Organic Compound - Ozone Precursors

2.4.4 All canisters were cleaned and certified contaminant-free prior to being placed in use. They were leak-tested by a pressure of approximately 30 psig with zero air. As a blank check of the canisters and part of the clean up procedure, the final humid zero air-fill of 100% of the canisters was analysed by GC/MS analytical system. The results were below detection limits for all target VOC parameters. Any canisters not certified clean were not used for sampling.

2.4.5 Simultaneous parallel sampling was carried out to allow assessment on measurement precision of two samples. The acceptance is based on 30% and 40% difference of the two samples for HKSAR and PRDEZ respectively. Two canisters positioned side by side were filled simultaneously under the same background conditions. For each sample, the following QC procedures were ensured:

- Timer and flow controller were at the appropriate values;
- Pressure of canister checked before sampling. Canisters rejected if leakage occurred;
- Flow rates checked by connecting a standard mass flow meter to the sampler's inlet port before and after sampling. Checked for leakage if measured flows were more than ±10% of expected value, otherwise recalibrated the sampler mass flow controller; and
- Checked and recorded the final pressure of canister. Invalidate samples with final pressure of more than ±10% deviation from the value calculated from the sampling time and flow rate. Identified and rectified cause of problem like leakage, mass flow controller and timer failure.

2.4.6 When sampler was neither in use nor running, its inlet line was capped.

Total Non-Methane Organic Compound

2.4.7 All canisters were cleaned and certified contaminant-free prior to being placed in use. They were leak-tested by a pressure of approximately 30 psig with zero air. As a blank check of the canisters and part of the clean up procedure, the final humid zero air-fill of 100% of the canisters were analysed by GC/MS analytical system and were below detection limits of all target VOC parameters.

Carbonyl (Formaldehyde, Acetone & Acetaldehyde)

2.4.8 The cartridges were opened only prior to sampling to avoid contamination. During sampling the cartridges were held vertically. The cartridges were protected from light during sampling and transportation. The cartridges were sealed using the supplied caps and placed in glass vials to avoid contamination during transport and storage prior to analyses. Storage was at 4°C.

2.4.9 The flow-rate was measured at the start and end of sampling. Allowed deviation was 10%.

3. LABORATORY ANALYTICAL METHODOLOGY

3.1 Laboratory Analytical Procedures

Volatile Organic Compound Ozone Precursors

3.1.1 After sampling, the sample canister was transported to the laboratory for analysis. A leakage check was performed prior to analysis. To analyze the sample, a known volume of sample directed from the canister and cryogenically cooled to approximately -180°C with liquid nitrogen in glass/Tenax traps. Moisture and carbon dioxide were removed by purge and trap technique within the system. The sample was then thermally desorbed and analysed by high-resolution gas chromatograph (GC) coupled to a mass spectrometer (MS).

Total Non-methane Organic Compound

3.1.2 After sampling, the sample canister was transported to the laboratory for analysis. A leakage check was performed prior to analysis. To analyze the sample, a known volume of sample directed from the canister and cryogenically cooled to approximately -180°C with liquid nitrogen in glass/Tenax traps. The sample was then thermal desorbed and analysed by flame ionisation detector (FID).

Carbonyl (Formaldehyde, Acetone & Acetaldehyde)

3.1.3 After sampling, the sample cartridges were individually capped and placed in shipping tubes and transported to the laboratory for analysis. To analyze the sample, each sample cartridge was separated into front and rear portions. Each portion was extracted with 5mL of acetonitrile. The DNPH derivatives are then analysed by high performance liquid chromatograph (HPLC) with an ultraviolet (UV) absorption detector.

3.1.4 The detection limits for each monitored parameter are listed in Table 3-1 to Table 3-3.

Table 3-1 Detection limits for VOCs

Parameters	Detection Limits (ppbv)	
	HKSAR	PRDEZ
Ethane & Ethene	2.0	2.1
Propyne	1.0	2.2
Propane	1.0	1.8
2-methylpropane	0.2	0.2
1-Butene	0.2	0.3
n-butane	0.2	0.3
1,3-butadiene	0.2	0.4
trans-2-butene	0.2	0.3
cis-2-butene	0.2	0.2
2-methyl-2-butene	0.2	0.2
2-methylbutane	0.2	0.3
1-pentene	0.2	0.3
n-pentane	0.2	0.1
2-methyl-1,3-butadiene	0.2	0.3
3-methyl-1-butene	0.2	0.3
trans-2-pentene	0.2	0.3
cis-2-pentene	0.2	not tested
2,2-Dimethyl-Butane	0.2	0.3
Cyclopentene	0.2	0.3
4-methyl-1-pentene	0.2	0.3
2,3-dimethylbutane	0.2	0.3
Cyclopentane	0.2	0.1
2-methylpentane	0.2	0.3
3-methyl-Pentane	0.2	0.3
n-hexane	0.2	0.4
trans-2-hexene	0.2	0.3

Parameters	Detection Limits (ppbv)	
	HKSAR	PRDEZ
cis-2-hexene	0.2	0.3
2,4-dimethylpentane	0.2	0.3
Methylcyclopentane	0.2	0.4
Cyclohexane	0.2	0.2
Benzene	0.2	0.1
2-methylhexane	0.2	0.3
2,3-dimethylpentane	0.2	0.2
3-methylhexane	0.2	0.2
2,2,4-trimethylpentane	0.2	0.5
n-heptane	0.2	0.1
Methylcyclohexane	0.2	0.2
2,3,4-trimethylpentane	0.2	0.2
2-methylheptane	0.2	0.2
3-methylheptane	0.2	0.2
Toluene	0.2	0.4
n-octane	0.2	0.2
Ethylbenzene	0.2	0.2
m,p-xylene	0.2	0.2
n-nonane	0.2	0.1
Styrene	0.2	0.3
o-xylene	0.2	0.2
(1-methylethyl)benzene	0.2	0.3
Propylbenzene	0.2	0.2
1,3,5-trimethylbenzene	0.2	0.3
1,2,4-trimethylbenzene	0.2	0.1

Table 3-2 Detection limits for TNMOC

Parameter	Detection Limit (ppmC)
Total Non-methane Hydrocarbon	0.02

Table 3-3 Detection limits for Carbonyl

Parameters	Detection Limit ($\mu g/m^3$)	
	HKSAR	PRDEZ
Formaldehyde	0.2	0.2
Acetaldehyde	0.3	0.2
Acetone	0.5	0.3

3.2 Laboratory Quality Control Procedures

3.2.1 Flow diagrams are presented in Figure 3-1 and Figure 3-2 to briefly illustrate the laboratory quality control procedures of this monitoring exercise. There were field sampling, laboratory analysis, and QA/QC procedures that were not tightly followed in the first phase of this monitoring exercise in PRDEZ. Discrepancies were identified and discussed during and after the first audit. The situation was largely improved after the first audit and the laboratory's performance was confirmed in the second phase of the programme that the laboratory adhered to standards as instructed by the auditor.

Volatile Organic Compound Ozone Precursors

3.2.2 Instrument Performance Check - Before the analyses of any samples, blanks, or calibration standards, the laboratory ensured that the GC/MS system met the mass spectral ion abundance criteria for the instrument performance check standard containing bromofluorobenzene (BFB). The instrument performance check solution was analysed initially and once per 24-hour time period of operation.

3.2.3 Initial Calibration - After the instrument performance check standard criteria had been met, but prior to the analysis of samples and blanks, each GC/MS system was calibrated at five concentrations that spanned the monitoring range of interest in an initial calibration sequence. As such, instrument sensitivity and the linearity of GC/MS response for the target compounds could be determined. In cases that corrective action which may change or affect the initial calibration, or if the daily calibration acceptance criteria had not been met, the GC/MS was calibrated again.

3.2.4 Daily Calibration - Prior to the analysis of samples and blanks, but after tuning criteria had been met, the initial calibration of GC/MS system was checked once every 24 hours. This was done by analysing a daily calibration standard, nominally a 10 ppbv level calibration standard, to ensure that the instrument was still under control.

3.2.5 Blank Analyses - Blanks were analysed to monitor for possible laboratory contamination. Every step in the analytical procedures was performed on the blank using all standards, reagents, equipment, apparatus, solvents and glassware that would be used for a sample analysis. In most cases, the field blanks were analysed before method blanks. If the result of the field blank were within the control limit (usually detection limit), the laboratory blank analysis would be omitted.

3.2.6 While conducting VOC analysis from canisters, the GC/MS system met the following three performance criteria:

- method detection limit as defined in Table 3-1;
- replicate precision within ±30% and ±40% for HKSAR and PRDEZ respectively;
- control accuracy check within 10% for concentration normally expected in contaminated ambient air.

Total Non-methane Organic Compound

3.2.7 Prior to sample analysis, a complete dynamic calibration of the analytical system for non-methane organic compound was conducted at five or more concentrations on each range to define the calibration curve. The calibration was verified with two or three-point calibration check (including zero) each day the analytical system was used to analyse samples.

3.2.8 To reduce the possibility of losing measurement data, simultaneous collection of duplicate samples at the same monitoring location was performed. Two or more canisters connecting in parallel were filled simultaneously. Replicate samples allowed the assessment of measurement precision based on an acceptance of ±30% between duplicate samples. For each sample, the QC procedures were followed in a consistent manner.

Carbonyl (Formaldehyde, Acetone & Acetaldehyde)

3.2.9 HPLC Calibration - Calibration standards in acetonitrile were prepared from the solid DNPH-carbonyl derivative or commercially available solution, from which working calibration standards were then produced. Each calibration standard (at least five levels) was analysed three times and linear response was documented. Precision for replicate HPLC injections shall be ± 10% or better for calibration standards.

3.2.10 Process Blank - One field blank was used for each day of field sampling, shipped and analysed with each group of samples. The field blank was treated identically to the samples with the exception that no air was drawn through the cartridge.

Figure 3-1 Flow Diagramme of the Laboratory Quality Control Procedures of TO12 and TO15

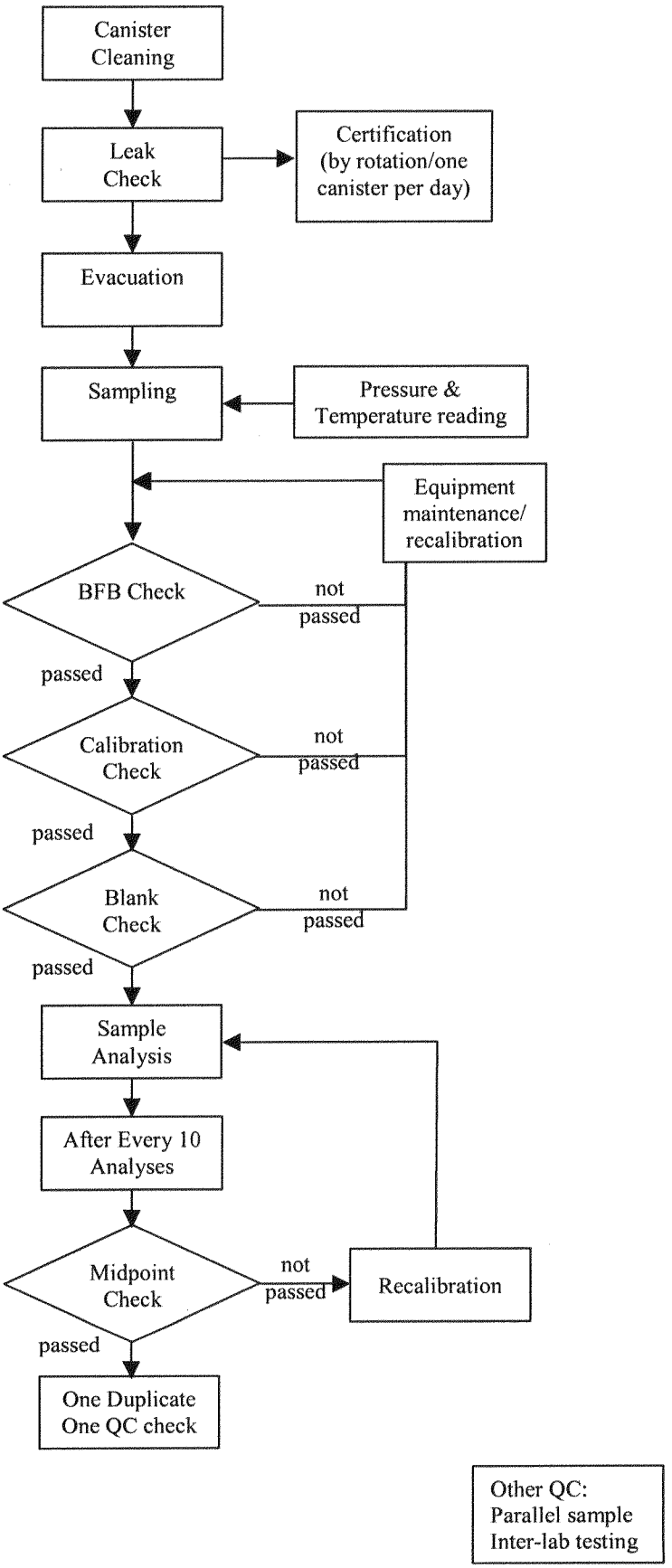
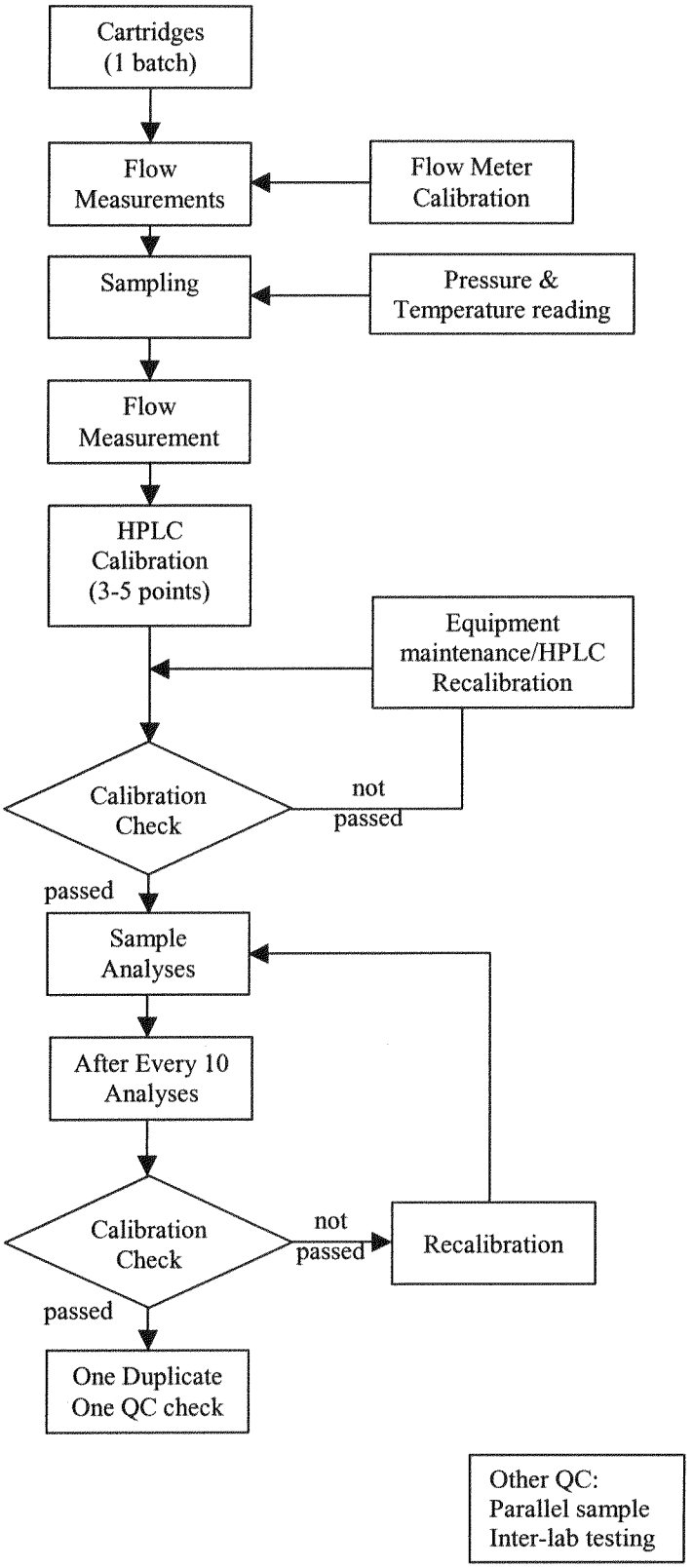


Figure 3-2 Flow Diagramme of the Laboratory Quality Control Procedures of TO-11



4. RESULTS OF THE MONITORING EXERCISE

4.1 Sampling and analysis

4.1.1 The monitoring exercise for the HKSAR started from 30 May 2000 to 10 November 2000 for VOC, TNMOC, and Carbonyl. The monitoring exercise for the PRDEZ started from 30 May 2000 to 27 September 2000 for Phase I VOC, TNMOC, and Carbonyl. Sampling was done simultaneously at all stations in specific time frame. Phase II VOC monitoring for PRDEZ was done on discrete days between July 15, 2000 and December 25, 2000. All samples collected were sent to laboratories for analysis. Results are included in this section of the report, unless such results were invalidated due to contaminations or other constraints.

4.2 Limitations and constraints

4.2.1 Daily log to record the sequence event of the equipment on calibration and analysis of QC samples clearly indicated the nature and identity of samples. However, the field properties in PRDEZ were not fully documented at the time when the samples were taken. There was incomplete information on a few field data sheets such as the ambient temperature and pressure but the effect of those lost information should not significantly affect the data quality.

4.2.2 There were cases when some procedures were technically infeasible due to equipment, experience or time constraints. Pressure gauges were not available during canister sampling. Noting the canisters were new and fitted with needle-type valves rather than quarter-turn valves, potential leakage would be minimal. The sampling team in PRDEZ recorded the pressure before the canisters were taken to the sampling site and after the canisters were delivered back to the laboratory to ensure that no leakage or contamination had occurred.

4.2.3 The laboratory in PRDEZ did not perform a mid-point calibration check after every 10-15 samples due to the tight analysis schedule. However, the QC check at the end of all sample analyses has confirmed that the equipment was still within calibrated state during the analysis period.

4.2.4 For samples that exceeded calibration range, the laboratory analysed the samples with a lesser sample volume.

4.2.5 Both laboratories used higher concentrations of the first 5 compounds of the Ozone Precursor series (as these compounds intrinsically show poor sensitivities) so as to meet the daily calibration check criteria.

4.2.6 The PRDEZ laboratory performed precision check once every cycle while the HKSAR laboratory performed precision check for about once per ten samples. Both laboratories performed QC recovery at least once per cycle.

4.2.7 As a small number of samples were taken during the PRDEZ Phase II monitoring on discrete days in July, October, and December, the samples were analysed once per month. The QC recovery, duplicate sampling, and field blanks were done once in 3 sampling days on average.

4.2.8 In the beginning of the sampling exercise, the sampling team in PRDEZ did not calculate correctly using the carbonyl-DNPH standard values and also did not compensate for the background concentrations in blank cartridges. Thus, this led to higher than normal values for the three target parameters. Corrections have been made to related calculations.

4.2.9 The concentrations in blank cartridges were analysed to estimate the background interferences. The concentrations detected were subtracted from the sample concentrations for a more relevant estimate.

4.2.10 The front and rear sections of each sampling cartridge were analysed separately with the rear portion used to check for breakthrough of the front section. Separate rear portion analysis confirmed that breakthrough of the DNPH cartridge had not occurred.

4.3 Data Screening

4.3.1 Five aspects were considered when performing data screening:

- The percentage difference between duplicate samples – the precision should be within control limit (criterion A)
- The percentage recovery of QC samples – the recovery should be within 30% difference. (criterion B)
- The blank sample results – the result should fall within the control limit (usually the detection limit) for a valid data (criterion C)
- The detection limits of tested parameters – the laboratory results of a tested parameter at a sampling location should be detected for at least 25%, otherwise the results of that parameter from that sampling location are considered invalid (criterion D)
- Statistical analysis – to screen for outliers in the whole data set (criterion E)

4.3.2 As explained in previous sections, simultaneous parallel sampling was carried out to allow assessment on measurement precision of two samples. The acceptance is based on 30% difference of the two samples, except for the VOC sampling in PRDEZ (40%). Sampling equipment positioned side by side was filled simultaneously under the same background conditions.

4.3.3 Results were considered invalid if precision check and QC check were either unavailable or unacceptable.

4.3.4 All duplicate samples were analysed and the results were found within the limits of acceptance. For VOC, the results from the laboratory in HKSAR achieved a percentage difference within 30% while the laboratory in PRDEZ achieved a percentage difference within 40%. For TNMOC and Carbonyl, the duplicate samples achieved precision within 30% difference for both PRDEZ & HKSAR.

4.3.5 QC samples were analysed to check the percentage recovery. The recoveries for all samples were within the acceptable range of 70%-130% and 60-140% for HKSAR and PRDEZ respectively. Different ranges were adopted by the two laboratories due to different level of skills and experience in sampling and analysis.

4.3.6 The laboratory blanks showed non-detected results for all parameters in the HKSAR and PRDEZ laboratories. No significant laboratory contamination was found throughout the analyses. There were exceptions for PRDEZ Carbonyl blanks. Inter-laboratory tests were also carried out to ensure precise results from both laboratories. In general, the quality of data is satisfactory. The percentile of the data of each parameter was calculated to assist the inspection.

4.3.7 Only stations that were successfully detected with more than 25% positive results after data processing will be included in the data presentation in subsequent sections. The quality of those samples was considered satisfactory based on the QC recovery check and precision check results as the percentage difference fell within acceptable ranges described in previous sections.

4.3.8 Statistical analyses including visual inspection of scattered plots for each tested parameter at each sampling station were performed. Suspected outliers were further tested with Discordance Test and Rosner's Test in accordance with the Guidance for Data Quality Assessment by the USEPA.

4.3.9 Given a datum did not satisfy any one of the listed criteria, remarks would be made, stating why that datum was screened out.

4.3.10 Results that were discarded due to problems such as contamination and mishandling are considered data not meeting the assessment criteria as well. Using Benzene, Toluene, Ethylbenzene, m,p-xylene, and o-xylene as indicators of VOC, it is found that the percent valid data were as high as 99% and 84% for HKSAR and PRDEZ respectively for the Phase I monitoring exercise, and 98% for PRDEZ Phase II monitoring exercise. Table 4-1 presents the percentage of data that passed all screening criteria. There has been a relatively low passing percentage for Acetone with respect to the screening exercise. Most Acetone data failed Criterion D due to the fact that Acetone was less abundant in ambient air and its concentration was often lower than that of the detection limit at the time when the air samples were taken.

Table 4-1 Percent valid data as the result of data quality assessment

Parameter		HKSAR	PRDEZ*
VOC	Benzene	97%	82% (98%)
	Toluene	96%	83% (93%)
	Ethylbenzene	97%	83% (78%)
	m,p-xylene	99%	84% (78%)
	o-xylene	97%	76% (80%)
TMNOC		97%	85%
Carbonyl	Formaldehyde	99%	63%
	Acetaldehyde	99%	62%
	Acetone	50%	7%

**Percentage in bracket represents Phase II monitoring result*

4.4 VOC Monitoring Result

4.4.1 Table 4-2 presents the percentiles of VOC results for HKSAR. Table 4-3 present the percentiles of VOC results for PRDEZ. The PRDEZ results include both Phase I and Phase II monitoring results.

Table 4-2 Percentiles of VOC (ppbv)-HKSAR

Sampling Location	Percentiles	Ethane & Ethene	Propyne	Propane	2-methylpropane
Hong Kong Tsing Yi Island	25%	2.0	2.0	2.0	0.2
	50%	2.0	2.0	2.0	2.0
	75%	4.9	2.6	17.0	10.3
Hong Kong Tai Po	25%	2.0	2.0	2.0	0.2
	50%	2.0	2.0	2.0	0.2
	75%	2.0	2.0	2.0	0.2
Sampling Location	Percentiles	1-Butene	n-butane	1,3-butadiene	trans-2-butene
Hong Kong Tsing Yi Island	25%	1.1	0.2	0.2	0.2
	50%	1.8	4.8	0.2	0.3
	75%	3.4	31.6	0.2	1.9
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.3	0.2	0.2
Sampling Location	Percentiles	cis-2-butene	2-methyl-2-butene	2-methylbutane	1-pentene
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.6	0.2
	50%	0.3	0.2	2.5	0.2
	75%	1.4	0.2	7.2	0.4
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.3	0.2
	75%	0.2	0.2	0.8	0.2
Sampling Location	Percentiles	n-pentane	2-methyl-1,3-butadiene	3-methyl-1-butene	trans-2-pentene
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.2	0.2
	50%	0.6	0.2	0.2	0.2
	75%	2.0	0.8	0.5	0.3
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.2	0.2	0.2
Sampling Location	Percentiles	cis-2-pentene	2,2-dimethylbutane	Cyclopentene	4-methyl-1-pentene
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.8	0.2	0.2	0.2
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.2	0.2	0.2
Sampling Location	Percentiles	2,3-dimethylbutane	Cyclopentane	2-methylpentane	3-methylpentane
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.2	1.2	0.8
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.2	0.2	0.2
Sampling Location	Percentiles	n-hexane	trans-2-hexene	cis-2-hexene	2,4-dimethylpentane
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	1.6	0.2	0.2	0.2
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.7	0.2	0.2	0.2
Sampling Location	Percentiles	Methylcyclopentane	Cyclohexane	Benzene	2-methylhexane
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.6	0.2
	75%	0.3	0.2	1.1	0.4
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.2	0.3	0.2

Table 4-2 Percentiles of VOC (ppbv)-HKSAR (cont'd)

Sampling Location	Percentiles	2,3-dimethylpentane	3-methylhexane	2,2,4-trimethylpentane	n-heptane
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.4	0.2	0.7
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.2	0.2	0.3
Sampling Location	Percentiles	Methylcyclohexane	2,3,4-trimethylpentane	2-methylheptane	3-methylheptane
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.5	0.2	0.2	0.2
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.2	0.2	0.2
Sampling Location	Percentiles	Toluene	n-octane	Ethylbenzene	m,p-xylene
Hong Kong Tsing Yi Island	25%	2.7	0.2	0.2	1.3
	50%	4.8	0.2	0.2	2.1
	75%	7.9	0.5	0.8	3.7
Hong Kong Tai Po	25%	1.2	0.2	0.2	0.2
	50%	2.0	0.2	0.2	0.2
	75%	5.0	0.2	0.2	1.2
Sampling Location	Percentiles	n-nonane	Styrene	o-xylene	(1-methylethyl)benzene
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.2	0.2
	50%	0.7	0.3	0.3	0.2
	75%	1.6	1.3	0.9	0.2
Hong Kong Tai Po	25%	0.2	0.2	0.2	0.2
	50%	0.2	0.2	0.2	0.2
	75%	0.2	0.2	0.4	0.2
Sampling Location	Percentiles	Propylbenzene	1,3,5-trimethylbenzene	1,2,4-trimethylbenzene	
Hong Kong Tsing Yi Island	25%	0.2	0.2	0.5	
	50%	1.2	0.2	1.4	
	75%	2.3	1.2	2.2	
Hong Kong Tai Po	25%	0.2	0.2	0.2	
	50%	0.2	0.2	0.2	
	75%	0.2	0.2	0.6	

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ

(a) Phase I

Sampling Location	Percentiles	Ethane & Ethene	Propyne	Propane	2-methylpropane
Dongguan City Changping Town	25%	2.1	2.2	1.8	0.3
	50%	2.1	2.2	1.8	0.4
	75%	2.1	2.2	1.8	0.7
Guangzhou City Conghua City	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.2
	75%	2.1	2.2	1.8	0.2
Guangzhou City Guang-Shen Highway	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.6
	75%	2.1	2.2	2.0	1.2
Guangzhou City Tianhe District	25%	2.1	2.2	1.8	0.5
	50%	2.1	2.2	1.8	0.8
	75%	2.1	2.2	1.8	1.1
Guangzhou City Huangpu District	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.3
	75%	2.1	2.2	1.8	0.6
Jiangmen City Fengjiang District	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.2
	75%	2.1	2.2	1.8	0.3
Shenzhen City Nanshan District	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.2
	75%	2.1	2.2	1.8	0.3
Zhuhai/Zhongshan City Guang-zhu Highway	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.2
	75%	2.1	2.2	1.8	0.3
Sampling Location	Percentiles	1-Butene	n-butane	1,3-butadiene	trans-2-butene
Dongguan City Changping Town	25%	0.3	0.4	0.4	0.3
	50%	0.4	0.8	0.4	0.3
	75%	0.6	1.3	0.7	0.3
Guangzhou City Conghua City	25%	0.3	0.3	0.4	0.3
	50%	0.3	0.3	0.4	0.3
	75%	0.3	0.3	0.4	0.3
Guangzhou City Guang-Shen Highway	25%	0.3	0.7	0.4	0.3
	50%	0.6	1.9	0.8	0.3
	75%	1.3	3.1	1.4	0.6
Guangzhou City Tianhe District	25%	0.4	0.8	0.4	0.3
	50%	0.5	1.2	0.4	0.3
	75%	1.3	2.0	0.7	0.7
Guangzhou City Huangpu District	25%	0.3	0.5	0.4	0.3
	50%	0.4	0.6	0.4	0.3
	75%	0.7	1.2	0.6	0.4
Jiangmen City Fengjiang District	25%	0.3	0.3	0.4	0.3
	50%	0.3	0.4	0.4	0.3
	75%	0.4	0.9	0.4	0.3
Shenzhen City Nanshan District	25%	0.3	0.3	0.4	0.3
	50%	0.3	0.5	0.4	0.3
	75%	0.3	0.8	0.4	0.3
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.3	0.3	0.4	0.3
	50%	0.3	0.6	0.4	0.3
	75%	0.3	1.0	0.4	0.3

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	cis-2-butene	2-methyl-2-butene	2-methylbutane	1-pentene
Dongguan City Changping Town	25%	0.2	0.2	0.5	0.3
	50%	0.2	0.2	0.6	0.7
	75%	0.2	0.2	1.3	1.2
Guangzhou City Conghua City	25%	0.2	0.2	0.3	0.3
	50%	0.2	0.2	0.3	0.3
	75%	0.2	0.2	0.3	0.3
Guangzhou City Guang-Shen Highway	25%	0.2	0.2	0.5	0.3
	50%	0.3	0.2	1.3	0.7
	75%	0.6	0.2	2.3	1.4
Guangzhou City Tianhe District	25%	0.2	0.2	1.1	0.4
	50%	0.2	0.2	1.4	0.7
	75%	0.6	0.2	2.0	1.1
Guangzhou City Huangpu District	25%	0.2	0.2	0.6	0.4
	50%	0.2	0.2	0.8	0.6
	75%	0.3	0.2	1.5	0.8
Jiangmen City Fengjiang District	25%	0.2	0.2	0.3	0.3
	50%	0.2	0.2	0.5	0.3
	75%	0.2	0.2	1.1	0.4
Shenzhen City Nanshan District	25%	0.2	0.2	0.3	0.3
	50%	0.2	0.2	0.4	0.3
	75%	0.2	0.2	0.8	0.5
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.2	0.2	0.3	0.3
	50%	0.2	0.2	0.4	0.3
	75%	0.2	0.2	0.6	0.5
Sampling Location	Percentiles	n-pentane	2-methyl-1,3-butadiene	3-methyl-1-butene	trans-2-pentene
Dongguan City Changping Town	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.5	0.5	0.3	0.3
Guangzhou City Conghua City	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.1	0.4	0.3	0.3
Guangzhou City Guang-Shen Highway	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.9	0.6	0.4	0.4
Guangzhou City Tianhe District	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	1.2	0.5	0.4	0.4
Guangzhou City Huangpu District	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.7	0.5	0.3	0.3
Jiangmen City Fengjiang District	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.1	0.4	0.3	0.3
Shenzhen City Nanshan District	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.1	0.3	0.3	0.3
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.1	0.4	0.3	0.3

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	2,2-Dimethyl-Butane	Cyclopentene	4-methyl-1-pentene	2,3-dimethylbutane
Dongguan City Changping Town	25%	0.3	0.3	0.3	0.3
	50%	0.3	0.3	0.6	0.4
	75%	0.3	0.3	1.0	0.6
Guangzhou City Conghua City	25%	0.3	0.3	0.3	0.3
	50%	0.3	0.3	0.3	0.3
	75%	0.3	0.3	0.3	0.3
Guangzhou City Guang-Shen Highway	25%	0.3	0.3	0.4	0.3
	50%	0.3	0.3	0.8	0.6
	75%	0.3	0.3	1.4	1.0
Guangzhou City Tianhe District	25%	0.3	0.3	0.6	0.4
	50%	0.3	0.3	0.9	0.7
	75%	0.3	0.3	1.3	0.9
Guangzhou City Huangpu District	25%	0.3	0.3	0.5	0.3
	50%	0.3	0.3	0.6	0.4
	75%	0.3	0.3	1.0	0.7
Jiangmen City Fengjiang District	25%	0.3	0.3	0.3	0.3
	50%	0.3	0.3	0.3	0.3
	75%	0.3	0.3	0.5	0.3
Shenzhen City Nanshan District	25%	0.3	0.3	0.3	0.3
	50%	0.3	0.3	0.3	0.3
	75%	0.3	0.3	0.5	0.4
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.3	0.3	0.3	0.3
	50%	0.3	0.3	0.3	0.3
	75%	0.3	0.3	0.4	0.3
Sampling Location	Percentiles	Cyclopentane	2-methylpentane	3-methyl-Pentane	n-hexane
Dongguan City Changping Town	25%	0.1	0.3	0.3	0.4
	50%	0.3	0.5	0.3	0.6
	75%	0.4	0.8	0.5	0.9
Guangzhou City Conghua City	25%	0.1	0.3	0.3	0.4
	50%	0.1	0.3	0.3	0.4
	75%	0.1	0.3	0.3	0.4
Guangzhou City Guang-Shen Highway	25%	0.1	0.4	0.3	0.4
	50%	0.2	0.8	0.3	0.5
	75%	0.5	1.3	0.5	0.8
Guangzhou City Tianhe District	25%	0.2	0.6	0.3	0.4
	50%	0.3	0.9	0.4	0.6
	75%	0.5	1.3	0.6	0.8
Guangzhou City Huangpu District	25%	0.1	0.4	0.3	0.4
	50%	0.2	0.5	0.3	0.4
	75%	0.4	0.9	0.5	0.8
Jiangmen City Fengjiang District	25%	0.1	0.3	0.3	0.4
	50%	0.1	0.3	0.3	0.4
	75%	0.2	0.5	0.3	0.4
Shenzhen City Nanshan District	25%	0.1	0.3	0.3	0.4
	50%	0.1	0.3	0.3	0.4
	75%	0.3	0.5	0.3	0.6
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.1	0.3	0.3	0.4
	50%	0.1	0.3	0.3	0.4
	75%	0.3	0.4	0.3	0.4

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	trans-2-hexene	cis-2-hexene	2,4-dimethylpentane	Methylcyclopentane
Dongguan City Changping Town	25%	0.3	0.3	0.3	0.4
	50%	0.3	0.3	0.6	0.5
	75%	0.3	0.3	1.5	0.7
Guangzhou City Conghua City	25%	0.3	0.3	0.3	0.4
	50%	0.3	0.3	0.3	0.4
	75%	0.3	0.3	0.3	0.4
Guangzhou City Guang-Shen Highway	25%	0.3	0.3	0.3	0.4
	50%	0.3	0.3	0.4	0.8
	75%	0.3	0.3	1.8	1.2
Guangzhou City Tianhe District	25%	0.3	0.3	0.3	0.4
	50%	0.3	0.3	0.9	0.8
	75%	0.3	0.3	1.6	1.0
Guangzhou City Huangpu District	25%	0.3	0.3	0.3	0.4
	50%	0.3	0.3	0.7	0.8
	75%	0.3	0.3	1.5	1.1
Jiangmen City Fengjiang District	25%	0.3	0.3	0.3	0.4
	50%	0.3	0.3	0.8	0.4
	75%	0.3	0.3	1.5	0.4
Shenzhen City Nanshan District	25%	0.3	0.3	0.3	0.4
	50%	0.3	0.3	0.3	0.4
	75%	0.3	0.3	0.6	0.4
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.3	0.3	0.3	0.4
	50%	0.3	0.3	0.3	0.4
	75%	0.3	0.3	1.0	0.4
Sampling Location	Percentiles	Cyclohexane	Benzene	2-methylhexane	2,3-dimethylpentane
Dongguan City Changping Town	25%	0.2	0.7	0.3	0.2
	50%	2.2	1.2	0.5	0.4
	75%	2.7	2.5	0.8	0.6
Guangzhou City Conghua City	25%	0.2	0.2	0.3	0.2
	50%	2.6	0.4	0.3	0.2
	75%	4.4	0.6	0.3	0.2
Guangzhou City Guang-Shen Highway	25%	1.1	2.3	0.4	0.2
	50%	2.3	2.8	0.6	0.2
	75%	3.0	4.9	0.9	0.8
Guangzhou City Tianhe District	25%	1.1	2.1	0.3	0.2
	50%	2.6	3.9	0.5	0.5
	75%	3.4	7.5	0.7	0.6
Guangzhou City Huangpu District	25%	1.1	1.5	0.4	0.2
	50%	2.3	2.2	0.4	0.2
	75%	5.1	4.0	0.8	0.5
Jiangmen City Fengjiang District	25%	2.1	0.6	0.3	0.2
	50%	2.4	1.0	0.3	0.2
	75%	4.3	1.5	0.4	0.2
Shenzhen City Nanshan District	25%	2.0	0.2	0.3	0.2
	50%	2.5	0.6	0.3	0.2
	75%	4.7	0.9	0.3	0.2
Zhuhai/Zhongshan City Guang-zhu Highway	25%	2.2	0.7	0.3	0.2
	50%	2.5	1.3	0.3	0.2
	75%	2.7	11.2	0.3	0.2

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	3-methylhexane	2,2,4-trimethylpentane	n-heptane	Methylcyclohexane
Dongguan City Changping Town	25%	0.2	0.5	0.3	0.2
	50%	0.2	0.5	0.6	0.2
	75%	0.2	0.5	1.2	0.2
Guangzhou City Conghua City	25%	0.2	0.5	0.1	0.2
	50%	0.2	0.5	0.1	0.2
	75%	0.2	0.5	0.1	0.2
Guangzhou City Guang-Shen Highway	25%	0.2	0.5	0.3	0.2
	50%	0.2	0.5	0.7	0.2
	75%	0.3	0.5	1.2	0.2
Guangzhou City Tianhe District	25%	0.2	0.5	0.3	0.2
	50%	0.2	0.5	0.4	0.2
	75%	0.5	0.5	1.0	0.3
Guangzhou City Huangpu District	25%	0.2	0.5	0.2	0.2
	50%	0.2	0.5	0.5	0.2
	75%	0.2	0.5	0.9	0.2
Jiangmen City Fengjiang District	25%	0.2	0.5	0.1	0.2
	50%	0.2	0.5	0.2	0.2
	75%	0.2	0.5	0.5	0.2
Shenzhen City Nanshan District	25%	0.2	0.5	0.1	0.2
	50%	0.2	0.5	0.2	0.2
	75%	0.2	0.5	0.3	0.2
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.2	0.5	0.1	0.2
	50%	0.2	0.5	0.2	0.2
	75%	0.2	0.5	0.4	0.2
Sampling Location	Percentiles	2,3,4-trimethylpentane	2-methylheptane	3-methylheptane	Toluene
Dongguan City Changping Town	25%	0.2	0.2	0.2	1.7
	50%	0.2	0.2	0.2	5.2
	75%	0.3	0.3	0.4	11.9
Guangzhou City Conghua City	25%	0.2	0.2	0.2	0.4
	50%	0.2	0.2	0.2	0.5
	75%	0.2	0.2	0.2	1.6
Guangzhou City Guang-Shen Highway	25%	0.2	0.2	0.2	1.6
	50%	0.2	0.2	0.2	5.5
	75%	0.4	0.4	0.6	11.5
Guangzhou City Tianhe District	25%	0.2	0.2	0.2	3.3
	50%	0.2	0.2	0.2	5.2
	75%	0.2	0.3	0.3	12.7
Guangzhou City Huangpu District	25%	0.2	0.2	0.2	2.2
	50%	0.2	0.2	0.2	4.8
	75%	0.2	0.3	0.3	9.9
Jiangmen City Fengjiang District	25%	0.2	0.2	0.2	2.3
	50%	0.2	0.2	0.2	4.8
	75%	0.2	0.2	0.2	7.4
Shenzhen City Nanshan District	25%	0.2	0.2	0.2	1.3
	50%	0.2	0.2	0.2	3.0
	75%	0.3	0.2	0.2	7.5
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.2	0.2	0.2	0.9
	50%	0.2	0.2	0.2	2.9
	75%	0.2	0.2	0.3	8.5

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	n-octane	Ethylbenzene	m,p-xylene	n-nonane
Dongguan City Changping Town	25%	0.3	0.4	0.2	0.1
	50%	0.6	1.1	0.5	0.1
	75%	1.1	1.8	1.1	0.2
Guangzhou City Conghua City	25%	0.2	0.2	0.2	0.1
	50%	0.2	0.2	0.2	0.1
	75%	0.2	0.3	0.3	0.1
Guangzhou City Guang-Shen Highway	25%	0.2	0.6	0.2	0.1
	50%	0.6	1.4	0.2	0.2
	75%	1.4	2.0	0.7	0.3
Guangzhou City Tianhe District	25%	0.3	0.6	0.2	0.1
	50%	0.7	1.0	0.6	0.1
	75%	1.6	1.6	1.6	0.2
Guangzhou City Huangpu District	25%	0.2	0.7	0.2	0.1
	50%	0.6	1.0	0.3	0.1
	75%	1.0	1.4	1.0	0.2
Jiangmen City Fengjiang District	25%	0.3	0.5	0.2	0.1
	50%	0.4	0.7	0.2	0.1
	75%	0.8	1.1	0.6	0.1
Shenzhen City Nanshan District	25%	0.2	0.6	0.2	0.1
	50%	0.2	2.3	0.4	0.1
	75%	0.6	3.6	1.8	0.3
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.3	0.3	0.2	0.1
	50%	0.7	0.7	0.2	0.1
	75%	1.7	1.4	0.3	0.1
Sampling Location	Percentiles	Styrene	o-xylene	(1-methylethyl)benzene	Propylbenzene
Dongguan City Changping Town	25%	0.3	0.3	0.3	0.2
	50%	0.3	0.6	0.3	0.2
	75%	0.6	0.9	0.3	0.2
Guangzhou City Conghua City	25%	0.3	0.2	0.3	0.2
	50%	0.3	0.2	0.3	0.2
	75%	0.3	0.2	0.3	0.2
Guangzhou City Guang-Shen Highway	25%	0.3	0.4	0.3	0.2
	50%	0.4	0.7	0.3	0.2
	75%	0.5	1.1	0.3	0.2
Guangzhou City Tianhe District	25%	0.3	0.4	0.3	0.2
	50%	0.3	0.6	0.3	0.2
	75%	0.4	1.0	0.3	0.3
Guangzhou City Huangpu District	25%	0.3	0.4	0.3	0.2
	50%	0.3	0.5	0.3	0.2
	75%	0.4	0.7	0.3	0.3
Jiangmen City Fengjiang District	25%	0.3	0.3	0.3	0.2
	50%	0.3	0.4	0.3	0.2
	75%	0.3	0.6	0.3	0.2
Shenzhen City Nanshan District	25%	0.3	0.3	0.3	0.2
	50%	0.3	0.9	0.3	0.2
	75%	0.3	1.8	0.3	0.3
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.3	0.2	0.3	0.2
	50%	0.3	0.3	0.3	0.2
	75%	0.3	0.6	0.3	0.2

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	1,3,5-trimethylbenzene	1,2,4-trimethylbenzene
Dongguan City Changping Town	25%	0.3	0.2
	50%	0.3	0.4
	75%	0.4	0.6
Guangzhou City Conghua City	25%	0.3	0.1
	50%	0.3	0.3
	75%	0.4	0.3
Guangzhou City Guang-Shen Highway	25%	0.3	0.5
	50%	0.4	0.7
	75%	0.5	0.9
Guangzhou City Tianhe District	25%	0.3	0.4
	50%	0.4	0.6
	75%	0.4	0.8
Guangzhou City Huangpu District	25%	0.3	0.4
	50%	0.3	0.5
	75%	0.4	0.7
Jiangmen City Fengjiang District	25%	0.3	0.3
	50%	0.3	0.4
	75%	0.4	0.6
Shenzhen City Nanshan District	25%	0.3	0.4
	50%	0.4	1.1
	75%	0.7	1.5
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.3	0.2
	50%	0.3	0.2
	75%	0.3	0.4

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

(b) Phase II

Sampling Location	Percentiles	Ethane & Ethene	Propyne	Propane	2-methylpropane
Guangzhou City Baiyunshan	25%	2.1	2.2	1.8	1.7
	50%	2.1	2.2	1.8	1.9
	75%	2.1	2.2	1.8	2.0
Guangzhou City Conghua City	25%	11.5	2.2	1.8	0.2
	50%	15.6	2.2	1.8	0.2
	75%	22.6	2.2	1.8	0.2
Guangzhou City Yuexiu District	25%	2.1	2.2	1.8	1.1
	50%	2.1	2.2	1.8	2.0
	75%	9.3	2.2	2.4	4.9
Guangzhou City Huadu City	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.2
	75%	2.1	2.2	1.8	0.5
Guangzhou City Baiyun District	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.2
	75%	2.1	2.2	1.8	0.4
Guangzhou City Lianhuashan	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.3
	75%	2.1	2.2	1.8	0.6
Guangzhou City Tianhe District	25%	2.1	2.2	1.8	1.4
	50%	15.0	2.2	1.8	1.9
	75%	34.5	2.4	2.1	2.2
Guangzhou City Xinken County	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.4
	75%	20.6	2.2	1.8	0.8
Shenzhen City Baoan District	25%	2.1	2.2	1.8	0.2
	50%	2.1	2.2	1.8	0.4
	75%	35.3	2.2	1.8	0.9
Sampling Location	Percentiles	1-Butene	n-butane	1,3-butadiene	trans-2-butene
Guangzhou City Baiyunshan	25%	1.5	2.7	2.0	0.3
	50%	1.5	3.1	2.0	0.3
	75%	1.5	3.7	2.0	0.6
Guangzhou City Conghua City	25%	0.3	0.3	0.4	0.3
	50%	0.3	0.3	0.4	0.3
	75%	0.3	0.3	0.4	0.3
Guangzhou City Yuexiu District	25%	1.6	1.8	1.3	0.6
	50%	2.6	2.9	1.6	1.0
	75%	3.3	7.9	2.9	1.3
Guangzhou City Huadu City	25%	0.3	0.3	0.4	0.3
	50%	0.3	0.5	0.4	0.3
	75%	0.4	1.2	0.5	0.3
Guangzhou City Baiyun District	25%	0.3	0.3	0.4	0.3
	50%	0.3	0.3	0.4	0.3
	75%	0.3	0.5	0.4	0.3
Guangzhou City Lianhuashan	25%	0.3	0.6	0.4	0.3
	50%	0.3	0.7	0.4	0.3
	75%	0.4	1.3	0.5	0.3
Guangzhou City Tianhe District	25%	0.9	2.1	0.6	0.5
	50%	1.3	2.6	0.7	0.7
	75%	1.5	3.2	0.9	0.8
Guangzhou City Xinken County	25%	0.3	0.5	0.4	0.3
	50%	0.5	1.2	0.4	0.3
	75%	0.7	2.0	0.5	0.3
Shenzhen City Baoan District	25%	0.3	0.7	0.4	0.3
	50%	0.5	1.2	0.4	0.3
	75%	0.9	2.3	0.6	0.3

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	cis-2-butene	2-methyl-2-butene	2-methylbutane	1-pentene
Guangzhou City Baiyunshan	25%	0.2	0.2	1.5	1.5
	50%	0.2	0.2	1.8	1.5
	75%	0.4	0.2	2.1	1.5
Guangzhou City Conghua City	25%	0.2	0.2	0.3	0.3
	50%	0.2	0.2	0.3	0.3
	75%	0.2	0.2	0.3	0.3
Guangzhou City Yuexiu District	25%	0.6	0.2	5.2	1.5
	50%	0.9	0.3	6.7	1.7
	75%	1.2	0.3	8.4	2.7
Guangzhou City Huadu City	25%	0.2	0.2	0.3	0.3
	50%	0.2	0.2	0.3	0.3
	75%	0.2	0.2	0.6	0.5
Guangzhou City Baiyun District	25%	0.2	0.2	0.3	0.3
	50%	0.2	0.2	0.3	0.3
	75%	0.2	0.2	0.7	0.3
Guangzhou City Lianhuashan	25%	0.2	0.2	0.3	0.3
	50%	0.2	0.2	0.5	0.4
	75%	0.2	0.2	0.8	0.6
Guangzhou City Tianhe District	25%	0.4	0.2	2.0	1.3
	50%	0.6	0.2	2.4	1.3
	75%	0.7	0.2	3.0	1.5
Guangzhou City Xinken County	25%	0.2	0.2	0.3	0.3
	50%	0.2	0.2	0.5	0.7
	75%	0.2	0.2	0.7	1.1
Shenzhen City Baoan District	25%	0.2	0.2	0.4	0.5
	50%	0.2	0.2	0.5	0.6
	75%	0.2	0.2	0.8	1.2
Sampling Location	Percentiles	n-pentane	2-methyl-1,3-butadiene	3-methyl-1-butene	trans-2-pentene
Guangzhou City Baiyunshan	25%	1.0	1.5	0.3	0.3
	50%	1.2	1.5	0.3	0.3
	75%	1.4	1.5	0.3	0.3
Guangzhou City Conghua City	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.1	0.3	0.3	0.3
Guangzhou City Yuexiu District	25%	0.1	0.5	0.6	0.6
	50%	0.1	1.1	1.0	1.0
	75%	1.3	2.5	1.8	1.7
Guangzhou City Huadu City	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.1	0.3	0.3	0.3
Guangzhou City Baiyun District	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.4	0.3	0.3
	75%	0.1	0.4	0.3	0.3
Guangzhou City Lianhuashan	25%	0.1	0.6	0.3	0.3
	50%	0.1	0.6	0.3	0.3
	75%	0.1	0.6	0.3	0.3
Guangzhou City Tianhe District	25%	0.1	0.5	0.5	0.5
	50%	0.1	0.6	0.5	0.5
	75%	0.1	0.6	0.6	0.6
Guangzhou City Xinken County	25%	0.1	1.8	0.3	0.3
	50%	0.1	2.0	0.3	0.3
	75%	0.1	2.4	0.3	0.3
Shenzhen City Baoan District	25%	0.1	0.3	0.3	0.3
	50%	0.1	0.3	0.3	0.3
	75%	0.1	0.3	0.3	0.3

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	2,2-Dimethyl-Butane	Cyclopentene	4-methyl-1-pentene	2,3-dimethylbutane
Guangzhou City Baiyunshan	25%	0.3	0.3	1.5	1.5
	50%	0.3	0.3	1.5	1.5
	75%	0.3	0.3	1.5	1.5
Guangzhou City Conghua City	25%	1.5	0.3	0.3	0.3
	50%	2.1	0.3	0.3	0.3
	75%	2.2	0.3	0.3	0.3
Guangzhou City Yuexiu District	25%	0.3	0.3	0.7	1.0
	50%	0.3	0.3	1.1	1.6
	75%	0.3	0.4	2.7	2.4
Guangzhou City Huadu City	25%	0.3	0.3	0.3	0.3
	50%	0.3	0.3	0.3	0.3
	75%	0.3	0.3	0.5	0.4
Guangzhou City Baiyun District	25%	0.3	0.3	0.3	0.3
	50%	0.3	0.3	0.3	0.3
	75%	0.3	0.3	0.6	0.5
Guangzhou City Lianhuashan	25%	0.3	0.3	0.4	0.3
	50%	0.3	0.3	0.5	0.4
	75%	0.3	0.3	0.8	0.5
Guangzhou City Tianhe District	25%	0.3	0.3	1.1	0.8
	50%	0.3	0.3	1.2	1.0
	75%	0.3	0.3	1.4	1.2
Guangzhou City Xinken County	25%	0.3	0.3	0.3	0.3
	50%	0.3	0.3	0.6	0.5
	75%	0.3	0.3	1.0	0.8
Shenzhen City Baoan District	25%	0.3	0.3	0.6	0.6
	50%	0.3	0.3	0.7	0.6
	75%	0.3	0.3	1.1	0.8
Sampling Location	Percentiles	Cyclopentane	2-methylpentane	3-methyl-Pentane	n-hexane
Guangzhou City Baiyunshan	25%	0.5	1.5	1.5	2.0
	50%	0.5	1.5	1.5	2.0
	75%	0.6	1.5	1.5	2.0
Guangzhou City Conghua City	25%	0.1	0.3	0.3	0.4
	50%	0.1	0.3	0.3	0.4
	75%	0.1	0.3	0.3	0.4
Guangzhou City Yuexiu District	25%	0.4	1.3	1.2	1.3
	50%	0.6	2.3	1.4	1.5
	75%	0.9	3.2	1.8	2.1
Guangzhou City Huadu City	25%	0.1	0.3	0.3	0.4
	50%	0.1	0.3	0.3	0.4
	75%	0.2	0.5	0.3	0.5
Guangzhou City Baiyun District	25%	0.2	0.3	0.3	0.4
	50%	0.2	0.3	0.3	0.4
	75%	0.4	0.6	0.3	0.5
Guangzhou City Lianhuashan	25%	0.1	0.4	0.3	0.4
	50%	0.2	0.5	0.3	0.4
	75%	0.3	0.8	0.3	0.5
Guangzhou City Tianhe District	25%	0.5	1.2	0.4	0.5
	50%	0.6	1.3	0.5	0.7
	75%	0.8	1.6	0.6	1.0
Guangzhou City Xinken County	25%	0.1	0.3	0.3	0.4
	50%	0.3	0.6	0.4	0.4
	75%	0.5	1.0	0.5	0.7
Shenzhen City Baoan District	25%	0.2	0.8	0.4	0.4
	50%	0.3	0.8	0.4	0.5
	75%	0.6	1.1	0.6	1.0

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	trans-2-hexene	cis-2-hexene	2,4-dimethylpentane	Methylcyclopentane
Guangzhou City Baiyunshan	25%	0.3	0.3	1.2	2.0
	50%	0.3	0.3	1.5	2.0
	75%	0.3	0.3	2.1	2.0
Guangzhou City Conghua City	25%	0.3	0.3	0.3	0.4
	50%	0.3	0.3	0.3	0.4
	75%	0.3	0.3	0.6	0.4
Guangzhou City Yuexiu District	25%	0.3	0.3	0.5	1.8
	50%	0.4	0.4	0.7	2.8
	75%	0.7	0.7	1.2	5.5
Guangzhou City Huadu City	25%	0.3	0.3	0.6	0.4
	50%	0.3	0.3	1.3	0.4
	75%	0.3	0.3	1.9	0.5
Guangzhou City Baiyun District	25%	0.3	20.0	0.3	0.4
	50%	0.3	20.0	0.3	0.4
	75%	0.3	22.5	1.8	0.8
Guangzhou City Lianhuashan	25%	0.3	0.3	1.0	0.4
	50%	0.3	0.3	1.2	0.4
	75%	0.3	0.3	1.6	0.6
Guangzhou City Tianhe District	25%	0.3	0.3	0.8	0.6
	50%	0.3	0.3	1.6	0.9
	75%	0.3	0.3	2.7	1.3
Guangzhou City Xinken County	25%	0.3	0.3	1.3	0.4
	50%	0.3	0.3	2.8	0.4
	75%	0.3	0.3	4.8	0.7
Shenzhen City Baoan District	25%	0.3	0.3	0.8	0.4
	50%	0.3	0.3	1.5	0.4
	75%	0.3	0.3	2.6	0.7

Sampling Location	Percentiles	Cyclohexane	Benzene	2-methylhexane	2,3-dimethylpentane
Guangzhou City Baiyunshan	25%	3.2	2.0	1.5	1.0
	50%	3.6	3.1	1.5	1.0
	75%	3.7	4.6	1.5	1.1
Guangzhou City Conghua City	25%	0.2	1.3	0.3	0.2
	50%	0.2	2.0	0.3	0.2
	75%	0.2	2.3	0.3	0.2
Guangzhou City Yuexiu District	25%	1.4	3.9	1.0	0.8
	50%	3.1	5.7	1.4	1.3
	75%	10.1	10.6	2.2	2.2
Guangzhou City Huadu City	25%	0.2	0.6	0.3	0.2
	50%	0.2	1.0	0.3	0.2
	75%	0.2	1.7	0.5	0.4
Guangzhou City Baiyun District	25%	9.8	1.3	0.5	0.2
	50%	10.3	1.8	0.6	0.2
	75%	11.7	3.3	0.9	0.7
Guangzhou City Lianhuashan	25%	0.2	0.9	0.6	0.2
	50%	0.2	1.1	0.6	0.2
	75%	0.2	2.8	1.0	0.7
Guangzhou City Tianhe District	25%	0.2	5.0	1.0	0.7
	50%	1.4	5.6	1.1	0.9
	75%	3.5	5.8	1.3	1.2
Guangzhou City Xinken County	25%	0.2	1.1	0.5	0.2
	50%	0.2	1.4	1.1	0.9
	75%	1.5	1.6	1.8	1.8
Shenzhen City Baoan District	25%	0.2	0.4	0.6	0.2
	50%	2.0	0.6	0.8	0.2
	75%	4.0	1.1	1.4	0.9

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	3-methylhexane	2,2,4-trimethylpentane	n-heptane	Methylcyclohexane
Guangzhou City Baiyunshan	25%	0.2	0.5	1.0	0.2
	50%	0.2	0.5	1.3	0.6
	75%	0.2	0.5	1.6	1.0
Guangzhou City Conghua City	25%	0.2	1.4	0.1	0.2
	50%	0.2	1.5	0.1	0.2
	75%	0.2	1.5	0.1	0.2
Guangzhou City Yuexiu District	25%	0.3	0.5	0.5	0.3
	50%	0.5	0.5	0.7	0.5
	75%	0.5	1.0	0.8	0.7
Guangzhou City Huadu City	25%	0.2	1.3	0.1	0.2
	50%	0.2	1.8	0.2	0.2
	75%	0.2	2.2	0.6	0.2
Guangzhou City Baiyun District	25%	20.0	0.5	0.1	0.2
	50%	20.0	0.5	0.1	0.2
	75%	22.5	0.5	0.4	0.2
Guangzhou City Lianhuashan	25%	0.2	0.5	0.6	0.2
	50%	0.2	1.3	0.6	0.2
	75%	0.2	2.1	0.9	0.2
Guangzhou City Tianhe District	25%	0.2	0.5	0.8	0.2
	50%	0.2	0.5	1.4	0.2
	75%	0.2	0.5	2.2	0.6
Guangzhou City Xinken County	25%	0.2	0.5	0.3	0.2
	50%	0.2	0.7	1.1	0.2
	75%	0.2	0.9	2.6	0.5
Shenzhen City Baoan District	25%	0.2	0.5	0.1	0.2
	50%	0.2	0.5	0.7	0.2
	75%	0.2	1.0	1.8	0.3
Sampling Location	Percentiles	2,3,4-trimethylpentane	2-methylheptane	3-methylheptane	Toluene
Guangzhou City Baiyunshan	25%	0.2	0.8	0.8	10.2
	50%	0.6	1.0	1.0	15.0
	75%	1.0	1.0	1.0	21.1
Guangzhou City Conghua City	25%	0.2	0.2	0.2	0.6
	50%	0.2	0.2	0.2	0.9
	75%	0.2	0.2	0.2	1.1
Guangzhou City Yuexiu District	25%	0.2	0.2	0.2	6.5
	50%	0.2	0.3	0.3	8.1
	75%	0.2	0.5	0.5	15.1
Guangzhou City Huadu City	25%	0.2	0.2	0.2	2.4
	50%	0.2	0.2	0.2	4.2
	75%	0.2	0.3	0.3	7.3
Guangzhou City Baiyun District	25%	0.2	0.2	0.2	0.9
	50%	0.2	0.2	0.2	1.5
	75%	0.2	0.2	0.2	4.8
Guangzhou City Lianhuashan	25%	0.2	0.2	0.2	6.2
	50%	0.2	0.2	0.2	7.3
	75%	0.2	0.2	0.2	9.6
Guangzhou City Tianhe District	25%	0.2	0.2	0.2	3.3
	50%	0.3	0.2	0.2	5.5
	75%	0.5	0.4	0.6	19.8
Guangzhou City Xinken County	25%	0.2	0.2	0.2	4.0
	50%	0.5	0.4	0.3	12.1
	75%	1.4	0.8	0.6	38.7
Shenzhen City Baoan District	25%	0.2	0.2	0.2	7.8
	50%	0.2	0.2	0.4	13.3
	75%	0.4	0.3	0.7	22.1

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	n-octane	Ethylbenzene	m,p-xylene	n-nonane
Guangzhou City Baiyunshan	25%	1.0	1.2	0.9	0.5
	50%	1.1	1.4	1.2	0.5
	75%	1.5	1.8	1.5	0.5
Guangzhou City Conghua City	25%	0.2	0.2	0.2	0.1
	50%	0.2	0.2	0.2	0.1
	75%	0.2	0.2	0.2	0.1
Guangzhou City Yuexiu District	25%	0.2	1.1	1.0	0.1
	50%	0.4	1.4	1.2	0.2
	75%	0.4	1.6	1.5	0.2
Guangzhou City Huadu City	25%	0.4	0.4	0.4	0.1
	50%	0.5	0.5	0.4	0.1
	75%	0.8	0.9	0.8	0.2
Guangzhou City Baiyun District	25%	20.0	0.3	0.3	0.1
	50%	20.0	0.4	0.3	0.1
	75%	22.5	0.6	0.5	0.2
Guangzhou City Lianhuashan	25%	0.7	0.9	0.7	0.1
	50%	1.0	1.1	0.8	0.1
	75%	1.4	1.6	1.2	0.2
Guangzhou City Tianhe District	25%	0.2	0.5	0.8	0.2
	50%	0.8	0.9	1.2	0.3
	75%	1.3	1.6	1.9	0.3
Guangzhou City Xinken County	25%	0.8	0.8	0.4	0.1
	50%	2.6	2.6	1.5	0.4
	75%	6.8	5.1	3.6	0.7
Shenzhen City Baoan District	25%	1.0	0.7	0.2	0.1
	50%	1.2	1.3	0.7	0.2
	75%	2.0	2.5	2.0	0.3
Sampling Location	Percentiles	Styrene	o-xylene	(1-methylethyl)benzene	Propylbenzene
Guangzhou City Baiyunshan	25%	1.5	1.0	0.3	0.2
	50%	1.5	1.0	0.3	0.2
	75%	1.5	1.1	0.3	0.4
Guangzhou City Conghua City	25%	0.3	0.2	0.3	0.2
	50%	0.3	0.2	0.3	0.2
	75%	0.3	0.2	0.3	0.2
Guangzhou City Yuexiu District	25%	0.3	0.8	0.3	0.2
	50%	0.3	1.1	0.3	0.4
	75%	0.5	2.2	0.3	0.4
Guangzhou City Huadu City	25%	0.3	0.2	0.3	0.2
	50%	0.3	0.2	0.3	0.2
	75%	0.4	0.4	0.3	0.2
Guangzhou City Baiyun District	25%	0.3	0.3	20.0	0.2
	50%	0.3	0.3	20.0	0.2
	75%	0.3	0.3	22.5	0.3
Guangzhou City Lianhuashan	25%	0.3	0.4	0.3	0.2
	50%	0.3	0.4	0.3	0.2
	75%	0.5	0.6	0.3	0.2
Guangzhou City Tianhe District	25%	0.2	0.5	0.3	0.2
	50%	0.3	0.7	0.3	0.2
	75%	0.5	1.0	0.3	0.2
Guangzhou City Xinken County	25%	0.3	0.2	0.3	0.2
	50%	0.3	0.8	0.3	0.2
	75%	0.8	1.8	0.3	0.2
Shenzhen City Baoan District	25%	0.4	0.4	0.3	0.2
	50%	0.6	0.5	0.3	0.2
	75%	1.3	1.0	0.3	0.2

Table 4-3 Percentiles of VOC (ppbv)-PRDEZ (cont'd)

Sampling Location	Percentiles	1,3,5-trimethylbenzene	1,2,4-trimethylbenzene
Guangzhou City Baiyunshan	25%	0.3	0.5
	50%	0.9	0.6
	75%	1.5	0.6
Guangzhou City Conghua City	25%	0.3	0.1
	50%	0.3	0.1
	75%	0.3	0.1
Guangzhou City Yuexiu District	25%	0.6	1.0
	50%	0.6	1.7
	75%	0.9	3.0
Guangzhou City Huadu City	25%	0.3	0.1
	50%	0.3	0.2
	75%	0.3	0.3
Guangzhou City Baiyun District	25%	0.3	0.2
	50%	0.3	0.3
	75%	0.3	0.3
Guangzhou City Lianhuashan	25%	0.4	0.1
	50%	0.5	0.2
	75%	0.7	0.3
Guangzhou City Tianhe District	25%	0.3	0.3
	50%	0.3	0.5
	75%	0.3	0.7
Guangzhou City Xinken County	25%	0.3	0.1
	50%	0.4	0.2
	75%	0.5	0.3
Shenzhen City Baoan District	25%	0.2	0.2
	50%	0.3	0.2
	75%	0.4	0.3

4.5 TNMOC Monitoring Result

4.5.1 Table 4-4 and Table 4-5 present the percentiles of TNMOC results for HKSAR and PRDEZ respectively.

Table 4-4 Percentiles of TNMOC (ppmC)-HKSAR

Sampling Location	**Percentiles**	**TNMOC**
Hong Kong Tsing Yi Island	25%	0.35
	50%	0.71
	75%	1.45
Hong Kong Tai Po	25%	0.05
	50%	0.09
	75%	0.20

Table 4-5 Percentiles of TNMOC (ppmC)-PRDEZ

Sampling Location	Percentiles	TNMOC
Dongguan City Changping Town	25%	0.49
	50%	0.55
	75%	0.86
Guangzhou City Conghua City	25%	0.06
	50%	0.10
	75%	0.13
Guangzhou City Guang-Shen Highway	25%	0.45
	50%	0.63
	75%	0.91
Guangzhou City Tianhe District	25%	0.35
	50%	0.50
	75%	0.73
Guangzhou City Huangpu District	25%	0.31
	50%	0.43
	75%	0.68
Jiangmen City Fengjiang District	25%	0.23
	50%	0.36
	75%	0.45
Shenzhen City Nanshan District	25%	0.26
	50%	0.36
	75%	0.60
Zhuhai/Zhongshan City Guang-zhu Highway	25%	0.27
	50%	0.32
	75%	0.43

4.6 Carbonyl Monitoring

4.6.1 Table 4-6 presents the percentiles of Carbonyl data for HKSAR. Table 4-7 presents the validated Carbonyl data in PRDEZ.

Table 4-6 Percentiles of Carbonyl ($\mu g/m^3$)-HKSAR

Sampling Location	Percentiles	Formaldehyde	Acetaldehyde	Acetone
Hong Kong Tsing Yi Island	25%	3.7	0.4	0.5
	50%	5.0	1.1	0.5
	75%	6.4	1.7	0.5
Hong Kong Tai Po	25%	1.5	0.3	0.5
	50%	2.4	0.4	0.5
	75%	2.8	0.6	0.6

Table 4-7 Percentiles of Carbonyl ($\mu g/m^3$)-PRDEZ

Sampling Location	Percentiles	Formaldehyde	Acetaldehyde	Acetone
Dongguan City Changping Town	25%	4.8	0.5	0.3
	50%	6.0	1.0	0.3
	75%	8.0	1.8	0.6
Guangzhou City Conghua City	25%	2.6	0.2	0.3
	50%	4.7	0.6	0.3
	75%	6.3	1.0	0.3
Guangzhou City Guang-Shen Highway	25%	7.1	1.0	0.3
	50%	9.9	1.4	0.3
	75%	12.4	3.2	0.3
Guangzhou City Tianhe District	25%	9.5	2.1	0.3
	50%	11.6	3.6	0.3
	75%	13.7	4.7	0.3
Guangzhou City Huangpu District	25%	6.0	2.6	0.3
	50%	11.7	3.5	0.3
	75%	16.5	6.5	0.3
Jiangmen City Fengjiang District	25%	4.6	0.3	0.3
	50%	6.1	1.2	0.3
	75%	7.8	1.8	0.3
Shenzhen City Nanshan District	25%	2.3	0.3	0.3
	50%	4.7	0.8	0.3
	75%	7.1	1.6	0.3
Zhuhai/Zhongshan City Guang-zhu Highway	25%	3.6	0.3	0.3
	50%	5.5	0.8	0.3
	75%	8.3	2.0	0.3