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report no. 4/87

a survey of exposures to gasoline vapour

Prepared for CONCAWE's Health Management Group and Industrial Hygiene Sub-group by a Special Task Force (H/STF-14)

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June 1987

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ABSTRACT

This report presents data on 540 personal gasoline vapour exposure measurements collected in 13 European countries by an industrial hygiene task force during 1984 and 1985 and stored in a CONCAWE computer database. Gasoline vapour exposures are quantified and characterised for up to 150 individual components for workers in 15 job groups involved in the manufacture and distribution of motor gasoline. A statistical analysis of exposures to total hydrocarbons is also presented. The report also discusses the assessment of exposure data against established limits for some individual components and gasoline or mixed hydrocarbon vapours.

Dit rapport bevat meetgegevens betreffende de blootstelling aan benzinedampen van 540 personen, die gedurende 1984 en 1985 in 13 Europese landen door een industriële werkgroep op het gebied van de gezondheidszorg verzameld en opgeslagen zijn in een geautomatiseerde gegevensbank van CONCAWE. De blootstelling aan benzinedampen zijn gekwantificeerd en gespecificeerd voor maximaal 150 verschillende bestanddelen voor werknemers in 15 functiegroepen die betrokken zijn bij de vervaardiging en distributie van motorbenzine. Tevens bevat het rapport een statistische analyse van blootstellingen aan totale koolwaterstoffen. Voorts worden de blootstellingsgegevens beoordeeld in het licht van de voorgeschreven limieten voor een aantal afzonderlijke componenten en benzine - of gemengde koolwaterstofdampen.

Mit diesem Bericht werden Daten zu Messungen der Exposition von 540 Personen gegenüber Benzindämpfen vorgelegt, die in 13 europäischen Ländern in den Jahren 1984 und 1985 von einer gewerbehygienischen Arbeitsgruppe gesammelt und von CONCAWE in einer Dantenbank gespeichert wurden. Die Benzindämpfe werden anhand von bis zu 150 Einzelkomponenten quantifiziert und charakterisiert, und zwar für Arbeitnehmer aus 15 Lohngruppen, die mit Herstellung und Umschlag von Motorenbenzin zu tun haben. Eine statistische Analyse der Exposition gegenüber Gesamtkohlenwasserstoffen wird ebenfalls vorgelegt. Auch wird in dem Bericht die Beurteilung der Expositionsdaten im Vergleich zu bestehenden Grenzwerten für einige Komponenten sowie für Benzindämpfe oder Dämpfe von Kohlenwasserstoffgemischen diskutiert.

Le présent rapport présente des données sur 540 mesurages d'expositions personnelles à la vapeur d'essence, recueillies dans 13 pays européens par un groupe de travail d'hygiène industrielle en 1984 et en 1985, et mémorisées dans une base de données informatiques de CONCAWE. Les expositions à la vapeur d'essence sont déterminées quantitativement et caractérisées pour un nombre allant jusqu'à 150 composants différents pour des ouvriers de 15 catégories de postes, travaillant dans la fabrication et la distribution de carburants-automobile. Une analyse statistique des expositions à l'ensemble des hydrocarbures est également présentée. Le rapport traite aussi de l'évaluation de données concernant les expositions par rapport aux limites établies pour certains composants et les carburants ou les vapeurs d'hydrocarbures mélangées.

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Este informe presenta datos de medición relativos a la exposición de 540 personas a vapores de gasolina, que fueron reunidos durante los años 1984 y 1985 en 13 países europeos por una comisión industrial sanitaria y almacenados en un banco electrónico de datos de CONCAWE. Las exposiciones a vapores de gasolina han sido cuantificadas y especificadas para un máximo de 150 componentes individuales y se refieren a trabajadores clasificados en 15 categorías de puestos, ocupados en la fabricación y distribución de gasolina para motores. El informe contiene también un análisis de exposiciónes a hidrocarburos totales. Además se evalúan los datos de exposición a base de los límites establecidos para algunos componentes individuales y vapores de gasolina o hidrocarburos mixtos.

Il presente rapporto contiene 540 misure da adottarsi in caso di esposizioni personali ai vapori di benzina raccolte in 13 paesi europei da un gruppo incaricato dell'igiene industriale nel 1984 en 1985 e memorizzate nel data base del cervello elettronico CONCAWE. Le esposizioni ai vapori di benzina sono state quantificate e caratterizzate per oltre 150 componenti individuali per lavoratori in 15 gruppo professionali addetti alla produzione e distribuzione di benzina per automobili. Si presenta inoltre un'analisi statistica sull'esposizione a tutti gli idrocarburi. Il rapporto da anche il suo giudizio sulla valutazione dei dati d'esposizione in confronto dei limiti stabiliti per alcuni componenti individuali e vapori di benzina o miscele d'idrocarburi.

CONTENTS

SUMMARY

During 1984-85 a CONCAWE industrial hygiene task force collected 540 personal gasoline exposure measurements in 13 European countries for workers involved in the manufacture and distribution of gasoline. A new method, developed by CONCAWE, for monitoring exposure to gasoline vapour in air enabled exposures to be quantified and characterised for up to 150 individual components of gasoline vapour for 15 different groups of jobs. The report describes these different jobs and the way in which vapour exposures can occur. Differences in composition between liquid gasoline and vapour are highlighted and the implications of these with respect to a realistic exposure limit for total hydrocarbons in gasoline vapour are discussed.

Establishment of a computer database of the measurements has assisted the preparation of summaries of exposures to total hydrocarbons and several individual components. The report reviews the exposure data for the various job groups and shows that, with the exception of filling drums in the absence of adequate local exhaust ventilation and possibly some marine loading operations (for which only limited data were obtained), 8-hour time-weighted average personal exposures to total hydrocarbons are well below a limit of 1700 mg/m^3 calculated from an average gasoline vapour composition. This calculated exposure limit is considered more appropriate than established limits of 900 mg/m^3 (ACGIH, USA) and 220 mg/m^3 (Sweden); both of these are based on the composition of liquid gasolines which, as this report clearly shows, is very different from the vapour to which exposures occur and to which potential health risks are related.

Similar conclusions to those for total hydrocarbons appy to assessment of exposures to benzene, n-hexane and trimethylbenzenes against established individual limits. For toluene and xylenes, all exposures are well below established limits.

1. INTRODUCTION

Because of the high volatility of some components, gasoline is manufactured and distributed, as far as is practicable, in enclosed systems in order to minimise evaporation which could lead to safety hazards, environmental contamination, and product losses. Such systems reduce the possibilities of exposures to gasoline vapour but do not exclude them. In order to provide information for assessing possible health concerns, CONCAWE's Health Management Group established a Special Task Force to quantify exposure to all significant components of gasoline vapours. This report presents the results of a survey carried out in 13 European countries during 1984-85.

Using the new exposure monitoring method described in CONCAWE Report No. 8/86 (1) and a standardised protocol for reporting results and ancillary information, a CONCAWE computer database containing 540 exposure measurements has been established. Summaries prepared from this database for 15 different activities (job groups) involved in the manufacture and distribution of gasoline provide information on exposures to total hydrocarbon vapours, their mean compositions compared to liquid gasoline, and the exposure ranges for up to 150 individual vapour components. Assessment of these data against established exposure limits is also discussed.

2. ACTIVITIES AND JOB GROUP CATEGORIES

The manufacture and distribution of gasoline involves a variety of work activities and types of job ranging from production and ancillary operations within the refinery to loading of ships, railcars and road tankers, delivery to service stations and, finally, attendant or self-service filling of customers' vehicles. Because of the variable potential for exposure to gasoline vapour in these different activities, fifteen different job groups were identified as detailed below. In eleven of these, potential for exposure exists essentially over the whole working day or shift and data were collected to be representative of 8-hour time-weighted average exposures. In two job groups, the main potential for exposure is over a relatively short part of the working day. Separate data were therefore collected to quantify exposures during these short-term operations. Although not strictly a "job", data for a third short-term operation, i.e. car drivers filling their own vehicles at self-service stations, were collected under the "short-term operations" category. A final activity or job group for which separate data were collected under "long-term operations" was for road tanker drivers delivering gasoline to service stations, i.e. driving and unloading. It was considered it would be useful to have data quantifying exposures for this important component of the road tanker driver's job.

Each job group was allocated a number and a short descriptive title. These are indicated in Sections 2.1 and 2.2 with short descriptions of the activities involved in each job group.

2.1 SHORT-TERM OPERATION JOB GROUPS

Two of the job groups in this category cover an important component part of the jobs of road tanker drivers who load their own vehicles at bulk fuel terminals. Two groups are required to distinguish between top loading which has been the most commonly used method and bottom loading which is coming into increasing use. The third group included in the short-term operation category covers the non-occupational exposures incurred by customers filling their own vehicles at self-service stations.

Job Group No. 1 - Road Top <1 hr

This covers exposures of road tanker drivers filling their own vehicles by the top loading procedure. With this system, the tanker compartments are filled through open hatches on top of the vehicle by the driver introducing the fill pipe and lowering it to the bottom of the compartment. This technique of submerged filling, in which gasoline enters the compartment under liquid fuel already present, has generally replaced the earlier method of

"splash-loading" in which only a short fill pipe was used and liquid gasoline entered the vapour space of the compartment. The submerged filling technique results in less vaporisation of the liquid gasoline. As each compartment is filled, the driver must remove the fill pipe, drain it and insert it into the next compartment.

During these operations, the driver has a potential for exposure to vapours which are displaced through the open hatch as liquid fills the compartment, from spillage, and from evaporation of liquid from the surface of the fill pipe as it is removed from one compartment and inserted into the next. There is a further potential for exposure during tank dipping and the closing of hatch covers. Actual exposures may vary considerably depending on the design of the equipment, the work practices of the driver and ambient weather conditions. In some installations, the location of a "dead-man's handle" (which must be depressed during filling) may require the driver to stand close to the open hatch. In other cases he may be able to stand well away from the hatch opening where metered filling or a remote "dead-man's handle" are installed. High ambient/product temperatures and absence of wind can be expected to lead to higher vapour concentrations. If the driver can stand "up-wind" of the open hatch his exposure is likely to be lower. Exposures may also be affected by the vapour content of the empty compartments, by simultaneous filling of other tankers in adjacent loading bays, and by filling rates as well as by tanker or compartment sizes.

Vapour control or recovery systems have been installed in some facilities; reduced exposures would be expected in such cases. However, these types of facility were not included in this survey.

In most cases, loading of a road tanker is completed within 30 minutes; this is confirmed by the mean sampling period of 24 minutes. However, delays will inevitably occur occasionally through technical, operating or other problems. This is reflected in the inclusion of data for sampling periods of up to one hour.

Job Group No. 2 - Road Bottom <1 hr

This covers exposures of road tanker drivers filling their own vehicles by the bottom loading procedure. With this system, the tanker compartments are filled through hose connections made by the driver to manifolds on the vehicle near ground level. The main sources of exposure potential are during the hose coupling and uncoupling procedures, and from vapour which may drift towards ground level from high-level vents. As with top loading, actual exposures will be subject to a number of variables such as weather conditions, simultaneous loading of other tankers in adjacent bays, occasional spillages etc. Although vapour control systems are installed at some facilities these were not included in this survey. Loading is normally completed within 30 minutes as shown by the mean sampling period of 27 minutes. Occasional longer loading times are reflected in the inclusion of data for sampling periods up to one hour.

Job Group No. 3 - Service Station, Self-fill

This group covers the occasional brief exposures, typically over periods of about two minutes, of customers filling their own vehicles at self-service stations.

2.2 LONG-TERM OPERATION JOB GROUPS

These are operations or combinations generally lasting between one hour and a full working shift. Except for Job Group No. 6 which comprises the road delivery component of the daily exposures of road tanker drivers, exposure measurements were either obtained over a full work-shift period or were representative of it so that they can be considered as indicating 8-hour time-weighted average exposures. Vapour control or recovery or remote venting systems were not in use for any of the sampled operations involving road tankers, railcars, open-loading of ships, filling of drums or service stations.

Job Group No. 4 - Road Top >1 hr

This covers representative full work-shift exposures of road tanker drivers during top-loading and delivery of gasoline. The potential for exposure is discussed in detail under Job Groups No. 1 and No. 6. Typically, a driver will complete two to three loadings and deliveries each day with occasionally more where short delivery distances are involved.

Job Group No. 5 - Road Bottom >1 hr

This covers the same as Job Group No. 4 except that bottom filling of road tankers is used. Potential for exposure is discussed in detail under Job Groups No. 2 and No. 6. As with Job Group No. 4, 2 to 3 loadings and deliveries per day are typical.

Job Group No. 6 - Road Delivery

This covers the important component of the road tanker driver's task of driving from the loading location to the delivery point and transferring product to a storage tank. During driving, there should normally be little or no exposure to gasoline vapour. However, exposures could result if overalls, shoes or gloves have been contaminated by spillages. Exposures during transfer of product to storage tanks may occur whilst connecting and disconnecting hoses, or from occasional small spillages. Depending on the relative location of storage tank vents, there may be a potential for exposure to displaced gasoline vapours. At service stations, low levels of gasoline vapour may also be present from the normal throughput of customer vehicles whilst the delivery is being made.

Job Group No. 7 - Service Station Attendants

Service station attendants may be exposed to gasoline vapour during the filling of customers' vehicles and whilst handling payments or conducting other general duties such as cleaning. Exposures can be expected to vary depending on factors such as throughput of vehicles, ambient/product temperatures, wind conditions, the degree to which the station may be enclosed, and the extent of any spillages which occur.

Job Group No. 8 - Ships Closed

This covers exposures of deck crews during loading of ships where automatic ullage measurement is installed, ullage ports and hatches are kept closed, and displaced vapours are vented at a remote point. Exposures can be expected to vary depending on wind conditions, ambient/product temperatures, vent locations in relation to personnel, and the reliability of automatic ullage measurements. Manual ullage checks still appear to be quite common practice because of a lack of confidence that automatic gauging will avoid overfilling of tanks. Exposures may also occur during connection and disconnection of cargo lines.

Job Group No. 9 - Ships Open

This covers exposures during open loading of ships where tank tops, ullage ports or dip hatches are left open and displaced vapours may be vented close to deck level. Crew can be exposed during connection and disconnection of cargo lines, whilst leaning over open hatches to check fill levels, and during tank dipping.

Job Group No. 10 - Barges Closed

This covers similar operations to Job Group No. 8. Decks of barges are generally flatter than for ships and vapour vents may be at a lower level.

Job Group No. 11 - Jettymen

This covers jetty staff who are involved in supervision of loading operations. There is a potential for exposure from displaced vapours and whilst carrying out operations such as sampling and tank dipping and the handling of hoses. The position of vents, wind speed and direction, and ambient/product temperatures are important variables likely to affect the level of exposures of jettymen.

Job Group No. 12 - Railcar Top

This covers operators involved in top loading of railcars. Exposures can occur during operations such as opening/closing of hatches and checking fill levels and during ancillary activities such as controlling movement of cars whilst at track level. Exposures will vary depending on the nature of the installation, for example, the degree of enclosure and automation, the throughput

of railcars, ambient weather conditions and product temperature, the location of other vapour sources in the vicinity, and possibly by occasional spillages. Although daily schedules for railcar loading are likely to vary considerably, operators generally carry out this task for several hours per day.

There is a tendency to adopt bottom loading (with vapour recovery) in place of top loading of railcars. Exposures would be expected to be lower with this system. However, only top loading operations without vapour control/recovery were covered in this survey.

Job Group No. 13 - Drumming

This covers operators filling drums with about 200 litres of gasoline. In the absence of good local exhaust ventilation (as was the case with the limited number of drum filling operations sampled in this survey), the operator is exposed to vapours displaced from the drum by the liquid.

Job Group No. 14 - Production - Onsite

This covers refinery operators who carry out the various tasks involved in controlling plants such as distillation units, crackers and reformers which process hydrocarbon streams to produce gasoline components. Part of the operator's work shift is spent inside the control room which, for safety reasons, is normally slightly pressurised; therefore, during these periods there is no significant exposure to hydrocarbon vapours. Other tasks involve activities on the process units themselves, such as opening and closing valves, collecting of samples, blowing down gauges etc. where there may be potential for exposure, particularly if there are any leaks of liquid or vapour. The division of the operator's time between the control room and the units will vary between plants and specific job responsibilities.

Job Group No. 15 - Production - Offsite

This covers ancillary operations carried out by refinery workers, such as laboratory technicians, employees involved in the control of bulk storage (tank farm) facilities and carrying out tasks such as tank dipping and sampling, and those involved in water effluent treatment such as skimming open oily water separators, e.g. API separators. Potential for exposure will vary with the type of job and the extent to which it involves handling of gasoline or light hydrocarbon refinery streams where they are not entirely contained within process units, pipework or storage tanks.

3. CONCAWE GASOLINE VAPOUR EXPOSURE SURVEY AND DATABASE

The CONCAWE gasoline vapour exposure survey task force collected a total of 540 personal exposure measurements during 1984-85 for personnel involved in the manufacture, distribution and handling of gasoline in 13 European countries. Measurements were obtained using the new exposure monitoring method described in CONCAWE Report No. 8/86 (1), developed by an analytical subgroup of the task force from research technology available from some member companies. In this method, a small low flow rate personal sampling pump is used to draw air from a worker's breathing zone through a sampler containing two beds of solid sorbents specifically selected to trap and retain essentially all components of gasoline vapour. Trapped components are subsequently thermally desorbed and analysed by capillary gas chromatography using a flame ionisation detector. In addition to determination of exposures to total gasoline hydrocarbon vapours, this method also permits specific identification and measurement of up to 150 individual major components. Although liquid gasoline contains many more components, those not included in the 150 which have been identified are either likely to be present at very low concentrations or are higher boiling point compounds which are not normally present in the vapour. A further important feature of this new monitoring method, in contrast to previously used procedures, is the use of technology to ensure that the most volatile vapour components are collected and retained during sampling.

Following analysis of samples at one of four laboratories of CONCAWE member companies, exposure results and ancillary information such as job details, sampling times and ambient weather conditions, were reported according to a standardised protocol. This information was then used to establish a computerised database to enable exposure data to be summarised in various ways, for example by the Job Groups described in Section 2 and for exposures to total hydrocarbons or individual components of the vapour. Statistical treatment of exposure data is also possible, as described in Appendix 1, for example, to predict the probability of a specified level of exposure being exceeded in a particular type of job.

A summary of the exposure information in the computer database on which this report is based is given in Table 1.

4. COMPOSITION OF GASOLINE LIQUID AND VAPOUR

In considering the composition of vapours to which exposures may occur during the manufacture and distribution of gasoline, it is important to appreciate that concentrations of individual components will differ from those in the liquid. The composition of liquid gasolines can vary quite widely depending on the required performance characteristics and product specifications, the crude oils used, the refinery processes available and the overall balance of product demand. However, all gasolines consist of a complex mixture of paraffinic, olefinic, naphthenic and aromatic hydrocarbons, mainly within the carbon atom per molecule range of 3 to 10. For example, paraffinic components range from propane with a boiling point of -42°C to decanes with boiling points around 180°C. Some currently marketed gasolines also contain oxygenated substances such as methanol, ethanol, tertiary-butyl alcohol (TBA) and methyl teriary-butyl ether (MTBE).

When liquid gasoline, which has a normal boiling range of about 25 to 220°C, is exposed to air, the more volatile components vapourise first. Therefore, the vapours to which exposures are likely to occur differ in composition from the liquid and consist mainly of the more volatile, lower boiling point, components. This is illustrated in Table 2 which summarises liquid and vapour composition ranges and mean values for ten European premium gasolines covering winter and summer grades from Denmark, France, West-Germany, Greece, Italy, Norway, Sweden and the UK. Thus, vapour typically contains around 80% by volume of C_3 to C_5 non-aromatic hydrocarbons and less than five percent aromatics compared to corresponding liquid contents of around 26 and 45% by weight respectively.

Table 2 also shows that the composition of gasoline vapour can vary quite widely. One reason for this is that gasoline volatility is adjusted to meet performance requirements according to location and season. In Europe the extremes are represented by low vapour pressure required in hot Southern countries in summer and high vapour pressure for Northern countries in winter.

5. EXPOSURE LIMITS FOR GASOLINE AND ITS COMPONENTS

Because of the complex and variable composition of gasoline there is no widely accepted exposure limit which is generally applicable. Limits which have been set are:

1. In the USA, the American Conference of Governmental Industrial Hygienists (ACGIH) has set an 8-hour time-weighted average Threshold Limit Value (TLV-TWA) of 900 mg/m^3 (300 ppm) and a Short Term Exposure Limit (TLV-STEL) over a 15 minutes period of 1500 mg/m^3 (500 ppm) (2). These limits are based on the composition of liquid gasoline in the USA which generally has a lower aromatic content than European gasolines;

2. In Sweden an 8-hour time-weighted average exposure limit of 220 mg/m^3 (about 70 ppm) and an STEL of 300 mg/m^3 (about 100 ppm) have been set. This is based on a typical liquid composition with an assumed aromatic content of 46%.

Both these limits are based on the composition of liquid gasolines which, as has been shown in Section 4, is very different from the vapour to which exposures occur. Potential health risks are related to the composition of inhaled vapour; therefore, the validity of exposure limits based on liquid composition is questionable.

When the composition of the vapour to which exposure occurs is known, a realistic exposure limit can be derived:

a) by assuming that the toxic effects of individual vapour components are additive, i.e. act upon the same organ system such as the central nervous system effects of hydrocarbons, calculate a general exposure limit using the additive formula recommended by ACGIH (2). This gives the exposure limit for a mixture as the total vapour concentration which results in

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \ldots \frac{C_n}{T_n} = 1$$

where C_n is the vapour concentration of an individual component and T_n its corresponding exposure limit value. The exposure limit for the mixture is exceeded if the sum of these fractions exceeds unity. The composite exposure limit for the mixture is given by the following, derived directly from the ACGIH additive formula:

$$\text{Composite Exposure Limit} = \frac{1}{\frac{F_1}{T_1} + \frac{F_2}{T_2} + \frac{F_3}{T_3} + \frac{F_n}{T_n}}$$

where F_n is the fraction of an individual component in a vapour mixture and T_n its corresponding exposure limit value.

b) by checking that individual exposure limits for components which have independent toxic effects, such as benzene and n-hexane, are not exceeded. If necessary, the general limit calculated in a) must be reduced until limits for independently toxic components are also met.

In order to use the ACGIH additive formula to calculate an exposure limit for the mean European vapour composition given in Table 2 it is necessary to assign exposure limits to each component group. Exposure limits established in the USA and Europe for gasoline components are summarised in Table 3.

Although exposure limits have not been established for all components of gasoline, both non-aromatic and aromatic types of compound in each carbon number group are represented in Table 3. By assuming that it is reasonable to use the same exposure limits for similar types of compounds with the same carbon numbers, an exposure limit of 1700 mg/m^3 (about 600 ppm) is obtained for the mean vapour composition in Table 2. This is considerably higher than the USA or Swedish limits, illustrating the difference between using the composition of the vapour instead of the liquid. If the same calculation is made using the mean liquid gasoline composition given in Table 2, the exposure limit is reduced to 500 mg/m^3 (about 130 ppm).

In summary, it is considered that the most appropriate guidelines against which to compare exposure data obtained in this survey are the calculated 1700 mg/m^3 limit for total hydrocarbons and established individual limits for components which may have independent toxic effects.

6. GASOLINE VAPOUR EXPOSURE SURVEY RESULTS

6.1 COMPOSITION OF GASOLINE VAPOUR EXPOSURES

The mean composition, in volume per cent normalised to 100%, of the gasoline vapour exposures measured for the 15 job groups is shown in Table 4. These are summarised by carbon number groups for non-aromatic and aromatic compounds, plus oxygenates and components not specifically identified. The overall mean gives the arithmetic mean of the 15 job groups.

Although there are variations, Table 4 shows clearly that exposures are predominantly to lower carbon number non-aromatic components. A number of factors can be expected to cause variations in the compositions of vapour exposures, such as the time periods over which vaporisation and exposures occur, the proximity of the exposed person to the source of the vapour, ambient weather conditions and exposures to other petroleum products, process streams or solvents. The higher percentages of unidentified components which are associated with reduced proportions of lower carbon number non-aromatics in some job groups are probably related to handling of other products such as kerosines and solvents during the monitoring period.

6.2 LEVELS OF EXPOSURES

Data on levels of exposures (in mg/m^3) are summarised by job groups in the following tables:

Table 5 presents a summary of exposures to total hydrocarbons, including statistical analyses;

Tables 6.1 to 6.6 show minimum, maximum and arithmetic mean exposures to each of the 150 identified components and total hydrocarbons;

Table 7 gives minimum, maximum and arithmetic mean exposures to the main groups of components, to individual compounds which have independent toxic effects, and to total hydrocarbons.

6.2.1 Total hydrocarbon exposures

The summary in Table 5 includes data obtained from statistical analyses made by computer using the techniques outlined in Appendix 1. Parameters calculated were:

- arithmetic and geometric means;
- standard and geometric deviations;

- best fit lines and fit factors for normal and log-normal distribution plots of exposure against cumulative frequency of occurrence.

In most cases the typical better fit of exposure data with a lognormal distribution was found. These plots were used to determine the exposure levels exceeded (or predicted to be exceeded) in 10, 5 and 1% of cases and the percentage, or predicted percentage, of exposures exceeding 100, 300, 500, 1000 and 3000 mg/m^3.

There are several important points in relation to the data presented in Table 5:

1. the Arithmetic Mean is the average of the exposure measurements for the group and is usually considered (where the data cover a full work shift) to be an indicator of the most likely average long-term exposure, i.e. over more than one week. However, it should be noted that, particularly where the number of samples is small, the arithmetic mean can be subject to appreciable distortion if unusually low or high measurements happen to be included;

2. the Geometric Mean is the value above and below which 50% of the data lie and is the most likely level of any single exposure measurement. It is lower than the arithmetic mean by an amount which reduces as the variability of the data decreases;

3. the Geometric Standard Deviation (GSD) gives an indication of the variability of the data, ranging from 1 (when all data values are the same) upwards as variability increases. For outdoor operations, in which many factors contribute to variability of exposure data, GSDs of up to 5 are common.

For the long-term operation Job Groups No. 4 to No. 15, the data in Table 5 show that:

- the arithmetic mean exposures are well below the total gasoline vapour 8-hour TWA exposure limit of 1700 mg/m^3 calculated in Section 5 using the mean gasoline vapour composition given in Section 4;

- the highest arithmetic mean of 858 mg/m^3 is for drumming (Job Group No. 13). However, these measurements are considered not to be typical of properly equipped drum filling plant because they were all obtained during operations without proper vapour control systems. Limited measurements, not yet included in the database, indicate that exposures are much lower in properly equipped plant;

- The arithmetic exposure for Job Group No. 6 (road delivery) is unexpectedly higher than for Job Groups 4 and 5 (road top and bottom >1 hr) which cover the same operations but with the additional potential exposures during vehicle loading. This anomaly appears to be largely due to one extremely high road delivery exposure measurement of 3615 mg/m^3. This is the highest single exposure recorded in the complete survey and suggests that an unusual event, such as a spillage, may have occurred;

- the arithmetic mean exposures of Job Groups Nos. 8 (ships closed) and 10 (barges closed) are unexpectedly higher than that for Job Group No. 9 (ships open). However, the number of measurements is small (9, 11 and 8 respectively) and the anomaly may be due to some untypically high results for closed loading and/or unusually low results for open loading or continued use of manual ullaging even where automatic gauging is installed, as discussed under Job Group No. 8 in Section 2.2;

- statistical analyses indicate that 95% of exposures (a common professional industrial hygiene approach to assessing compliance with an exposure limit, discussed in Appendix 1) are well below the 1700 mg/m^3 limit except for drumming (considered non-typical of properly equipped plant, as discussed above) and for Job Group No. 10 (barges closed). For the latter it is predicted that 5% of exposures could be expected to exceed 2100 mg/m^3; however, this prediction is based on extrapolation from only 11 measurements and its reliability is therefore questionable.

For the short-term operation Job Groups No. 1, 2 and 3, the data in Table 5 show that:

- the arithmetic mean exposures are well below the total gasoline vapour 8-hour TWA exposure limit of 1700 mg/m^3 calculated in Section 5;

- statistical analyses indicated that 95% of exposures are well below the 8-hour TWA limit. For the highest exposure group (Job Group No. 1, road top <1hr) 95% of exposures were below 1100 mg/m^3. It should be noted that for an 8-hour TWA exposure limit of the order of 1700 mg/m^3 a short-term limit would typically be set by ACGIH at a level of 25 to 50% higher.

6.2.2 Exposures to components with independent toxic effects

Gasoline vapour components which are considered to have independent toxic effects are benzene and n-hexane. Summarised exposure data on these components for each job group, included in Table 7, are discussed below.

6.2.2.1 Benzene

Benzene exposure data, including information obtained from statistical analysis, are summarised in Table 8. These data have previously been included in a comprehensive review by CONCAWE of European oil industry benzene exposure data (3). The data in Table 8 generally support the conclusions reached from the more comprehensive review. These can be summarised briefly as:

- 8-hour TWA exposures should not normally exceed the proposed EEC Directive "Limit Value" of 5 ppm (16 mg/m^3) although drum filling and marine loading may require further attention;
- 8-hour TWA exposures of service station attendants are clearly normally below the proposed EEC "Action Level" of 1 ppm (3 mg/m^3);
- road tanker drivers and refinery operators are unlikely to exceed an 8-hour TWA exposure of 1 ppm;
- under some conditions, an 8-hour TWA exposure of 1 ppm is likely to be exceeded in marine and railcar loading, and in drum filling without efficient local exhaust ventilation.

6.2.2.2 n-Hexane

8-hour TWA exposure limits for n-hexane (see Table 3) range from 176 to 360 mg/m^3. Data in Table 7 indicate that, for long-term operations, the highest arithmetic mean exposure (apart from drum filling) was 6.3 mg/m^3 for Job Group No. 10 (barges closed) and the highest maximum exposure recorded was 154.3 mg/m^3 in Job Group 14 (production on-site). Therefore, in all normal operations, exposures to n-hexane are well below established limits. In the non-typical drum filling operations, the arithmetic mean exposure was 51.8 mg/m^3 with a maximum measured of 297 mg/m^3.

6.2.3 Exposures to toluene, xylenes and trimethylbenzenes

Although there is no evidence that toluene, xylenes and trimethylbenzenes have independent toxic effects similar to benzene, the fact that they are higher molecular weight homologues containing, respectively, one, two and three methyl groups, has resulted in interest in exposure levels.

6.2.3.1 Toluene

Table 3 shows that established 8-hour TWA exposure limits for toluene range from 300 to 375 mg/m^3. The highest arithmetic mean exposure shown in Table 7 of 41.3 mg/m^3 and the highest maximum exposure of 194.8 mg/m^3 (both for Job Group No. 13, drumming) clearly show that exposures are well below these limits.

6.2.3.2 Xylenes

Established 8-hour TWA exposure limits shown in Table 3 for xylenes are from 350 to 440 mg/m^3. The maximum exposure to xylenes shown in Table 7, 17.6 mg/m^3 for Job Group No. 12 (railcar top), clearly shows that exposures are well below these limits.

6.2.2.3 Trimethylbenzenes

Table 3 indicates established 8-hour TWA exposure limits for trimethylbenzene as 120 or 125 mg/m^3. From Table 7, the highest arithmetic mean exposure for long-term operations (apart from drum filling) was 7.8 mg/m^3 for Job Group No. 6 (road delivery) for which the highest maximum exposure of 176.8 mg/m^3 was also recorded. In drum filling the arithmetic mean exposure was 24.25 mg/m^3 and the maximum 131.7 mg/m^3. These data show that exposures to trimethylbenzenes are well below established exposure limits.

7. REFERENCES

1. CONCAWE (1986) Method for monitoring exposure to gasoline vapour in air. Report No. 8/86. The Hague: CONCAWE

2. ACGIH (1985) Threshold limit values for chemical substances in the work environment adopted by ACGIH for 1985-6. Cincinnati, OH: American Conference of Governmental Industrial Hygienists

3. CONCAWE (1986) Review of European oil industry benzene exposure data. Report No. 3/86. The Hague: CONCAWE

Table 1 Exposure information in the computer database

JOB GROUP	No. of Exposure Measurements	Mean Sampling Duration (Mins)	Range of Sampling Durations (Mins)
A: Short Term Operations			
1. Road Top <1 hr	142	24	6- 60
2. Road Btm <1 hr	59	27	8- 60
3. Service Stn. Self-fill	21	2	1- 8
B: Long Term Operations			
4. Road Top >1 hr	63	308	65-540
5. Road Btm >1 hr	34	416	75-678
6. Road Delivery	29	169	23-347
7. Service Stn. Attendant	13	252	84-492
8. Ships Closed	9	98	26-255
9. Ships Open	8	340	78-580
10. Barges Closed	11	262	22-440
11. Jettymen	21	155	19-475
12. Railcar Top	32	271	15-510
13. Drumming	9	85	34-244
14. production - Onsite	62	377	51-503
15. Production - Offsite	27	386	35-515

Table 2 Summarised liquid and vapour compositions for European gasolines

Component Group	Liquid Gasoline wt %		Gasoline Vapour vol % (b)	
	Range	Mean (a)	Range	Mean (a)
Non-aromatics				
C.No 3	0 - 0.1	0.06	0 - 4.8	1.6
iso 4	0.1 - 2.9	1.6	1.8 - 23.5	15.5
4	0.9 - 8.1	5.4	15.2 - 44.5	34.9
iso 5	7.3 - 11.7	9.4	16.7 - 30.4	23.3
5	4.5 - 12.4	9.7	6.4 - 26.8	15.4
6	7.8 - 17.4	14.2	1.3 - 18.1	6.8
7	4.4 - 11.9	7.9	0.1 - 1.7	0.9
8	1.4 - 7.1	3.9	0 - 0.4	0.2
9	0.1 - 2.1	0.9		
10	0 - 2.6	0.4		
Aromatics				
C.No 6	1.5 - 6.5	4.0	0.1 - 2.3	0.7
7	8.3 - 16.8	12.2	0.1 - 2.2	0.8
8	10.3 - 20.8	14.6	0 - 0.4	0.3
9	4.6 - 15.4	9.2	0 - 0.1	
10	0.6 - 8.9	3.3		
MTBE	0 - 5.8	5.4	0 - 5.8	5.4

Notes:

(a) Mean for samples which contain the component.
(b) For six of the ten samples vapour compositions were measured. For the other four samples they were predicted using Raoult's Law for evaporation from a bulk liquid surface in a closed system under equilibrium conditions.

Table 3 National exposure limits for gasoline components

COMPONENT NUMBERS [a]	COMPONENT OR GROUP	NATIONAL EXPOSURE LIMITS [b] (mg/m^3)							8-HOUR (TWA) OR SHORT TERM
		EEC	US	UK	WG	FR	SW	NL	
2, 3, 4, 5, 6, 7,	BUTANES	-	1900	1430	2350	-	-	1400	TWA
			-	1700	-	-	-	-	STEL
8, 9, 10, 11, 13, 14	PENTANES	-	1800	1800	2950	-	1800	1800	TWA
15, 16, 18,			2250	2250	-	-	2000	-	STEL
17, 19, 20, 22, 23,	HEXANES	-	1800	-	-	-	1100	-	TWA
24, 26-34, 36, 37, 39, 43			3600	-	-	-	1300	-	STEL
35, 38, 41, 42, 44,	HEPTANES	1600	1600	1600	2000	-	1200	1600	TWA
46-49, 51-57, 59-62, 66			2000	2000	4000	-	1600	-	STEL
45, 64, 65, 67-80	OCTANES	-	1450	1450	2350	-	1400	1450	TWA
			1800	1800	4700	-	1800	-	STEL
81, 83-88	NONANES	-	1050	-	-	-	1100	1050	TWA
			1300	-	-	-	1300	-	STEL
	DECANES	-	-	-	-	-	500	-	TWA
	AND ABOVE	-	-	-	-	-	625	-	STEL
21	CYCLOPENTANE	-	1720	-	-	-	-	860	TWA
			2580	-	-	-	-	-	STEL
40	CYCLOHEXANE	1050	1050	1050	1050	1050	1050	1050	TWA
			1300	1300	2100	1300	1300	-	STEL
56	CYCLOHEXENE	-	1015	1015	1015	-	-	1015	TWA
			-	-	2030	-	-	-	STEL
25	n-HEXANE	260	180	360	180	176	180	360	TWA
			-	450	360 [c]	-	250	-	STEL
58	BENZENE	-	30	30	16 [c]	16	16	30	TWA
			75	-	-	-	30	-	STEL
82	TOLUENE	375	375	375	375	375	300	375	TWA
90, 91, 93	XYLENES	435	435	435	440	435	350	430	TWA
			650	650	880	650	450	-	STEL
97	ISOPROPYLBENZENE	-	245	245	-	-	120	245	TWA
	(CUMENE)		365	365	-	-	170	-	STEL
103, 107, 111	TRIMETHYLBENZENES		125	125	-	-	120	-	TWA
			170	125	-	-	170	-	STEL
142	NAPHTHALENE	50	50	50	50	50	-	50	TWA
			75	75	100	-	-	-	STEL
ALL	GASOLINE		900	-	-	-	220	-	TWA
			1500	-	-	-	300	-	STEL

Notes:

(a) Component numbers refer to those used in Tables 6.1 to 6.6 for 150 gasoline components.

(b) US = American Conference of Governmental Industrial Hygienists, Threshold Limit Values. 1985/86.
UK = United Kingdom Health and Safety Executive Guidance. Guidance Note EH40 1985 Occupational Exposure Limits.
FR = France. 1985 Exposure Limits.
SW = Sweden. Arbetarskddsstyrelsens ordinance AFS 1984/85.
NL = Netherlands Labour Inspectorate. 1985 MAC values.
EEC = Proposed Directive for harmonisation of exposure limits, Amendment to 80/1107/EEC dated 30/5/86.
WG = W. Germany. 1985 MAK values.

(c) W. Germany. 1985 TRK value.

Note: This table is not intended to be comprehensive but only a guide.

Table 4 Mean vapour compositions of exposures in volume % (normalised to 100%) by Job Groups

SUBSTANCE GROUP	JOB GROUP NUMBER: 1 ROAD: TOP <1 Hour	4 >1 Hour	2 BOTTOM <1 Hour	5 >1 Hour	6 DELIVERY	12 RAILCAR TOP	7 S.STN. ATTENDANT	3 S.STN. SELF-FILL	9 SHIPS OPEN	8 CLOSED	10 BARGES CLOSED	11 JETTYMEN	13 DRUMMING	14 PRODUCTION ONSITE	15 OFFSITE	OVERALL MEAN
C3 NON AROMATICS	1.75	1.35	0.68	0.64	1.03	1.03	1.52	3.37	0.41	0.86	0.91	3.11	0.18	3.87	0.88	1.44
C4 NON AROMATICS	48.13	41.74	16.14	43.58	30.58	38.95	36.25	47.09	22.74	55.36	29.58	32.55	26.45	33.54	25.15	35.19
C5 NON AROMATICS	29.16	28.00	16.41	24.35	17.59	29.54	33.44	26.23	32.56	25.19	36.05	32.66	22.50	22.48	15.64	26.12
C6 NON AROMATICS	8.75	10.59	7.43	8.58	12.21	11.91	7.49	9.66	12.64	7.62	10.21	15.69	21.88	20.25	14.61	11.97
C7 NON AROMATICS	1.81	2.38	2.14	2.76	2.32	2.91	1.90	1.65	3.16	2.02	2.77	2.92	4.58	2.57	5.99	2.79
C8 NON AROMATICS	0.28	0.92	1.68	1.53	0.35	1.28	0.58	0.81	1.66	0.54	1.62	1.44	0.57	0.38	3.45	1.14
C9 NON AROMATICS	0.12	0.21	5.29	0.62	0.04	0.67	0.18	0.14	0.74	0.22	0.09	0.38	0.07	0.17	1.94	0.73
C10 NON AROMATICS	0.12	0.17	2.60	0.34	0.01	0.44	0.00	0.03	0.77	0.07	0.09	0.10	0.09	0.28	2.49	0.51
C11 NON AROMATICS	0.00	0.00	0.05	0.00	0.00	0.00	0.21	0.07	0.39	0.00	0.01	0.03	0.00	0.00	0.00	0.05
C12 NON AROMATICS	0.05	0.03	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.10	0.05	0.02
C6 AROMATICS	1.35	1.47	1.88	1.85	2.32	1.71	1.20	1.77	1.25	1.37	1.80	1.27	3.17	1.66	1.47	1.70
C7 AROMATICS	2.51	3.28	8.50	2.30	4.69	3.41	1.99	1.63	2.58	1.24	2.22	2.00	4.81	3.80	3.32	3.22
C8 AROMATICS	1.16	1.59	8.31	2.32	3.56	2.14	0.61	0.49	2.88	0.63	0.83	1.46	2.83	1.77	3.73	2.29
C9 AROMATICS	0.31	0.61	5.88	1.08	0.65	1.15	0.20	0.15	1.05	0.11	0.25	0.66	0.34	0.86	3.11	1.09
C10 AROMATICS	0.25	0.07	0.00	0.00	0.00	0.02	3.46	0.22	0.00	0.03	0.00	0.00	0.00	0.99	0.71	0.38
C11 AROMATICS	0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.05	0.02	0.01
C12 AROMATICS	0.00	0.03	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.07	0.01
OXYGENATES	0.69	1.09	0.02	0.39	3.41	0.00	0.00	0.70	0.00	0.00	6.15	0.52	2.19	0.00	0.00	1.01
UNIDENTIFIED	3.53	6.42	22.98	9.66	21.24	4.84	10.90	5.95	17.19	4.75	7.42	5.22	10.34	7.18	17.36	10.33

Table 5 Summary of total hydrocarbon exposure data (mg/m^3)

OPERATION	No. of Samples	Arithmetic Mean (mg/m^3)	Standard Deviation (mg/m^3)	Geometric Mean (mg/m^3)	Geometric S.D (mg/m^3)	Exposure levels (mg/m^3) exceeded by: 10%	5%	1%	Percentages of exposures exceeding: 100	300	500	1000	3000 (mg/m^3)[b]
Short-term													
1. Road top <1 hr	142	451	411	294	2.8	880	1100	2200	86	57	35	8	1
2. Road bottom <1 hr	59	76	65	51	2.6	175	225	240[a]	32	0	0	0	0
3. Service Station self-fill	21	244	205	178	2.3	570	670	ID[c]	81	33	19	0	0
Long-term													
4. Road top >1 hr	63	118	173	60	3.4	280	335	1250[a]	38	10	2	2	0
5 Road bottom >1 hr	34	66	138	18	5.3	160	345	1200[a]	18	6	3	0	0
6. Road delivery	29	219	670	49	4.8	420	860	ID[c]	22	10	10	3	3
7. Service Station attendant	13	29	26	23	2.1	62	102[a]	ID[c]	8	0	0	0	0
8. Ships closed	9	340	361	148	6.3	980	1025[a]	ID[c]	78	38	25	13	0
9. Ships open	8	118	101	70	4.0	300	390[a]	ID[c]	38	13	0	0	0
10. Barges closed	11	263	554	36	10.9	1100	2100[a]	ID[c]	36	18	18	9	0
11 Jettymen	21	120	167	39	5.5	330	480	ID[c]	38	14	5	0	0
12. Railcar top	32	85	126	32	4.8	315	400	660[a]	22	13	3	0	0
13. Drumming	9	858	539	581	3.1	1600	1900[a]	ID[c]	78	78	78	33	0
14. Production - onsite	62	53	237	8.2	3.9	58	135	2100[a]	6	3	2	2	0
15. Production - offsite	27	66	176	22	3.3	150	260	ID[c]	11	4	4	0	0

Notes:

(a) Extrapolated from data distribution on probability graph
(b) Equivalent values in ppm not calculated due to variable molecular weights
(c) ID - Insufficient data for extrapolation

Table 6, 1 - 6 Minimum, maximum and mean exposures of the 15 job groups for the 150 identified components and total hydrocarbons

All values in mg/m^3

Table 6 - 1

COMPONENT GROUP	Group 1: ROAD TOP <1 Hour Min	Max	Mean	Group 2: ROAD BOTTOM <1 Hour Min	Max	Mean	Group 3: S. STN. SELF-FILL Min	Max	Mean
1 PROPANE	0.000	106.250	7.902	0.000	9.500	0.514	0.000	42.360	8.226
2 ISOBUTANE	0.000	662.800	67.769	0.000	24.700	3.674	2.680	148.620	34.390
3 N BUTANE	0.000	953.700	122.473	0.730	33.500	7.580	2.280	256.220	74.041
4 BUTENE-1	0.000	302.240	13.367	0.000	2.100	0.036	0.000	0.000	0.000
5 ISOBUTENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6 TRANS BUTENE-2	0.000	142.240	7.513	0.000	3.620	0.464	0.000	20.010	2.821
7 CIS BUTENE-2	0.000	56.250	4.427	0.000	3.120	0.355	0.000	16.470	2.117
8 3 METHYL BUTENE 1	0.000	2.760	0.193	0.000	0.760	0.039	0.000	3.330	0.408
9 ISOPENTANE	0.050	618.100	80.273	0.000	46.450	8.295	7.120	151.970	42.716
10 N PENTANE	0.000	325.800	43.989	0.000	16.540	3.557	2.430	45.550	15.018
11 PENTENE-1	0.000	2.080	0.015	0.000	0.000	0.000	0.000	0.000	0.000
12 1 3 BUTADIENE	0.000	32.320	1.419	0.000	2.980	0.181	0.000	10.630	1.589
13 2 METHYL BUTENE-1	0.000	4.800	0.038	0.000	1.400	0.024	0.000	0.000	0.000
14 TRANS PENTENE-2	0.000	11.380	1.416	0.000	3.710	0.232	0.000	11.840	1.928
15 CIS PENTENE-2	0.000	6.480	0.691	0.000	2.050	0.123	0.000	6.490	0.817
16 2 METHYL BUTENE-2	0.000	19.370	2.649	0.000	0.410	0.007	0.000	11.750	1.726
17 2 2 DIMETHYL BUTANE	0.000	11.770	0.533	0.000	5.960	0.349	0.000	17.780	2.476
18 CYCLOPENTENE	0.000	10.710	0.179	0.000	0.000	0.000	0.000	0.000	0.000
19 2 3 DIMETHYL BUTANE	0.000	35.900	5.796	0.000	4.500	0.828	0.000	6.650	1.700
20 2 METHYL PENTANE	0.000	78.200	9.312	0.000	13.720	1.353	1.110	22.260	8.159
21 CYCLOPENTANE	0.000	17.060	1.996	0.000	3.150	0.222	0.000	4.610	1.425
22 2 3 DIMETHYL BUTENE-1	0.000	3.700	0.096	0.000	0.140	0.002	0.000	1.650	0.079
23 4 METHYL PENTENE-2	0.000	8.200	0.285	0.000	0.930	0.048	0.000	0.670	0.065
24 3 METHYL PENTANE	0.000	78.600	8.145	0.000	7.140	1.025	0.500	13.950	4.698
25 N HEXANE	0.000	47.400	8.293	0.000	6.500	1.275	0.000	15.900	3.348
26 2 METHYL PENTENE-1	0.000	11.810	0.112	0.000	0.000	0.000	0.000	0.860	0.041
27 TRANS HEXENE-3	0.000	6.400	0.129	0.000	2.300	0.100	0.000	13.630	0.751
28 CIS HEXENE-3	0.000	0.130	0.001	0.000	0.000	0.000	0.000	0.000	0.000
29 TRANS HEXENE-2	0.000	10.300	0.199	0.000	1.100	0.105	0.000	1.570	0.173
30 2 METHYL PENTENE-2	0.000	2.000	0.059	0.000	0.930	0.061	0.000	1.330	0.149
31 CIS 3 METHYL PENTENE-2	0.000	2.400	0.108	0.000	0.000	0.000	0.000	0.810	0.140
32 TRANS 4 METHYL CYCLOPENTENE	0.000	0.640	0.016	0.000	0.960	0.056	0.000	1.260	0.261
33 TRANS 3 METHYL PENTENE-2	0.000	6.200	0.200	0.000	0.000	0.000	0.000	0.660	0.086
34 CIS HEXENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 2 4 DIMETHYLPENTANE	0.000	18.500	0.496	0.000	1.450	0.102	0.000	2.150	0.358
36 METHYL CYCLOPENTANE	0.000	26.800	4.158	0.000	4.490	0.436	0.000	4.450	1.349
37 2 3 DIMETHYL BUTENE-2	0.000	1.310	0.012	0.000	0.000	0.000	0.000	1.180	0.101
38 2 METHYL HEXANE	0.000	15.700	1.226	0.000	2.440	0.315	0.000	1.770	0.114
39 CIS 4 METHYL CYCLOPENTENE	0.000	0.143	0.004	0.000	0.000	0.000	0.000	0.000	0.000
40 CYCLOHEXANE	0.000	24.800	1.961	0.000	1.160	0.020	0.000	0.000	0.000
41 2 3 DIMETHYL PENTANE	0.000	23.600	1.483	0.000	2.560	0.236	0.000	3.890	0.835
42 4 METHYL HEXENE-2	0.000	1.490	0.089	0.000	1.030	0.063	0.000	1.170	0.276
43	0.000	1.000	0.017	0.000	0.000	0.000	0.000	0.000	0.000
44 3 METHYL HEXANE	0.000	19.500	2.315	0.000	2.950	0.493	0.000	5.820	0.898
45 2 2 4 TRIMETHYL PENTANE	0.000	7.070	0.720	0.000	4.290	0.686	0.000	13.850	1.637
46 4 METHYL HEXENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.002
47 TRANS 1 3 DIMETHYL CYCLOPENTANE	0.000	5.400	0.097	0.000	0.280	0.005	0.000	0.000	0.000
48 CIS 1 3 DIMETHYL CYCLOPENTANE	0.000	0.560	0.009	0.000	0.680	0.043	0.000	4.210	0.373
49 TRANS 1 2 DIMETHYL CYCLOPENTANE	0.000	0.980	0.018	0.000	0.480	0.038	0.000	3.050	0.197
50 CYCLOHEXENE	0.000	0.960	0.028	0.000	0.050	0.001	0.000	0.000	0.000
51 2 METHYL HEXENE-1	0.000	0.130	0.001	0.000	0.350	0.008	0.000	0.000	0.000
52 2 3 DIMETHYL PENTENE-2	0.000	0.101	0.002	0.000	0.050	0.002	0.000	0.000	0.000
53 N HEPTANE	0.000	14.900	1.486	0.000	1.770	0.106	0.000	9.150	0.863
54 3 METHYL HEXENE-1	0.000	6.300	0.062	0.000	0.000	0.000	0.000	0.000	0.000
55 3 METHYL HEXENE-3	0.000	2.000	0.016	0.000	0.180	0.011	0.000	0.000	0.000
56 CIS 1 2 DIMETHYL CYCLOPENTANE	0.000	1.640	0.027	0.000	0.270	0.018	0.000	0.000	0.000
57 HEPTENE-3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58 BENZENE	0.000	60.500	6.098	0.000	5.480	1.434	0.000	13.130	4.325
59 2 METHYL HEXENE-2	0.000	0.800	0.063	0.000	0.440	0.009	0.000	0.000	0.000
60 HEPTENE-2	0.000	0.120	0.003	0.000	0.300	0.015	0.000	0.230	0.011
61 3 METHYL HEXENE 2	0.000	4.600	0.054	0.000	0.250	0.016	0.000	0.000	0.000
62 C7 OLEFINE	0.000	0.252	0.016	0.000	0.320	0.022	0.000	0.730	0.044
63 METHYL CYCLOHEXANE	0.000	18.800	0.673	0.000	1.120	0.109	0.000	0.550	0.066
64 2 5 DIMETHYL HEXANE	0.000	2.000	0.022	0.000	0.230	0.004	0.000	0.630	0.030
65 2 4 DIMETHYL HEXANE	0.000	0.320	0.022	0.000	0.950	0.052	0.000	0.570	0.043
66 ETHYL CYCLOPENTANE	0.000	0.420	0.017	0.000	0.320	0.017	0.000	0.000	0.000
67 1 2 4 TRIMETHYL CYCLOPENTANE	0.000	0.210	0.004	0.000	0.200	0.004	0.000	0.000	0.000
68 2 3 4 TRIMETHYL PENTANE	0.000	3.300	0.046	0.000	0.810	0.024	0.000	0.000	0.000
69 2 3 3 TRIMETHYL PENTANE	0.000	1.400	0.018	0.000	0.050	0.001	0.000	0.000	0.000
70 2 3 DIMETHYL HEXANE	0.000	0.550	0.012	0.000	0.570	0.027	0.000	0.530	0.025
71 2 METHYL HEPTANE	0.000	4.000	0.121	0.000	1.300	0.120	0.000	0.260	0.012
72 4 METHYL HEPTANE	0.000	0.950	0.031	0.000	0.470	0.008	0.000	0.000	0.000
73 3 4 DIMETHYL HEXANE	0.000	0.890	0.016	0.000	0.400	0.022	0.000	0.000	0.000
74 3 METHYL HEPTANE	0.000	0.646	0.033	0.000	0.410	0.026	0.000	0.000	0.000
75 TRANS 1 3 DIMETHYL CYCLOHEXANE	0.000	1.430	0.028	0.000	0.460	0.011	0.000	0.050	0.007

Table 6 - 1 cont'd

COMPONENT GROUP	Group 1: ROAD TOP <1 Hour Min	Max	Mean	Group 2: ROAD BOTTOM <1 Hour Min	Max	Mean	Group 3: S. STN. SELF-FILL Min	Max	Mean
76 CIS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	3.100	0.043	0.000	0.320	0.010	0.000	3.630	0.222
77 TRANS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	0.520	0.006	0.000	0.160	0.008	0.000	0.000	0.000
78 N OCTANE	0.000	3.790	0.129	0.000	1.920	0.263	0.000	0.000	0.000
79 C8 OLEFINE	0.000	0.180	0.002	0.000	0.050	0.002	0.000	0.000	0.000
80 TRANS 1 2 DIMETHYL CYCLOHEXANE	0.000	0.108	0.002	0.000	0.260	0.009	0.000	0.000	0.000
81 2 4 DIMETHYL HEPTANE	0.000	7.310	0.051	0.000	0.000	0.000	0.000	0.000	0.000
82 TOLUENE	0.000	63.100	11.335	0.005	43.700	6.472	0.050	17.440	3.991
83 2 6 DIMETHYL HEPTANE	0.000	9.500	0.173	0.000	0.470	0.041	0.000	1.270	0.346
84 3 5 DIMETHYL HEPTANE	0.000	0.530	0.007	0.000	0.110	0.006	0.000	0.000	0.000
85 2 METHYL OCTANE	0.000	3.600	0.082	0.000	3.110	0.414	0.000	0.000	0.000
86 4 METHYL OCTANE	0.000	9.700	0.115	0.000	0.000	0.000	0.000	0.000	0.000
87 3 METHYL OCTANE	0.000	3.570	0.044	0.000	2.270	0.377	0.000	0.000	0.000
88 N NONANE	0.000	1.100	0.047	0.000	19.220	3.192	0.000	0.000	0.000
89 ETHYL BENZENE	0.000	12.300	0.947	0.000	6.000	0.962	0.000	0.250	0.022
90 M XYLENE	0.000	18.800	3.237	0.000	11.300	2.363	0.000	3.290	0.926
91 P XYLENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.650	0.031
92 DIMETHYL OCTANE	0.000	0.450	0.006	0.000	0.050	0.002	0.000	1.380	0.066
93 O XYLENE	0.000	9.000	1.039	0.000	13.200	3.000	0.000	1.290	0.215
94 4 METHYL NONANE	0.000	0.000	0.000	0.000	1.570	0.027	0.000	0.000	0.000
95 2 METHYL NONANE	0.000	4.030	0.051	0.000	0.050	0.001	0.000	0.000	0.000
96 TRIMETHYL HEPTANE	0.000	4.150	0.133	0.000	8.300	1.400	0.000	0.000	0.000
97 ISOPROPYL BENZENE	0.000	6.500	0.358	0.000	27.100	3.435	0.000	0.250	0.012
98 3 METHYL NONANE	0.000	2.080	0.022	0.000	0.000	0.000	0.000	0.000	0.000
99 N-DECANE	0.000	5.900	0.320	0.000	4.000	0.552	0.000	0.190	0.011
100 N PROPYL BENZENE	0.000	4.200	0.198	0.000	10.600	0.692	0.000	0.340	0.016
101 1 METHYL 3 ETHYL BENZENE	0.000	5.000	0.254	0.000	0.000	0.000	0.000	0.000	0.000
102 1 METHYL 4 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
103 1 3 5 TRIMETHYL BENZENE	0.000	1.470	0.038	0.000	2.060	0.171	0.000	1.920	0.115
104 C11 PARAFFIN	0.000	0.310	0.005	0.000	0.470	0.014	0.000	1.320	0.063
105 C11 PARAFFIN	0.000	0.330	0.006	0.000	0.480	0.027	0.000	0.770	0.076
106 1 METHYL 2 ETHYL BENZENE	0.000	0.850	0.024	0.000	0.380	0.006	0.000	0.000	0.000
107 1 2 4 TRIMETHYL BENZENE	0.000	4.700	0.323	0.000	2.170	0.176	0.000	2.740	0.221
108 SEC BUTYL BENZENE	0.000	0.760	0.008	0.000	0.000	0.000	0.000	0.000	0.000
109 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.410	0.020
110 AROMATIC	0.000	5.200	0.037	0.000	0.000	0.000	0.000	0.000	0.000
111 1 2 3 TRIMETHYL BENZENE	0.000	7.140	0.182	0.000	0.000	0.000	0.000	0.000	0.000
112 N UNDECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
113 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
114 1 METHYL 3 PROPYL BENZENE	0.000	0.238	0.002	0.000	0.000	0.000	0.000	1.340	0.064
115 N BUTYL BENZENE	0.000	0.215	0.004	0.000	0.000	0.000	0.000	0.910	0.113
116 1 3 DIMETHYL 5 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
117 1 METHYL 2 PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
118 1 4 DIMETHYL 2 ETHYL BENZENE	0.000	0.120	0.001	0.000	0.000	0.000	0.000	0.890	0.042
119 1 3 DIMETHYL 4 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.920	0.051
120 1 2 DIMETHYL 4 ETHYL BENZENE	0.000	9.000	0.323	0.000	0.000	0.000	0.000	5.030	0.266
121 C10 AROMATIC	0.000	0.186	0.001	0.000	0.000	0.000	0.000	0.000	0.000
122 C12 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
123 INDENE	0.000	17.900	0.550	0.000	0.000	0.000	0.000	0.000	0.000
124 C12 PARAFFIN	0.000	7.060	0.218	0.000	0.000	0.000	0.000	0.760	0.036
125 1 3 DIMETHYL 2 ETHYL BENZENE	0.000	0.550	0.007	0.000	0.000	0.000	0.000	0.000	0.000
126 1 2 4 5 TETRAMETHYL BENZENE	0.000	1.670	0.029	0.000	0.000	0.000	0.000	0.000	0.000
127 1 2 3 5 TETRAMETHYL BENZENE	0.000	3.700	0.090	0.000	0.000	0.000	0.000	0.000	0.000
128 N DODECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
129 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
130 C10 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
131 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.180	0.009
132 INDENE	0.000	2.700	0.056	0.000	0.000	0.000	0.000	0.000	0.000
133 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
134 2 3 DIHYDRO 4 METHYL INDENE	0.000	0.140	0.001	0.000	0.000	0.000	0.000	0.220	0.010
135 DIMETHYL PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
136 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.280	0.013
137 2 3 DIHYDRO 1 3 DIMETHYL INDENE	0.000	0.295	0.002	0.000	0.000	0.000	0.000	0.000	0.000
138 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
139 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
140 N TRIDECANE	0.000	0.727	0.005	0.000	0.000	0.000	0.000	0.000	0.000
141 2 3 DIHYDRO 1 6 DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
142 NAPHTHALENE	0.000	2.780	0.020	0.000	0.000	0.000	0.000	0.000	0.000
143 2 3 DIHYDRO 4 7 DIMETHYL INDENE	0.000	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000
144 DIHYDRO DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
145 1 METHYL NAPHTHALENE	0.000	0.750	0.015	0.000	0.000	0.000	0.000	0.000	0.000
146 2 METHYL NAPHTHALENE	0.000	4.300	0.128	0.000	0.000	0.000	0.000	0.000	0.000
147 METHANOL	0.000	86.210	1.953	0.000	0.000	0.000	0.000	12.310	1.573
148 ETHANOL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
149 TERTIARY BUTYL ALCHOHOL	0.000	7.180	0.160	0.000	0.000	0.000	0.000	1.510	0.133
150 METHYL TERTIARY BUTYL ETHER	0.000	28.400	0.995	0.000	0.280	0.013	0.000	0.000	0.000
151 TOTAL HYDROCARBONS	6.400	3029.800	450.796	8.200	235.920	76.144	52.300	728.520	244.111

Table 6 - 2

COMPONENT GROUP	Group 4: ROAD TOP >1 Hour Min	Max	Mean	Group 5: ROAD BOTTOM >1 Hour Min	Max	Mean	Group 6: ROAD DELIVERY Min	Max	Mean
1 PROPANE	0.000	15.800	1.592	0.000	11.560	0.422	0.000	50.200	2.263
2 ISOBUTANE	0.000	65.900	13.084	0.000	112.600	7.513	0.000	223.600	18.552
3 N BUTANE	0.000	221.900	28.237	0.000	201.820	18.844	0.100	693.800	46.325
4 BUTENE-1	0.000	148.600	4.824	0.000	0.000	0.000	0.000	5.290	0.182
5 ISOBUTENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6 TRANS BUTENE-2	0.000	10.680	1.504	0.000	13.240	1.005	0.000	7.900	1.062
7 CIS BUTENE-2	0.000	7.300	1.022	0.000	10.300	0.808	0.000	7.100	0.810
8 3 METHYL BUTENE 1	0.000	3.400	0.150	0.000	4.890	0.147	0.000	0.000	0.000
9 ISOPENTANE	0.000	257.100	18.662	0.100	172.760	9.462	0.500	156.700	24.701
10 N PENTANE	0.000	216.300	11.994	0.000	79.950	4.658	0.000	142.000	12.490
11 PENTENE-1	0.000	1.000	0.016	0.000	0.000	0.000	0.000	0.140	0.005
12 1 3 BUTADIENE	0.000	4.650	0.402	0.000	14.070	0.425	0.000	0.000	0.000
13 2 METHYL BUTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14 TRANS PENTENE-2	0.000	6.780	0.591	0.000	15.470	0.469	0.000	0.320	0.011
15 CIS PENTENE-2	0.000	3.540	0.311	0.000	8.800	0.267	0.000	0.140	0.005
16 2 METHYL BUTENE-2	0.000	8.380	0.537	0.000	22.540	0.663	0.000	0.320	0.110
17 2 2 DIMETHYL BUTANE	0.000	5.130	0.245	0.000	6.330	0.211	0.000	0.000	0.000
18 CYCLOPENTENE	0.000	2.070	0.046	0.000	0.000	0.000	0.000	0.530	0.018
19 2 3 DIMETHYL BUTANE	0.000	9.600	1.207	0.000	7.400	0.769	0.000	19.300	1.874
20 2 METHYL PENTANE	0.000	63.700	3.070	0.000	16.500	0.880	0.000	215.000	10.335
21 CYCLOPENTANE	0.000	8.700	0.608	0.000	5.920	0.314	0.000	20.700	1.166
22 2 3 DIMETHYL BUTENE-1	0.000	0.440	0.025	0.000	0.950	0.028	0.000	0.000	0.000
23 4 METHYL PENTENE-2	0.000	1.030	0.143	0.000	1.100	0.067	0.000	4.300	0.172
24 3 METHYL PENTANE	0.000	41.300	2.390	0.000	12.830	1.299	0.000	124.900	6.819
25 N HEXANE	0.000	58.600	2.914	0.000	19.750	1.204	0.000	37.700	3.121
26 2 METHYL PENTENE-1	0.000	7.140	0.132	0.000	0.000	0.000	0.000	0.000	0.000
27 TRANS HEXENE-3	0.000	8.820	0.238	0.000	1.620	0.073	0.000	1.300	0.045
28 CIS HEXENE-3	0.000	0.240	0.009	0.000	0.000	0.000	0.000	0.000	0.000
29 TRANS HEXENE-2	0.000	1.300	0.130	0.000	2.670	0.126	0.000	4.600	0.179
30 2 METHYL PENTENE-2	0.000	0.740	0.059	0.000	2.430	0.075	0.000	0.000	0.000
31 CIS 3 METHYL PENTENE-2	0.000	2.000	0.078	0.000	1.700	0.050	0.000	0.000	0.000
32 TRANS 4 METHYL CYCLOPENTENE	0.000	0.400	0.016	0.000	0.690	0.024	0.000	0.000	0.000
33 TRANS 3 METHYL PENTENE-2	0.000	3.020	0.193	0.000	1.140	0.034	0.000	0.000	0.000
34 CIS HEXENE-2	0.000	0.600	0.010	0.000	0.000	0.000	0.000	0.000	0.000
35 2 4 DIMETHYLPENTANE	0.000	2.000	0.207	0.000	10.600	0.484	0.000	9.300	0.376
36 METHYL CYCLOPENTANE	0.000	9.200	0.942	0.000	9.330	0.520	0.000	27.600	1.917
37 2 3 DIMETHYL BUTENE-2	0.000	0.510	0.014	0.000	0.460	0.014	0.000	0.000	0.000
38 2 METHYL HEXANE	0.000	3.850	0.291	0.000	4.200	0.216	0.000	0.420	0.014
39 CIS 4 METHYL CYCLOPENTENE	0.000	0.700	0.025	0.000	0.000	0.000	0.000	0.000	0.000
40 CYCLOHEXANE	0.000	10.900	0.582	0.000	1.600	0.169	0.000	43.200	2.268
41 2 3 DIMETHYL PENTANE	0.000	5.600	0.629	0.000	3.500	0.185	0.000	14.000	0.721
42 4 METHYL HEXENE-2	0.000	0.230	0.011	0.000	0.500	0.016	0.000	0.000	0.000
43	0.000	1.100	0.017	0.000	0.150	0.004	0.000	0.000	0.000
44 3 METHYL HEXANE	0.000	11.700	0.632	0.000	4.830	0.403	0.000	42.900	2.249
45 2 2 4 TRIMETHYL PENTANE	0.000	10.830	0.567	0.000	18.410	0.697	0.000	3.300	0.138
46 4 METHYL HEXENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47 TRANS 1 3 DIMETHYL CYCLOPENTANE	0.000	2.600	0.106	0.000	0.200	0.006	0.000	0.000	0.000
48 CIS 1 3 DIMETHYL CYCLOPENTANE	0.000	3.370	0.099	0.000	1.180	0.036	0.000	0.000	0.000
49 TRANS 1 2 DIMETHYL CYCLOPENTANE	0.000	0.290	0.018	0.000	0.880	0.026	0.000	0.000	0.000
50 CYCLOHEXENE	0.000	0.170	0.006	0.000	0.000	0.000	0.000	0.000	0.000
51 2 METHYL HEXENE-1	0.000	0.050	0.001	0.000	0.000	0.000	0.000	0.000	0.000
52 2 3 DIMETHYL PENTENE-2	0.000	1.900	0.044	0.000	0.000	0.000	0.000	0.000	0.000
53 N HEPTANE	0.000	8.200	0.397	0.000	3.570	0.212	0.000	30.100	1.497
54 3 METHYL HEXENE-1	0.000	1.270	0.052	0.000	0.000	0.000	0.000	0.280	0.010
55 3 METHYL HEXENE-3	0.000	0.050	0.002	0.000	0.190	0.006	0.000	0.000	0.000
56 CIS 1 2 DIMETHYL CYCLOPENTANE	0.000	0.200	0.016	0.000	0.490	0.014	0.000	0.000	0.000
57 HEPTENE-3	0.000	0.100	0.002	0.000	0.000	0.000	0.000	0.000	0.000
58 BENZENE	0.000	30.700	1.734	0.000	12.000	1.212	0.000	101.900	5.086
59 2 METHYL HEXENE-2	0.000	2.480	0.060	0.000	0.000	0.000	0.000	0.000	0.000
60 HEPTENE-2	0.000	0.160	0.008	0.000	0.750	0.022	0.000	0.000	0.000
61 3 METHYL HEXENE 2	0.000	0.390	0.016	0.000	0.390	0.011	0.000	0.000	0.000
62 C7 OLEFINE	0.000	0.540	0.017	0.000	0.600	0.018	0.000	0.000	0.000
63 METHYL CYCLOHEXANE	0.000	1.200	0.172	0.000	2.290	0.143	0.000	4.100	0.214
64 2 5 DIMETHYL HEXANE	0.000	0.270	0.011	0.000	0.350	0.010	0.000	0.000	0.000
65 2 4 DIMETHYL HEXANE	0.000	0.530	0.027	0.000	0.500	0.015	0.000	0.000	0.000
66 ETHYL CYCLOPENTANE	0.000	0.390	0.020	0.000	0.470	0.014	0.000	0.000	0.000
67 1 2 4 TRIMETHYL CYCLOPENTANE	0.000	0.150	0.007	0.000	0.280	0.008	0.000	0.000	0.000
68 2 3 4 TRIMETHYL PENTANE	0.000	1.160	0.059	0.000	0.600	0.018	0.000	2.600	0.103
69 2 3 3 TRIMETHYL PENTANE	0.000	0.650	0.023	0.000	0.300	0.009	0.000	6.000	0.207
70 2 3 DIMETHYL HEXANE	0.000	0.410	0.018	0.000	0.580	0.017	0.000	0.000	0.000
71 2 METHYL HEPTANE	0.000	1.200	0.081	0.000	1.010	0.067	0.000	1.300	0.114
72 4 METHYL HEPTANE	0.000	0.790	0.038	0.000	0.950	0.028	0.000	0.000	0.000
73 3 4 DIMETHYL HEXANE	0.000	0.180	0.007	0.000	0.400	0.012	0.000	0.000	0.000
74 3 METHYL HEPTANE	0.000	0.330	0.022	0.000	0.170	0.005	0.000	0.000	0.000
75 TRANS 1 3 DIMETHYL CYCLOHEXANE	0.000	0.650	0.018	0.000	0.360	0.011	0.000	0.000	0.000

Table 6 - 2 cont'd

COMPONENT GROUP	Group 4: ROAD TOP >1 Hour Min	Max	Mean	Group 5: ROAD BOTTOM >1 Hour Min	Max	Mean	Group 6: ROAD DELIVERY Min	Max	Mean
76 CIS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	2.300	0.046	0.000	0.270	0.008	0.000	0.000	0.000
77 TRANS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	0.150	0.008	0.000	0.260	0.008	0.000	0.000	0.000
78 N OCTANE	0.000	1.990	0.135	0.000	0.700	0.049	0.000	4.700	0.194
79 C8 OLEFINE	0.000	0.210	0.008	0.000	0.380	0.011	0.000	0.000	0.000
80 TRANS 1 2 DIMETHYL CYCLOHEXANE	0.000	0.210	0.007	0.000	0.260	0.008	0.000	0.000	0.000
81 2 4 DIMETHYL HEPTANE	0.000	1.440	0.040	0.000	0.000	0.000	0.000	0.000	0.000
82 TOLUENE	0.000	66.300	3.856	0.000	13.000	1.507	0.500	189.200	10.255
83 2 6 DIMETHYL HEPTANE	0.000	0.220	0.020	0.000	0.230	0.011	0.000	0.000	0.000
84 3 5 DIMETHYL HEPTANE	0.000	0.180	0.014	0.000	0.290	0.009	0.000	0.000	0.000
85 2 METHYL OCTANE	0.000	0.290	0.037	0.000	1.080	0.046	0.000	1.200	0.041
86 4 METHYL OCTANE	0.000	0.100	0.006	0.000	0.000	0.000	0.000	0.000	0.000
87 3 METHYL OCTANE	0.000	0.310	0.026	0.000	1.010	0.061	0.000	0.000	0.000
88 N NONANE	0.000	0.900	0.099	0.000	7.560	0.280	0.000	0.530	0.036
89 ETHYL BENZENE	0.000	6.800	0.347	0.000	3.200	0.321	0.000	35.900	1.577
90 M XYLENE	0.000	18.200	1.108	0.000	5.530	0.687	0.000	103.900	4.616
91 P XYLENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
92 DIMETHYL OCTANE	0.000	0.140	0.005	0.000	0.130	0.004	0.000	0.000	0.000
93 O XYLENE	0.000	6.000	0.410	0.000	4.580	0.511	0.000	37.000	1.597
94 4 METHYL NONANE	0.000	0.000	0.000	0.000	0.410	0.012	0.000	0.000	0.000
95 2 METHYL NONANE	0.000	0.120	0.003	0.000	0.000	0.000	0.000	0.000	0.000
96 TRIMETHYL HEPTANE	0.000	0.700	0.041	0.000	2.140	0.134	0.000	0.300	0.010
97 ISOPROPYL BENZENE	0.000	4.500	0.241	0.000	7.120	0.400	0.000	1.600	0.072
98 3 METHYL NONANE	0.000	0.370	0.015	0.000	0.000	0.000	0.000	0.000	0.000
99 N-DECANE	0.000	1.230	0.131	0.000	1.220	0.075	0.000	0.200	0.012
100 N PROPYL BENZENE	0.000	4.100	0.201	0.000	1.200	0.159	0.000	33.200	1.294
101 1 METHYL 3 ETHYL BENZENE	0.000	0.980	0.084	0.000	1.910	0.056	0.000	0.350	0.012
102 1 METHYL 4 ETHYL BENZENE	0.000	0.330	0.005	0.000	0.000	0.000	0.000	0.140	0.005
103 1 3 5 TRIMETHYL BENZENE	0.000	0.330	0.017	0.000	0.610	0.028	0.000	0.140	0.005
104 C11 PARAFFIN	0.000	0.050	0.001	0.000	0.050	0.001	0.000	0.000	0.000
105 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.050	0.001	0.000	0.000	0.000
106 1 METHYL 2 ETHYL BENZENE	0.000	0.390	0.021	0.000	0.000	0.000	0.000	0.210	0.007
107 1 2 4 TRIMETHYL BENZENE	0.000	0.960	0.076	0.000	1.910	0.067	0.000	0.000	0.000
108 SEC BUTYL BENZENE	0.000	0.150	0.006	0.000	0.000	0.000	0.000	0.000	0.000
109 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
110 AROMATIC	0.000	0.180	0.004	0.000	0.000	0.000	0.000	0.000	0.000
111 1 2 3 TRIMETHYL BENZENE	0.000	1.490	0.077	0.000	0.000	0.000	0.000	0.560	0.019
112 N UNDECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
113 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
114 1 METHYL 3 PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
115 N BUTYL BENZENE	0.000	0.620	0.016	0.000	0.000	0.000	0.000	0.000	0.000
116 1 3 DIMETHYL 5 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
117 1 METHYL 2 PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
118 1 4 DIMETHYL 2 ETHYL BENZENE	0.000	0.150	0.004	0.000	0.000	0.000	0.000	0.000	0.000
119 1 3 DIMETHYL 4 ETHYL BENZENE	0.000	0.100	0.002	0.000	0.000	0.000	0.000	0.000	0.000
120 1 2 DIMETHYL 4 ETHYL BENZENE	0.000	0.110	0.003	0.000	0.000	0.000	0.000	0.000	0.000
121 C10 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
122 C12 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
123 INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
124 C12 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
125 1 3 DIMETHYL 2 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
126 1 2 4 5 TETRAMETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
127 1 2 3 5 TETRAMETHYL BENZENE	0.000	0.270	0.007	0.000	0.000	0.000	0.000	0.000	0.000
128 N DODECANE	0.000	1.140	0.036	0.000	0.000	0.000	0.000	0.000	0.000
129 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
130 C10 AROMATIC	0.000	0.480	0.015	0.000	0.000	0.000	0.000	0.000	0.000
131 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
132 INDENE	0.000	0.810	0.019	0.000	0.000	0.000	0.000	0.000	0.000
133 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
134 2 3 DIHYDRO 4 METHYL INDENE	0.000	0.200	0.006	0.000	0.000	0.000	0.000	0.000	0.000
135 DIMETHYL PROPYL BENZENE	0.000	0.200	0.005	0.000	0.000	0.000	0.000	0.000	0.000
136 C11 AROMATIC	0.000	0.200	0.005	0.000	0.000	0.000	0.000	0.000	0.000
137 2 3 DIHYDRO 1 3 DIMETHYL INDENE	0.000	0.210	0.005	0.000	0.000	0.000	0.000	0.000	0.000
138 C11 AROMATIC	0.000	0.130	0.002	0.000	0.000	0.000	0.000	0.000	0.000
139 C11 AROMATIC	0.000	0.270	0.007	0.000	0.000	0.000	0.000	0.000	0.000
140 N TRIDECANE	0.000	0.110	0.002	0.000	0.000	0.000	0.000	0.000	0.000
141 2 3 DIHYDRO 1 6 DIMETHYL INDENE	0.000	0.580	0.015	0.000	0.000	0.000	0.000	0.000	0.000
142 NAPHTHALENE	0.000	0.530	0.008	0.000	0.000	0.000	0.000	0.000	0.000
143 2 3 DIHYDRO 4 7 DIMETHYL INDENE	0.000	0.270	0.006	0.000	0.000	0.000	0.000	0.000	0.000
144 DIHYDRO DIMETHYL INDENE	0.000	0.170	0.004	0.000	0.000	0.000	0.000	0.000	0.000
145 1 METHYL NAPHTHALENE	0.000	0.410	0.011	0.000	0.000	0.000	0.000	0.000	0.000
146 2 METHYL NAPHTHALENE	0.000	0.550	0.014	0.000	0.000	0.000	0.000	0.000	0.000
147 METHANOL	0.000	20.140	0.653	0.000	0.000	0.000	0.000	0.000	0.000
148 ETHANOL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
149 TERTIARY BUTYL ALCHOHOL	0.000	0.730	0.027	0.000	5.200	0.224	0.000	2.600	0.110
150 METHYL TERTIARY BUTYL ETHER	0.000	17.900	0.604	0.000	0.700	0.032	0.000	169.600	7.356
151 TOTAL HYDROCARBONS	4.140	1229.490	117.560	0.500	728.300	65.614	3.200	3614.900	218.854

Table 6 - 3

COMPONENT GROUP	Group 7: S. STN. ATTENDANT Min	Max	Mean	Group 8: SHIPS CLOSED Min	Max	Mean	Group 9: SHIPS OPEN Min	Max	Mean
1 PROPANE	0.000	1.700	0.445	0.000	10.780	2.936	0.000	2.230	0.479
2 ISOBUTANE	0.570	6.740	2.344	0.340	154.070	39.644	0.000	15.750	4.795
3 N BUTANE	1.550	29.490	7.022	0.000	350.850	95.686	0.110	75.410	19.108
4 BUTENE-1	0.000	0.000	0.000	0.000	50.230	6.553	0.000	0.000	0.000
5 ISOBUTENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6 TRANS BUTENE-2	0.000	2.040	0.559	0.000	80.590	23.242	0.000	2.850	0.966
7 CIS BUTENE-2	0.000	1.390	0.426	0.000	55.170	16.612	0.000	2.920	0.901
8 3 METHYL BUTENE 1	0.000	0.310	0.024	0.000	7.540	1.992	0.000	1.170	0.256
9 ISOPENTANE	0.200	18.620	6.808	0.610	159.920	48.383	0.080	82.140	21.370
10 N PENTANE	0.400	4.930	1.756	0.410	56.520	17.061	0.080	51.090	13.283
11 PENTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12 1 3 BUTADIENE	0.000	1.050	0.259	0.000	21.020	6.347	0.000	4.220	1.070
13 2 METHYL BUTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14 TRANS PENTENE-2	0.000	1.220	0.288	0.000	23.390	6.627	0.000	5.030	1.198
15 CIS PENTENE-2	0.000	1.100	0.179	0.000	13.140	3.664	0.000	2.740	0.655
16 2 METHYL BUTENE-2	0.000	1.960	0.668	0.000	30.680	6.820	0.000	3.260	0.516
17 2 2 DIMETHYL BUTANE	0.000	0.170	0.013	0.000	9.780	2.297	0.000	8.090	1.639
18 CYCLOPENTENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19 2 3 DIMETHYL BUTANE	0.000	0.580	0.098	0.000	5.680	1.846	0.000	3.760	1.087
20 2 METHYL PENTANE	0.200	2.190	0.978	0.100	19.070	6.497	0.000	19.170	5.426
21 CYCLOPENTANE	0.000	0.570	0.064	0.000	4.070	1.031	0.000	3.960	1.151
22 2 3 DIMETHYL BUTENE-1	0.000	0.000	0.000	0.000	1.170	0.130	0.000	0.330	0.075
23 4 METHYL PENTENE-2	0.000	0.000	0.000	0.000	1.860	0.399	0.000	0.360	0.079
24 3 METHYL PENTANE	0.000	1.180	0.509	0.000	10.760	3.893	0.000	7.750	2.526
25 N HEXANE	0.000	2.950	0.432	0.000	10.050	4.151	0.000	4.660	1.759
26 2 METHYL PENTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27 TRANS HEXENE-3	0.000	0.000	0.000	0.000	1.950	0.522	0.000	1.750	0.379
28 CIS HEXENE-3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29 TRANS HEXENE-2	0.000	0.150	0.012	0.000	3.300	0.942	0.000	0.980	0.260
30 2 METHYL PENTENE-2	0.000	0.250	0.019	0.000	3.470	1.083	0.000	0.720	0.175
31 CIS 3 METHYL PENTENE-2	0.000	0.000	0.000	0.000	1.690	0.371	0.000	0.450	0.162
32 TRANS 4 METHYL CYCLOPENTENE	0.000	0.170	0.013	0.000	0.850	0.289	0.000	0.110	0.026
33 TRANS 3 METHYL PENTENE-2	0.000	0.180	0.014	0.000	2.040	0.430	0.000	0.490	0.183
34 CIS HEXENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 2 4 DIMETHYLPENTANE	0.000	0.000	0.000	0.000	0.760	0.169	0.000	0.000	0.000
36 METHYL CYCLOPENTANE	0.000	0.490	0.099	0.000	7.800	2.734	0.000	2.950	1.034
37 2 3 DIMETHYL BUTENE-2	0.000	0.050	0.004	0.000	0.000	0.000	0.000	0.180	0.038
38 2 METHYL HEXANE	0.000	0.330	0.035	0.000	5.310	1.176	0.000	2.390	0.970
39 CIS 4 METHYL CYCLOPENTENE	0.000	0.000	0.000	0.000	1.440	0.196	0.000	0.440	0.055
40 CYCLOHEXANE	0.000	0.000	0.000	0.000	1.020	0.113	0.000	0.000	0.000
41 2 3 DIMETHYL PENTANE	0.000	2.830	0.299	0.000	4.320	0.707	0.000	1.230	0.258
42 4 METHYL HEXENE-2	0.000	0.000	0.000	0.000	21.780	2.501	0.000	0.130	0.031
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44 3 METHYL HEXANE	0.000	0.270	0.025	0.000	3.830	1.119	0.000	1.500	0.780
45 2 2 4 TRIMETHYL PENTANE	0.000	1.060	0.169	0.000	3.560	1.020	0.000	3.090	0.978
46 4 METHYL HEXENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47 TRANS 1 3 DIMETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48 CIS 1 3 DIMETHYL CYCLOPENTANE	0.000	1.520	0.132	0.000	0.810	0.188	0.000	0.530	0.189
49 TRANS 1 2 DIMETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.160	0.018	0.000	0.250	0.136
50 CYCLOHEXENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.013
51 2 METHYL HEXENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52 2 3 DIMETHYL PENTENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.013
53 N HEPTANE	0.000	0.500	0.065	0.000	1.940	0.506	0.080	1.470	0.765
54 3 METHYL HEXENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.013
55 3 METHYL HEXENE-3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.013
56 CIS 1 2 DIMETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.140	0.032
57 HEPTENE-3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58 BENZENE	0.000	1.280	0.352	0.000	21.890	4.644	0.090	4.620	1.470
59 2 METHYL HEXENE-2	0.000	0.000	0.000	0.000	1.170	0.252	0.000	0.000	0.000
60 HEPTENE-2	0.000	0.000	0.000	0.000	0.190	0.021	0.000	0.050	0.013
61 3 METHYL HEXENE 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.120	0.029
62 C7 OLEFINE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.630	0.145
63 METHYL CYCLOHEXANE	0.000	0.000	0.000	0.000	1.120	0.204	0.000	0.910	0.282
64 2 5 DIMETHYL HEXANE	0.000	0.000	0.000	0.000	1.360	0.196	0.000	0.180	0.050
65 2 4 DIMETHYL HEXANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.120	0.041
66 ETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.056
67 1 2 4 TRIMETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.006
68 2 3 4 TRIMETHYL PENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69 2 3 3 TRIMETHYL PENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70 2 3 DIMETHYL HEXANE	0.000	0.000	0.000	0.000	0.290	0.032	0.000	0.340	0.090
71 2 METHYL HEPTANE	0.000	0.000	0.000	0.000	0.920	0.102	0.000	0.520	0.114
72 4 METHYL HEPTANE	0.000	0.000	0.000	0.000	0.710	0.079	0.000	0.170	0.027
73 3 4 DIMETHYL HEXANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.460	0.113
74 3 METHYL HEPTANE	0.000	0.000	0.000	0.000	0.970	0.108	0.000	0.420	0.119
75 TRANS 1 3 DIMETHYL CYCLOHEXANE	0.000	0.000	0.000	0.000	2.040	0.227	0.000	0.270	0.069

Table 6 - 3 cont'd

COMPONENT GROUP	Group 7: S. STN. ATTENDANT Min	Max	Mean	Group 8: SHIPS CLOSED Min	Max	Mean	Group 9: SHIPS OPEN Min	Max	Mean
76 CIS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.025
77 TRANS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.075
78 N OCTANE	0.000	0.000	0.000	0.000	0.610	0.068	0.000	1.160	0.184
79 C8 OLEFINE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.039
80 TRANS 1 2 DIMETHYL CYCLOHEXANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.120	0.027
81 2 4 DIMETHYL HEPTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
82 TOLUENE	0.160	1.900	0.583	0.100	17.910	4.202	0.110	12.940	3.050
83 2 6 DIMETHYL HEPTANE	0.000	0.490	0.053	0.000	1.690	0.686	0.000	0.600	0.172
84 3 5 DIMETHYL HEPTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.220	0.058
85 2 METHYL OCTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.660	0.185
86 4 METHYL OCTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
87 3 METHYL OCTANE	0.000	0.000	0.000	0.000	0.510	0.057	0.000	0.590	0.161
88 N NONANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.270	0.299
89 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.470	0.052	0.050	2.660	0.576
90 M XYLENE	0.000	0.500	0.123	0.000	10.000	1.931	0.110	9.270	1.989
91 P XYLENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.710	0.536
92 DIMETHYL OCTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.760	0.170
93 O XYLENE	0.000	0.480	0.056	0.000	0.580	0.150	0.000	0.810	0.293
94 4 METHYL NONANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95 2 METHYL NONANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.990	0.194
96 TRIMETHYL HEPTANE	0.000	0.000	0.000	0.000	0.840	0.093	0.000	0.190	0.055
97 ISOPROPYL BENZENE	0.000	0.100	0.008	0.000	0.000	0.000	0.000	0.000	0.000
98 3 METHYL NONANE	0.000	0.000	0.000	0.000	0.290	0.048	0.000	0.000	0.000
99 N-DECANE	0.000	0.000	0.000	0.000	0.660	0.103	0.000	2.780	0.489
100 N PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.190	0.043
101 1 METHYL 3 ETHYL BENZENE	0.000	0.110	0.008	0.000	0.000	0.000	0.000	0.530	0.162
102 1 METHYL 4 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
103 1 3 5 TRIMETHYL BENZENE	0.000	0.000	0.000	0.000	0.510	0.057	0.000	0.000	0.000
104 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.190	0.055
105 C11 PARAFFIN	0.000	0.490	0.038	0.000	0.000	0.000	0.000	1.140	0.406
106 1 METHYL 2 ETHYL BENZENE	0.000	0.000	0.000	0.000	1.100	0.122	0.000	0.740	0.093
107 1 2 4 TRIMETHYL BENZENE	0.000	0.380	0.042	0.000	1.120	0.186	0.000	1.910	0.936
108 SEC BUTYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
109 C11 PARAFFIN	0.000	0.310	0.024	0.000	0.000	0.000	0.000	0.000	0.000
110 AROMATIC	0.000	0.180	0.014	0.000	0.000	0.000	0.000	0.000	0.000
111 1 2 3 TRIMETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112 N UNDECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
113 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
114 1 METHYL 3 PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
115 N BUTYL BENZENE	0.000	0.440	0.034	0.000	0.000	0.000	0.000	0.000	0.000
116 1 3 DIMETHYL 5 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
117 1 METHYL 2 PROPYL BENZENE	0.000	0.160	0.020	0.000	0.000	0.000	0.000	0.000	0.000
118 1 4 DIMETHYL 2 ETHYL BENZENE	0.000	0.190	0.015	0.000	0.000	0.000	0.000	0.000	0.000
119 1 3 DIMETHYL 4 ETHYL BENZENE	0.000	0.270	0.035	0.000	0.000	0.000	0.000	0.000	0.000
120 1 2 DIMETHYL 4 ETHYL BENZENE	0.000	2.280	0.577	0.000	0.000	0.000	0.000	0.000	0.000
121 C10 AROMATIC	0.000	0.300	0.023	0.000	0.000	0.000	0.000	0.000	0.000
122 C12 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
123 INDENE	0.000	1.130	0.254	0.000	0.000	0.000	0.000	0.000	0.000
124 C12 PARAFFIN	0.000	0.140	0.011	0.000	0.000	0.000	0.000	0.000	0.000
125 1 3 DIMETHYL 2 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
126 1 2 4 5 TETRAMETHYL BENZENE	0.000	0.250	0.019	0.000	0.000	0.000	0.000	0.000	0.000
127 1 2 3 5 TETRAMETHYL BENZENE	0.000	0.290	0.022	0.000	0.000	0.000	0.000	0.000	0.000
128 N DODECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
129 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
130 C10 AROMATIC	0.000	0.000	0.000	0.000	0.850	0.094	0.000	0.000	0.000
131 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
132 INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
133 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
134 2 3 DIHYDRO 4 METHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
135 DIMETHYL PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
136 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
137 2 3 DIHYDRO 1 3 DIMETHYL INDENE	0.000	0.150	0.012	0.000	0.000	0.000	0.000	0.000	0.000
138 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
139 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
140 N TRIDECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
141 2 3 DIHYDRO 1 6 DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
142 NAPHTHALENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
143 2 3 DIHYDRO 4 7 DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
144 DIHYDRO DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
145 1 METHYL NAPHTHALENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
146 2 METHYL NAPHTHALENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
147 METHANOL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
148 ETHANOL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
149 TERTIARY BUTYL ALCHOHOL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
150 METHYL TERTIARY BUTYL ETHER	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
151 TOTAL HYDROCARBONS	7.890	101.340	29.271	2.380	1089.400	339.737	2.440	322.010	118.023

Table 6 - 4

COMPONENT GROUP	Group 10: BARGES CLOSED Min	Max	Mean	Group 11: JETTYMEN Min	Max	Mean	Group 12: RAILCAR TOP Min	Max	Mean
1 PROPANE	0.000	10.490	2.385	0.000	67.710	3.730	0.000	4.470	0.870
2 ISOBUTANE	0.140	90.590	18.409	0.000	165.550	11.591	0.000	34.420	6.996
3 N BUTANE	0.290	245.500	46.805	0.050	81.260	15.870	0.000	175.850	22.420
4 BUTENE-1	0.000	0.000	0.000	0.000	3.650	0.174	0.000	0.000	0.000
5 ISOBUTENE	0.000	0.000	0.000	0.000	2.490	0.119	0.000	0.100	0.003
6 TRANS BUTENE-2	0.000	35.340	5.601	0.000	29.420	5.209	0.000	19.700	1.900
7 CIS BUTENE-2	0.000	28.750	4.389	0.000	22.590	3.495	0.000	8.850	1.080
8 3 METHYL BUTENE 1	0.000	4.460	0.680	0.000	2.110	0.520	0.000	2.130	0.201
9 ISOPENTANE	0.000	353.490	52.844	0.100	102.690	22.235	0.000	148.510	18.114
10 N PENTANE	0.000	301.040	33.612	0.000	42.020	9.365	0.000	28.390	4.729
11 PENTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12 1 3 BUTADIENE	0.000	15.240	2.581	0.000	15.910	2.638	0.000	6.220	0.595
13 2 METHYL BUTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14 TRANS PENTENE-2	0.000	13.240	2.411	0.000	18.270	3.094	0.000	6.580	0.710
15 CIS PENTENE-2	0.000	21.620	2.785	0.000	10.230	1.718	0.000	3.690	0.374
16 2 METHYL BUTENE-2	0.000	0.000	0.000	0.000	24.250	1.155	0.000	1.900	0.249
17 2 2 DIMETHYL BUTANE	0.000	31.450	4.972	0.000	14.430	3.285	0.000	11.890	0.984
18 CYCLOPENTENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19 2 3 DIMETHYL BUTANE	0.000	10.600	2.137	0.000	6.530	1.364	0.000	6.580	1.093
20 2 METHYL PENTANE	0.000	3.110	0.529	0.000	34.760	5.767	0.000	23.560	3.410
21 CYCLOPENTANE	0.000	24.310	2.458	0.000	7.380	1.140	0.000	5.430	0.647
22 2 3 DIMETHYL BUTENE-1	0.000	0.000	0.000	0.000	0.570	0.080	0.000	0.420	0.029
23 4 METHYL PENTENE-2	0.000	1.360	0.254	0.000	1.030	0.189	0.000	0.450	0.055
24 3 METHYL PENTANE	0.000	31.410	4.845	0.000	13.790	2.879	0.000	10.900	1.848
25 N HEXANE	0.000	46.100	6.284	0.000	7.040	1.631	0.000	4.890	1.205
26 2 METHYL PENTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27 TRANS HEXENE-3	0.000	0.200	0.018	0.000	1.690	0.330	0.000	0.600	0.064
28 CIS HEXENE-3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29 TRANS HEXENE-2	0.000	2.660	0.506	0.000	2.720	0.476	0.000	0.950	0.105
30 2 METHYL PENTENE-2	0.000	4.700	0.845	0.000	2.320	0.473	0.000	0.820	0.096
31 CIS 3 METHYL PENTENE-2	0.000	3.690	0.663	0.000	1.590	0.187	0.000	0.050	0.005
32 TRANS 4 METHYL CYCLOPENTENE	0.000	3.530	0.635	0.000	2.680	0.321	0.000	1.320	0.128
33 TRANS 3 METHYL PENTENE-2	0.000	1.860	0.227	0.000	2.390	0.199	0.000	0.000	0.000
34 CIS HEXENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 2 4 DIMETHYLPENTANE	0.000	3.270	0.467	0.000	0.890	0.161	0.000	2.610	0.329
36 METHYL CYCLOPENTANE	0.000	31.890	3.161	0.000	7.080	1.412	0.000	5.350	0.806
37 2 3 DIMETHYL BUTENE-2	0.000	13.630	1.300	0.000	0.430	0.055	0.000	0.000	0.000
38 2 METHYL HEXANE	0.000	1.300	0.175	0.000	4.090	0.700	0.000	0.950	0.112
39 CIS 4 METHYL CYCLOPENTENE	0.000	0.210	0.019	0.000	1.430	0.156	0.000	0.000	0.000
40 CYCLOHEXANE	0.000	5.060	0.460	0.000	0.300	0.014	0.000	2.000	0.263
41 2 3 DIMETHYL PENTANE	0.000	12.590	2.563	0.000	1.750	0.306	0.000	3.980	0.330
42 4 METHYL HEXENE-2	0.000	3.210	0.630	0.000	0.450	0.141	0.000	2.000	0.150
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44 3 METHYL HEXANE	0.000	1.300	0.288	0.000	3.620	0.710	0.000	4.880	0.556
45 2 2 4 TRIMETHYL PENTANE	0.000	12.000	1.740	0.000	3.160	0.724	0.000	9.310	0.388
46 4 METHYL HEXENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47 TRANS 1 3 DIMETHYL CYCLOPENTANE	0.000	0.050	0.005	0.000	1.110	0.053	0.000	0.000	0.000
48 CIS 1 3 DIMETHYL CYCLOPENTANE	0.000	3.150	0.589	0.000	1.590	0.243	0.000	2.840	0.188
49 TRANS 1 2 DIMETHYL CYCLOPENTANE	0.000	2.560	0.333	0.000	0.490	0.100	0.000	0.390	0.033
50 CYCLOHEXENE	0.000	0.000	0.000	0.000	0.340	0.028	0.000	0.000	0.000
51 2 METHYL HEXENE-1	0.000	0.240	0.022	0.000	0.050	0.002	0.000	0.450	0.029
52 2 3 DIMETHYL PENTENE-2	0.000	0.000	0.000	0.000	0.120	0.010	0.000	0.260	0.008
53 N HEPTANE	0.000	4.070	0.441	0.000	1.770	0.310	0.000	2.560	0.321
54 3 METHYL HEXENE-1	0.000	0.050	0.005	0.000	0.150	0.010	0.000	2.690	0.084
55 3 METHYL HEXENE-3	0.000	0.420	0.075	0.000	0.270	0.025	0.000	0.000	0.000
56 CIS 1 2 DIMETHYL CYCLOPENTANE	0.000	1.390	0.219	0.000	0.400	0.061	0.000	0.270	0.013
57 HEPTENE-3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58 BENZENE	0.000	31.540	4.729	0.000	5.880	1.522	0.000	9.460	1.450
59 2 METHYL HEXENE-2	0.000	0.000	0.000	0.000	1.260	0.078	0.000	0.000	0.000
60 HEPTENE-2	0.000	0.700	0.119	0.000	0.560	0.072	0.000	0.270	0.020
61 3 METHYL HEXENE 2	0.000	1.140	0.186	0.000	0.240	0.036	0.000	0.540	0.071
62 C7 OLEFINE	0.000	0.970	0.192	0.000	0.520	0.079	0.000	0.310	0.017
63 METHYL CYCLOHEXANE	0.000	5.700	0.785	0.000	2.090	0.349	0.000	1.400	0.178
64 2 5 DIMETHYL HEXANE	0.000	0.640	0.130	0.000	0.260	0.033	0.000	1.290	0.058
65 2 4 DIMETHYL HEXANE	0.000	1.010	0.201	0.000	0.400	0.066	0.000	2.280	0.124
66 ETHYL CYCLOPENTANE	0.000	1.320	0.194	0.000	0.330	0.060	0.000	0.330	0.022
67 1 2 4 TRIMETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.180	0.016	0.000	0.000	0.000
68 2 3 4 TRIMETHYL PENTANE	0.000	0.710	0.094	0.000	0.160	0.015	0.000	0.000	0.000
69 2 3 3 TRIMETHYL PENTANE	0.000	1.200	0.205	0.000	0.050	0.005	0.000	1.940	0.100
70 2 3 DIMETHYL HEXANE	0.000	0.670	0.103	0.000	1.700	0.149	0.000	2.480	0.132
71 2 METHYL HEPTANE	0.000	2.970	0.435	0.000	0.680	0.138	0.000	0.680	0.066
72 4 METHYL HEPTANE	0.000	3.190	0.445	0.000	0.580	0.107	0.000	0.930	0.032
73 3 4 DIMETHYL HEXANE	0.000	0.000	0.000	0.000	0.350	0.053	0.000	0.110	0.003
74 3 METHYL HEPTANE	0.000	2.150	0.257	0.000	0.530	0.060	0.000	0.490	0.033
75 TRANS 1 3 DIMETHYL CYCLOHEXANE	0.000	0.630	0.090	0.000	0.850	0.133	0.000	0.220	0.014

Table 6 - 4 cont'd

COMPONENT GROUP	Group 10: BARGES CLOSED Min	Max	Mean	Group 11: JETTYMEN Min	Max	Mean	Group 12: RAILCAR TOP Min	Max	Mean
76 CIS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	0.710	0.092	0.000	0.280	0.032	0.000	0.050	0.002
77 TRANS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	2.750	0.271	0.000	0.280	0.042	0.000	0.000	0.000
78 N OCTANE	0.000	0.660	0.114	0.000	0.600	0.107	0.000	1.290	0.117
79 C8 OLEFINE	0.000	0.550	0.055	0.000	0.180	0.024	0.000	0.050	0.002
80 TRANS 1 2 DIMETHYL CYCLOHEXANE	0.000	0.240	0.034	0.000	0.340	0.031	0.000	0.310	0.010
81 2 4 DIMETHYL HEPTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
82 TOLUENE	0.050	24.360	5.835	0.050	8.900	2.398	0.100	27.920	2.888
83 2 6 DIMETHYL HEPTANE	0.000	0.830	0.114	0.000	1.030	0.308	0.000	0.650	0.058
84 3 5 DIMETHYL HEPTANE	0.000	0.390	0.040	0.000	0.150	0.019	0.000	0.920	0.086
85 2 METHYL OCTANE	0.000	0.210	0.028	0.000	0.340	0.056	0.000	0.600	0.310
86 4 METHYL OCTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.002
87 3 METHYL OCTANE	0.000	0.100	0.009	0.000	0.270	0.036	0.000	0.190	0.011
88 N NONANE	0.000	0.250	0.044	0.000	0.300	0.035	0.000	2.000	0.108
89 ETHYL BENZENE	0.000	2.710	0.490	0.000	1.260	0.225	0.000	1.300	0.210
90 M XYLENE	0.000	7.810	1.345	0.000	4.150	1.113	0.000	18.510	1.242
91 P XYLENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.720	0.023
92 DIMETHYL OCTANE	0.000	0.170	0.015	0.000	0.050	0.005	0.000	0.110	0.003
93 O XYLENE	0.000	1.350	0.335	0.000	1.580	0.417	0.000	2.300	0.341
94 4 METHYL NONANE	0.000	0.000	0.000	0.000	0.050	0.002	0.000	8.570	0.269
95 2 METHYL NONANE	0.000	0.000	0.000	0.000	0.050	0.007	0.000	0.050	0.002
96 TRIMETHYL HEPTANE	0.000	0.300	0.027	0.000	0.620	0.076	0.000	1.300	0.051
97 ISOPROPYL BENZENE	0.000	0.940	0.168	0.000	0.400	0.067	0.000	0.900	0.226
98 3 METHYL NONANE	0.000	0.580	0.053	0.000	0.000	0.000	0.000	0.100	0.003
99 N-DECANE	0.000	1.380	0.139	0.000	0.500	0.035	0.000	0.580	0.042
100 N PROPYL BENZENE	0.000	0.100	0.022	0.000	0.350	0.040	0.000	1.200	0.059
101 1 METHYL 3 ETHYL BENZENE	0.000	0.440	0.080	0.000	1.380	0.066	0.000	0.000	0.000
102 1 METHYL 4 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
103 1 3 5 TRIMETHYL BENZENE	0.000	0.000	0.000	0.000	0.510	0.067	0.000	7.780	0.279
104 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.400	0.026	0.000	0.000	0.000
105 C11 PARAFFIN	0.000	0.270	0.029	0.000	0.050	0.010	0.000	0.000	0.000
106 1 METHYL 2 ETHYL BENZENE	0.000	0.490	0.045	0.000	1.190	0.129	0.000	2.160	0.068
107 1 2 4 TRIMETHYL BENZENE	0.000	2.100	0.340	0.000	3.930	0.420	0.000	9.780	0.344
108 SEC BUTYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
109 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
110 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
111 1 2 3 TRIMETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112 N UNDECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
113 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
114 1 METHYL 3 PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
115 N BUTYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
116 1 3 DIMETHYL 5 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
117 1 METHYL 2 PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
118 1 4 DIMETHYL 2 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
119 1 3 DIMETHYL 4 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
120 1 2 DIMETHYL 4 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.300	0.013
121 C10 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
122 C12 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
123 INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
124 C12 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
125 1 3 DIMETHYL 2 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
126 1 2 4 5 TETRAMETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
127 1 2 3 5 TETRAMETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.003
128 N DODECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
129 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
130 C10 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
131 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
132 INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
133 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
134 2 3 DIHYDRO 4 METHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
135 DIMETHYL PROPYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
136 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
137 2 3 DIHYDRO 1 3 DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
138 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
139 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
140 N TRIDECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
141 2 3 DIHYDRO 1 6 DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
142 NAPHTHALENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
143 2 3 DIHYDRO 4 7 DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
144 DIHYDRO DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
145 1 METHYL NAPHTHALENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
146 2 METHYL NAPHTHALENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
147 METHANOL	0.000	132.900	13.318	0.000	11.120	0.530	0.000	0.000	0.000
148 ETHANOL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
149 TERTIARY BUTYL ALCOHOL	0.000	29.880	2.844	0.000	2.100	0.100	0.000	0.000	0.000
150 METHYL TERTIARY BUTYL ETHER	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
151 TOTAL HYDROCARBONS	1.530	1750.400	262.933	3.300	658.210	120.113	2.000	535.430	84.710

Table 6 - 5

COMPONENT GROUP	Group 13: DRUMMING Min	Max	Mean	Group 14: PRODUCTION-ONSITE Min	Max	Mean	Group 15: PRODUCTION-OFFSITE Min	Max	Mean
1 PROPANE	0.000	11.300	1.511	0.000	47.060	2.042	0.000	2.800	0.583
2 ISOBUTANE	0.000	235.800	82.511	0.000	272.350	5.735	0.000	20.200	2.272
3 N BUTANE	0.000	301.200	120.111	0.000	459.310	10.285	0.000	221.100	11.251
4 BUTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5 ISOBUTENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6 TRANS BUTENE-2	0.000	36.000	14.056	0.000	58.280	1.220	0.000	44.700	1.964
7 CIS BUTENE-2	0.000	27.400	10.389	0.000	7.130	0.206	0.000	22.000	1.003
8 3 METHYL BUTENE 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9 ISOPENTANE	9.500	252.400	124.044	0.000	220.610	6.322	0.000	95.700	6.237
10 N PENTANE	14.600	139.800	64.422	0.000	186.120	4.398	0.000	38.200	3.394
11 PENTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12 1 3 BUTADIENE	0.000	0.000	0.000	0.000	11.350	0.272	0.000	1.610	0.107
13 2 METHYL BUTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14 TRANS PENTENE-2	0.000	0.000	0.000	0.000	14.940	0.345	0.000	2.410	0.127
15 CIS PENTENE-2	0.000	0.000	0.000	0.000	7.970	0.186	0.000	1.320	0.074
16 2 METHYL BUTENE-2	0.000	0.000	0.000	0.000	25.190	0.602	0.000	3.950	0.257
17 2 2 DIMETHYL BUTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18 CYCLOPENTENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19 2 3 DIMETHYL BUTANE	0.000	60.800	20.567	0.000	145.600	2.714	0.000	9.000	0.637
20 2 METHYL PENTANE	0.000	266.300	44.867	0.000	104.980	2.189	0.000	31.600	2.276
21 CYCLOPENTANE	0.000	12.800	4.689	0.000	0.730	0.023	0.000	5.800	0.232
22 2 3 DIMETHYL BUTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23 4 METHYL PENTENE-2	0.000	6.200	2.189	0.000	16.450	0.339	0.000	6.900	0.348
24 3 METHYL PENTANE	0.000	176.200	37.556	0.000	78.630	1.569	0.000	17.700	1.548
25 N HEXANE	2.400	297.300	51.822	0.000	154.270	2.967	0.000	13.490	2.751
26 2 METHYL PENTENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27 TRANS HEXENE-3	0.000	3.500	0.900	0.000	0.000	0.000	0.000	5.400	0.207
28 CIS HEXENE-3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.020	0.260
29 TRANS HEXENE-2	0.000	5.500	1.567	0.000	0.000	0.000	0.000	9.000	0.348
30 2 METHYL PENTENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31 CIS 3 METHYL PENTENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32 TRANS 4 METHYL CYCLOPENTENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33 TRANS 3 METHYL PENTENE-2	0.000	0.000	0.000	0.000	0.550	0.009	0.000	0.190	0.007
34 CIS HEXENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 2 4 DIMETHYLPENTANE	0.000	13.000	3.689	0.000	1.100	0.018	0.000	11.000	0.426
36 METHYL CYCLOPENTANE	0.000	44.000	14.356	0.000	34.180	0.751	0.000	17.200	1.263
37 2 3 DIMETHYL BUTENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38 2 METHYL HEXANE	0.000	0.000	0.000	0.000	9.030	0.270	0.000	3.200	0.255
39 CIS 4 METHYL CYCLOPENTENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40 CYCLOHEXANE	0.000	56.500	14.000	0.000	7.700	0.160	0.000	0.000	0.000
41 2 3 DIMETHYL PENTANE	0.000	36.600	7.822	0.000	10.100	0.259	0.000	10.800	0.574
42 4 METHYL HEXENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.520	0.255
43	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44 3 METHYL HEXANE	0.000	66.300	15.133	0.000	10.000	0.306	0.000	8.800	0.629
45 2 2 4 TRIMETHYL PENTANE	0.000	6.000	1.056	0.000	0.960	0.030	0.000	3.550	0.310
46 4 METHYL HEXENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47 TRANS 1 3 DIMETHYL CYCLOPENTANE	0.000	0.800	0.089	0.000	0.960	0.015	0.000	1.080	0.040
48 CIS 1 3 DIMETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.590	0.010	0.000	2.000	0.074
49 TRANS 1 2 DIMETHYL CYCLOPENTANE	0.000	0.800	0.133	0.000	0.000	0.000	0.000	0.000	0.000
50 CYCLOHEXENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51 2 METHYL HEXENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52 2 3 DIMETHYL PENTENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53 N HEPTANE	0.000	46.000	9.922	0.000	8.200	0.356	0.000	14.420	0.928
54 3 METHYL HEXENE-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55 3 METHYL HEXENE-3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56 CIS 1 2 DIMETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.000	0.074
57 HEPTENE-3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58 BENZENE	0.000	116.300	27.222	0.000	23.000	0.878	0.000	14.100	0.967
59 2 METHYL HEXENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60 HEPTENE-2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61 3 METHYL HEXENE 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62 C7 OLEFINE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63 METHYL CYCLOHEXANE	0.000	9.300	2.544	0.000	1.710	0.123	0.000	10.630	0.623
64 2 5 DIMETHYL HEXANE	0.000	0.000	0.000	0.000	0.400	0.010	0.000	0.870	0.032
65 2 4 DIMETHYL HEXANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66 ETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.080	0.077
67 1 2 4 TRIMETHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.360	0.050
68 2 3 4 TRIMETHYL PENTANE	0.000	3.400	0.867	0.000	1.200	0.030	0.000	3.000	0.222
69 2 3 3 TRIMETHYL PENTANE	0.000	0.000	0.000	0.000	0.500	0.016	0.000	6.290	0.355
70 2 3 DIMETHYL HEXANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.300	0.011
71 2 METHYL HEPTANE	0.000	9.400	1.900	0.000	0.300	0.009	0.000	3.990	0.148
72 4 METHYL HEPTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.610	0.097
73 3 4 DIMETHYL HEXANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
74 3 METHYL HEPTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75 TRANS 1 3 DIMETHYL CYCLONEXANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 6 - 5 cont'd

COMPONENT GROUP	Group 13: DRUMMING Min	Max	Mean	Group 14: PRODUCTION-ONSITE Min	Max	Mean	Group 15: PRODUCTION-OFFSITE Min	Max	Mean
76 CIS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.260	0.047
77 TRANS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.590	0.059
78 N OCTANE	0.000	4.900	1.056	0.000	2.000	0.102	0.000	14.900	0.945
79 C8 OLEFINE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80 TRANS 1 2 DIMETHYL CYCLOHEXANE	0.000	0.000	0.000	0.000	0.300	0.005	0.000	0.000	0.000
81 2 4 DIMETHYL HEPTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
82 TOLUENE	3.100	194.800	41.289	0.000	67.100	2.008	0.000	19.600	2.193
83 2 6 DIMETHYL HEPTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
84 3 5 DIMETHYL HEPTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
85 2 METHYL OCTANE	0.000	1.100	0.233	0.000	0.400	0.028	0.000	4.650	0.259
86 4 METHYL OCTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
87 3 METHYL OCTANE	0.000	1.100	0.167	0.000	0.400	0.011	0.000	3.600	0.200
88 N NONANE	0.000	1.100	0.222	0.000	1.300	0.053	0.000	11.630	0.824
89 ETHYL BENZENE	0.000	28.500	5.222	0.000	7.200	0.201	0.000	4.730	0.556
90 M XYLENE	0.000	78.500	13.900	0.000	18.700	0.487	0.000	11.400	1.073
91 P XYLENE	0.000	0.000	0.000	0.000	0.030	0.000	0.000	0.000	0.000
92 DIMETHYL OCTANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.440	0.016
93 O XYLENE	0.000	24.700	5.133	0.000	6.900	0.245	0.000	5.500	0.830
94 4 METHYL NONANE	0.000	0.000	0.000	0.000	0.690	0.015	0.000	2.410	0.089
95 2 METHYL NONANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
96 TRIMETHYL HEPTANE	0.000	2.300	0.511	0.000	0.700	0.029	0.000	1.960	0.130
97 ISOPROPYL BENZENE	0.000	6.400	1.422	0.000	1.130	0.195	0.000	12.630	1.264
98 3 METHYL NONANE	0.000	0.000	0.000	0.000	0.740	0.018	0.000	20.480	0.773
99 N-DECANE	0.000	1.800	0.267	0.000	2.600	0.084	0.000	6.810	0.637
100 N PROPYL BENZENE	0.000	5.200	1.467	0.000	2.400	0.072	0.000	5.400	0.343
101 1 METHYL 3 ETHYL BENZENE	0.000	0.000	0.000	0.000	1.210	0.055	0.000	4.540	0.286
102 1 METHYL 4 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.300	0.005	0.000	2.280	0.084
103 1 3 5 TRIMETHYL BENZENE	0.000	0.000	0.000	0.000	1.300	0.031	0.000	0.000	0.000
104 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
105 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
106 1 METHYL 2 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.100	0.004	0.000	0.100	0.004
107 1 2 4 TRIMETHYL BENZENE	0.000	0.000	0.000	0.000	3.500	0.083	0.000	0.310	0.029
108 SEC BUTYL BENZENE	0.000	0.000	0.000	0.000	0.130	0.003	0.000	0.000	0.000
109 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
110 AROMATIC	0.000	0.000	0.000	0.000	2.000	0.037	0.000	0.000	0.000
111 1 2 3 TRIMETHYL BENZENE	0.000	0.000	0.000	0.000	0.060	0.007	0.000	0.480	0.043
112 N UNDECANE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
113 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
114 1 METHYL 3 PROPYL BENZENE	0.000	0.000	0.000	0.000	0.130	0.004	0.000	0.000	0.000
115 N BUTYL BENZENE	0.000	0.000	0.000	0.000	0.100	0.002	0.000	0.000	0.000
116 1 3 DIMETHYL 5 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
117 1 METHYL 2 PROPYL BENZENE	0.000	0.000	0.000	0.000	0.120	0.002	0.000	0.000	0.000
118 1 4 DIMETHYL 2 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
119 1 3 DIMETHYL 4 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
120 1 2 DIMETHYL 4 ETHYL BENZENE	0.000	0.000	0.000	0.000	2.830	0.209	0.000	3.920	0.169
121 C10 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
122 C12 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
123 INDENE	0.000	0.000	0.000	0.000	1.230	0.182	0.000	1.880	0.176
124 C12 PARAFFIN	0.000	0.000	0.000	0.000	0.580	0.049	0.000	0.470	0.035
125 1 3 DIMETHYL 2 ETHYL BENZENE	0.000	0.000	0.000	0.000	0.500	0.014	0.000	0.060	0.002
126 1 2 4 5 TETRAMETHYL BENZENE	0.000	0.000	0.000	0.000	0.220	0.016	0.000	0.350	0.029
127 1 2 3 5 TETRAMETHYL BENZENE	0.000	0.000	0.000	0.000	0.400	0.015	0.000	1.510	0.071
128 N DODECANE	0.000	0.000	0.000	0.000	0.030	0.000	0.000	0.000	0.000
129 C11 PARAFFIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
130 C10 AROMATIC	0.000	0.000	0.000	0.000	0.130	0.005	0.000	0.110	0.004
131 C11 AROMATIC	0.000	0.000	0.000	0.000	0.200	0.005	0.000	0.000	0.000
132 INDENE	0.000	0.000	0.000	0.000	0.800	0.022	0.000	0.170	0.010
133 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
134 2 3 DIHYDRO 4 METHYL INDENE	0.000	0.000	0.000	0.000	0.050	0.001	0.000	0.000	0.000
135 DIMETHYL PROPYL BENZENE	0.000	0.000	0.000	0.000	0.100	0.004	0.000	0.090	0.003
136 C11 AROMATIC	0.000	0.000	0.000	0.000	0.050	0.002	0.000	0.070	0.003
137 2 3 DIHYDRO 1 3 DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.100	0.005	0.000	0.000	0.000
138 C11 AROMATIC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
139 C11 AROMATIC	0.000	0.000	0.000	0.000	0.060	0.001	0.000	0.000	0.000
140 N TRIDECANE	0.000	0.000	0.000	0.000	0.210	0.004	0.000	0.000	0.000
141 2 3 DIHYDRO 1 6 DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.090	0.011	0.000	0.330	0.027
142 NAPHTHALENE	0.000	0.000	0.000	0.000	0.180	0.011	0.000	0.070	0.005
143 2 3 DIHYDRO 4 7 DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.080	0.005	0.000	0.110	0.005
144 DIHYDRO DIMETHYL INDENE	0.000	0.000	0.000	0.000	0.130	0.012	0.000	0.200	0.016
145 1 METHYL NAPHTHALENE	0.000	0.000	0.000	0.000	0.060	0.006	0.000	0.040	0.001
146 2 METHYL NAPHTHALENE	0.000	0.000	0.000	0.000	0.130	0.008	0.000	0.140	0.008
147 METHANOL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
148 ETHANOL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
149 TERTIARY BUTYL ALCOHOL	0.000	1.300	0.278	0.000	0.000	0.000	0.000	0.000	0.000
150 METHYL TERTIARY BUTYL ETHER	0.000	101.900	18.478	0.000	0.000	0.000	0.000	0.000	0.000
151 TOTAL HYDROCARBONS	61.100	1747.800	858.356	0.670	1819.000	52.833	3.770	922.800	66.001

Table 6 - 6

GASOLINE COMPONENT	OVERALL Min	Max	Mean
1 PROPANE	0.000	106.250	2.393
2 ISOBUTANE	0.000	662.800	21.285
3 N BUTANE	0.000	953.700	43.071
4 BUTENE-1	0.000	302.240	1.676
5 ISOBUTENE	0.000	2.490	0.008
6 TRANS BUTENE-2	0.000	142.240	4.606
7 CIS BUTENE-2	0.000	56.250	3.203
8 3 METHYL BUTENE 1	0.000	7.540	0.307
9 ISOPENTANE	0.000	618.100	32.698
10 N PENTANE	0.000	325.800	16.248
11 PENTENE-1	0.000	2.080	0.002
12 1 3 BUTADIENE	0.000	32.320	1.192
13 2 METHYL BUTENE-1	0.000	4.800	0.004
14 TRANS PENTENE-2	0.000	23.390	1.296
15 CIS PENTENE-2	0.000	21.620	0.790
16 2 METHYL BUTENE-2	0.000	30.680	1.064
17 2 2 DIMETHYL BUTANE	0.000	31.450	1.134
18 CYCLOPENTENE	0.000	10.710	0.016
19 2 3 DIMETHYL BUTANE	0.000	145.600	2.914
20 2 METHYL PENTANE	0.000	266.300	7.003
21 CYCLOPENTANE	0.000	24.310	1.144
22 2 3 DIMETHYL BUTENE-1	0.000	3.700	0.036
23 4 METHYL PENTENE-2	0.000	16.450	0.309
24 3 METHYL PENTANE	0.000	176.200	5.437
25 N HEXANE	0.000	297.300	6.216
26 2 METHYL PENTENE-1	0.000	11.810	0.019
27 TRANS HEXENE-3	0.000	13.630	0.250
28 CIS HEXENE-3	0.000	7.020	0.018
29 TRANS HEXENE-2	0.000	10.300	0.342
30 2 METHYL PENTENE-2	0.000	4.700	0.206
31 CIS 3 METHYL PENTENE-2	0.000	3.690	0.118
32 TRANS 4 METHYL CYCLOPENTENE	0.000	3.530	0.119
33 TRANS 3 METHYL PENTENE-2	0.000	6.200	0.105
34 CIS HEXENE-2	0.000	0.600	0.001
35 2 4 DIMETHYLPENTANE	0.000	18.500	0.485
36 METHYL CYCLOPENTANE	0.000	44.000	2.329
37 2 3 DIMETHYL BUTENE-2	0.000	13.630	0.103
38 2 METHYL HEXANE	0.000	15.700	0.391
39 CIS 4 METHYL CYCLOPENTENE	0.000	1.440	0.030
40 CYCLOHEXANE	0.000	56.500	1.334
41 2 3 DIMETHYL PENTANE	0.000	36.600	1.147
42 4 METHYL HEXENE-2	0.000	21.780	0.278
43	0.000	1.800	0.003
44 3 METHYL HEXANE	0.000	66.300	1.769
45 2 2 4 TRIMETHYL PENTANE	0.000	18.410	0.724
46 4 METHYL HEXENE-1	0.000	0.050	0.000
47 TRANS 1 3 DIMETHYL CYCLOPENTANE	0.000	5.400	0.028
48 CIS 1 3 DIMETHYL CYCLOPENTANE	0.000	4.210	0.145
49 TRANS 1 2 DIMETHYL CYCLOPENTANE	0.000	3.050	0.070
50 CYCLOHEXENE	0.000	0.960	0.005
51 2 METHYL HEXENE-1	0.000	0.450	0.004
52 2 3 DIMETHYL PENTENE-2	0.000	1.900	0.005
53 N HEPTANE	0.000	46.000	1.212
54 3 METHYL HEXENE-1	0.000	6.300	0.016
55 3 METHYL HEXENE-3	0.000	2.000	0.010
56 CIS 1 2 DIMETHYL CYCLOPENTANE	0.000	2.000	0.032
57 HEPTENE-3	0.000	0.100	0.000
58 BENZENE	0.000	116.300	4.208
59 2 METHYL HEXENE-2	0.000	8.800	0.031
60 HEPTENE-2	0.000	0.750	0.020
61 3 METHYL HEXENE 2	0.000	4.600	0.028
62 C7 OLEFINE	0.000	0.970	0.037
63 METHYL CYCLOHEXANE	0.000	18.800	0.431
64 2 5 DIMETHYL HEXANE	0.000	2.000	0.039
65 2 4 DIMETHYL HEXANE	0.000	2.280	0.039
66 ETHYL CYCLOPENTANE	0.000	2.080	0.032
67 1 2 4 TRIMETHYL CYCLOPENTANE	0.000	1.360	0.006
68 2 3 4 TRIMETHYL PENTANE	0.000	3.400	0.099
69 2 3 3 TRIMETHYL PENTANE	0.000	6.290	0.063
70 2 3 DIMETHYL HEXANE	0.000	2.480	0.041
71 2 METHYL HEPTANE	0.000	9.400	0.228
72 4 METHYL HEPTANE	0.000	3.190	0.059
73 3 4 DIMETHYL HEXANE	0.000	0.890	0.015
74 3 METHYL HEPTANE	0.000	2.150	0.044
75 TRANS 1 3 DIMETHYL CYCLOHEXANE	0.000	2.040	0.041

Table 6 - 6 cont'd

GASOLINE COMPONENT	OVERALL Min	Max	Mean
76 CIS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	3.630	0.035
77 TRANS 1 ETHYL 3 METHYL CYCLOPENTANE	0.000	2.750	0.032
78 N OCTANE	0.000	14.900	0.232
79 C8 OLEFINE	0.000	0.550	0.010
80 TRANS 1 2 DIMETHYL CYCLOHEXANE	0.000	0.340	0.009
81 2 4 DIMETHYL HEPTANE	0.000	7.310	0.006
82 TOLUENE	0.000	194.800	6.791
83 2 6 DIMETHYL HEPTANE	0.000	9.500	0.132
84 3 5 DIMETHYL HEPTANE	0.000	0.920	0.016
85 2 METHYL OCTANE	0.000	4.650	0.115
86 4 METHYL OCTANE	0.000	9.700	0.008
87 3 METHYL OCTANE	0.000	3.600	0.077
88 N NONANE	0.000	19.220	0.349
89 ETHYL BENZENE	0.000	35.900	0.781
90 M XYLENE	0.000	103.900	2.409
91 P XYLENE	0.000	3.710	0.039
92 DIMETHYL OCTANE	0.000	1.380	0.019
93 O XYLENE	0.000	37.000	0.971
94 4 METHYL NONANE	0.000	8.570	0.028
95 2 METHYL NONANE	0.000	4.030	0.017
96 TRIMETHYL HEPTANE	0.000	8.300	0.179
97 ISOPROPYL BENZENE	0.000	27.100	0.525
98 3 METHYL NONANE	0.000	20.480	0.062
99 N-DECANE	0.000	6.810	0.193
100 N PROPYL BENZENE	0.000	33.200	0.307
101 1 METHYL 3 ETHYL BENZENE	0.000	5.000	0.071
102 1 METHYL 4 ETHYL BENZENE	0.000	2.280	0.007
103 1 3 5 TRIMETHYL BENZENE	0.000	7.780	0.054
104 C11 PARAFFIN	0.000	1.320	0.011
105 C11 PARAFFIN	0.000	1.140	0.040
106 1 METHYL 2 ETHYL BENZENE	0.000	2.160	0.035
107 1 2 4 TRIMETHYL BENZENE	0.000	9.780	0.216
108 SEC BUTYL BENZENE	0.000	0.760	0.001
109 C11 PARAFFIN	0.000	0.410	0.003
110 AROMATIC	0.000	5.200	0.006
111 1 2 3 TRIMETHYL BENZENE	0.000	7.140	0.022
112 N UNDECANE	0.000	0.000	0.000
113 C11 PARAFFIN	0.000	0.000	0.000
114 1 METHYL 3 PROPYL BENZENE	0.000	1.340	0.005
115 N BUTYL BENZENE	0.000	0.910	0.011
116 1 3 DIMETHYL 5 ETHYL BENZENE	0.000	0.000	0.000
117 1 METHYL 2 PROPYL BENZENE	0.000	0.160	0.001
118 1 4 DIMETHYL 2 ETHYL BENZENE	0.000	0.890	0.004
119 1 3 DIMETHYL 4 ETHYL BENZENE	0.000	0.920	0.006
120 1 2 DIMETHYL 4 ETHYL BENZENE	0.000	9.000	0.104
121 C10 AROMATIC	0.000	0.300	0.002
122 C12 PARAFFIN	0.000	0.000	0.000
123 INDENE	0.000	17.900	0.077
124 C12 PARAFFIN	0.000	7.060	0.023
125 1 3 DIMETHYL 2 ETHYL BENZENE	0.000	0.550	0.002
126 1 2 4 5 TETRAMETHYL BENZENE	0.000	1.670	0.006
127 1 2 3 5 TETRAMETHYL BENZENE	0.000	3.700	0.014
128 N DODECANE	0.000	1.140	0.002
129 C11 PARAFFIN	0.000	0.000	0.000
130 C10 AROMATIC	0.000	0.850	0.008
131 C11 AROMATIC	0.000	0.200	0.001
132 INDENE	0.000	2.700	0.007
133 C11 AROMATIC	0.000	0.000	0.000
134 2 3 DIHYDRO 4 METHYL INDENE	0.000	0.220	0.001
135 DIMETHYL PROPYL BENZENE	0.000	0.200	0.001
136 C11 AROMATIC	0.000	0.280	0.002
137 2 3 DIHYDRO 1 3 DIMETHYL INDENE	0.000	0.295	0.002
138 C11 AROMATIC	0.000	0.130	0.000
139 C11 AROMATIC	0.000	0.270	0.001
140 N TRIDECANE	0.000	0.727	0.001
141 2 3 DIHYDRO 1 6 DIMETHYL INDENE	0.000	0.580	0.004
142 NAPHTHALENE	0.000	2.780	0.003
143 2 3 DIHYDRO 4 7 DIMETHYL INDENE	0.000	0.270	0.001
144 DIHYDRO DIMETHYL INDENE	0.000	0.200	0.002
145 1 METHYL NAPHTHALENE	0.000	0.750	0.002
146 2 METHYL NAPHTHALENE	0.000	4.300	0.011
147 METHANOL	0.000	132.900	1.202
148 ETHANOL	0.000	0.000	0.000
149 TERTIARY BUTYL ALCOHOL	0.000	29.880	0.258
150 METHYL TERTIARY BUTYL ETHER	0.000	169.600	1.832
151 TOTAL HYDROCARBONS	0.500	3614.900	207.004

Table 7 Minimum, maximum and arithmetic mean exposures (mg/m^3) to individual compounds, groups of components and total hydrocarbons by job groups

COMPONENT / GROUP	Group 1: ROAD TOP <1 Hour			Group 2: ROAD BOTTOM <1 Hour			Group 3: S. STN. SELF-FILL		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
PROPANE	0.000	106.250	7.902	0.000	9.500	0.514	0.000	42.360	8.226
BUTANES	0.000	2149.550	216.968	0.730	70.020	12.290	4.960	451.950	114.958
PENTANES	0.050	1018.540	131.439	0.000	74.470	12.499	9.550	235.540	64.038
HEXANES	0.000	359.463	39.464	0.000	49.880	5.659	1.610	104.610	23.576
HEPTANES	0.000	143.793	8.153	0.000	17.240	1.628	0.000	32.770	4.037
OCTANES	0.000	30.464	1.255	0.000	12.850	1.277	0.000	19.520	1.976
NONANES	0.000	143.793	8.153	0.000	17.240	1.628	0.000	32.770	4.037
CYCLOPENTANE	0.000	17.060	1.996	0.000	3.150	0.222	0.000	4.610	1.425
N-HEXANE	0.000	47.400	8.293	0.000	6.500	1.275	0.000	15.900	3.348
CYCLOHEXANE	0.000	24.860	1.961	0.000	1.160	0.020	0.000	0.000	0.000
CYCLOHEXENE	0.000	0.960	0.028	0.000	0.050	0.001	0.000	0.000	0.000
BENZENE	0.000	60.500	6.098	0.000	5.480	1.434	0.000	13.130	4.325
TOLUENE	0.000	63.100	11.335	0.005	43.700	6.472	0.050	17.440	3.991
XYLENES	0.000	13.310	0.543	0.000	4.230	0.347	0.000	4.660	0.336
TRIMETHYLBENZENES	0.000	40.100	5.223	0.000	30.500	6.325	0.000	5.480	1.194
CUMENE	0.000	6.500	0.358	0.000	27.100	3.435	0.000	0.250	0.012
NAPHTHALENE	0.000	2.780	0.020	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL HYDROCARBONS	6.400	3029.800	450.796	8.200	235.920	76.144	52.300	728.520	244.111

COMPONENT / GROUP	Group 4: ROAD TOP >1 Hour			Group 5: ROAD BOTTOM >1 Hour			Group 6: ROAD DELIVERY		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
PROPANE	0.000	15.800	1.592	0.000	11.560	0.422	0.000	50.200	2.263
BUTANES	0.000	459.030	49.073	0.000	352.030	28.595	0.100	937.690	66.931
PENTANES	0.000	507.270	32.915	0.100	310.330	15.980	0.500	320.850	38.506
HEXANES	0.000	226.640	12.445	0.000	86.650	5.627	0.000	477.900	26.730
HEPTANES	0.000	46.570	2.800	0.000	34.640	1.812	0.000	101.100	5.081
OCTANES	0.000	22.010	1.082	0.000	25.780	1.001	0.000	17.900	0.756
NONANES	0.000	46.570	2.800	0.000	34.640	1.812	0.000	101.100	5.081
CYCLOPENTANE	0.000	8.700	0.608	0.000	5.920	0.314	0.000	20.700	1.166
N-HEXANE	0.000	58.600	2.914	0.000	19.750	1.284	0.000	37.700	3.121
CYCLOHEXANE	0.000	10.900	0.582	0.000	1.600	0.169	0.000	43.200	2.268
CYCLOHEXENE	0.000	0.170	0.006	0.000	0.000	0.000	0.000	0.000	0.000
BENZENE	0.000	30.700	1.734	0.000	12.000	1.212	0.000	101.900	5.086
TOLUENE	0.000	66.300	3.856	0.000	13.000	1.507	0.500	189.200	10.255
XYLENES	0.000	2.780	0.170	0.000	2.520	0.095	0.000	0.700	0.024
TRIMETHYLBENZENES	0.000	31.000	1.865	0.000	13.310	1.519	0.000	176.800	7.790
CUMENE	0.000	4.500	0.241	0.000	7.120	0.400	0.000	1.600	0.072
NAPHTHALENE	0.000	0.530	0.008	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL HYDROCARBONS	4.140	1229.400	117.560	0.500	728.300	65.614	3.200	3614.900	218.054

COMPONENT / GROUP	Group 7: S. STN. ATTENDANT			Group 8: SHIPS CLOSED			Group 9: SHIPS OPEN		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
PROPANE	0.000	1.700	0.445	0.000	10.780	2.936	0.000	2.230	0.479
BUTANES	2.120	40.710	10.610	0.340	711.930	188.084	0.110	101.150	26.840
PENTANES	0.600	28.710	9.787	1.020	295.260	85.578	0.160	149.390	38.429
HEXANES	0.200	8.360	2.191	0.100	81.930	25.893	0.000	52.240	14.916
HEPTANES	0.000	5.450	0.556	0.000	41.390	6.861	0.080	9.700	3.725
OCTANES	0.000	1.060	0.169	0.000	10.460	1.832	0.000	7.360	1.957
NONANES	0.000	5.450	0.556	0.000	41.390	6.861	0.080	9.700	3.725
CYCLOPENTANE	0.000	0.570	0.064	0.000	4.070	1.031	0.000	3.960	1.151
N-HEXANE	0.000	2.950	0.432	0.000	10.050	4.151	0.000	4.660	1.759
CYCLOHEXANE	0.000	0.000	0.000	0.000	1.020	0.113	0.000	0.000	0.000
CYCLOHEXENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.013
BENZENE	0.000	1.280	0.352	0.000	21.890	4.644	0.090	4.620	1.470
TOLUENE	0.160	1.900	0.583	0.100	17.910	4.202	0.110	12.940	3.050
XYLENES	0.000	0.380	0.042	0.000	1.630	0.243	0.000	1.910	0.936
TRIMETHYLBENZENES	0.000	0.980	0.179	0.000	11.050	2.133	0.160	16.450	3.394
CUMENE	0.000	0.100	0.008	0.000	0.000	0.000	0.000	0.000	0.000
NAPHTHALENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL HYDROCARBONS	7.890	101.340	29.271	2.380	1089.400	339.737	2.440	322.010	118.023

Table 7 cont'd

COMPONENT GROUP	Group 10: BARGES CLOSED Min	Max	Mean	Group 11: JETTYMEN Min	Max	Mean	Group 12: RAILCAR TOP Min	Max	Mean
PROPANE	0.000	10.490	2.385	0.000	67.710	3.730	0.000	4.470	0.870
BUTANES	0.430	415.420	77.785	0.050	320.870	39.096	0.000	245.140	32.994
PENTANES	0.000	718.160	94.790	0.100	206.950	39.227	0.000	196.630	25.024
HEXANES	0.000	191.460	26.855	0.000	101.120	18.846	0.000	69.780	10.091
HEPTANES	0.000	43.430	7.288	0.000	21.750	3.506	0.000	26.730	2.461
OCTANES	0.000	30.080	4.266	0.000	10.580	1.735	0.000	21.430	1.081
NONANES	0.000	43.430	7.288	0.000	21.750	3.504	0.000	26.730	2.461
CYCLOPENTANE	0.000	24.310	2.458	0.000	7.380	1.140	0.000	5.430	0.647
N-HEXANE	0.000	46.100	6.284	0.000	7.040	1.631	0.000	4.890	1.205
CYCLOHEXANE	0.000	5.040	0.460	0.000	0.360	0.014	0.000	2.000	0.263
CYCLOHEXENE	0.000	0.000	0.000	0.000	0.340	0.028	0.000	0.000	0.000
BENZENE	0.000	31.540	4.729	0.000	5.880	1.522	0.000	9.460	1.450
TOLUENE	0.050	24.360	5.835	0.050	8.900	2.390	0.100	27.920	2.808
XYLENES	0.000	2.100	0.340	0.000	4.440	0.487	0.000	17.560	0.623
TRIMETHYLBENZENES	0.000	11.870	2.170	0.000	6.990	1.755	0.000	22.830	1.816
CUMENE	0.000	0.940	0.168	0.000	0.400	0.067	0.000	0.900	0.226
NAPHTHALENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL HYDROCARBONS	1.530	1750.400	262.933	3.300	658.210	120.113	2.000	535.430	84.710

COMPONENT GROUP	Group 13: DRUMMING Min	Max	Mean	Group 14: PRODUCTION-ONSITE Min	Max	Mean	Group 15: PRODUCTION-OFFSITE Min	Max	Mean
PROPANE	0.000	11.300	1.511	0.000	47.060	2.042	0.000	2.800	0.583
BUTANES	0.000	606.400	227.067	0.000	808.420	17.718	0.000	309.610	16.597
PENTANES	24.100	405.000	193.155	0.000	455.560	11.876	0.000	147.380	10.321
HEXANES	2.400	916.300	187.824	0.000	542.360	10.698	0.000	117.500	9.645
HEPTANES	0.000	172.800	39.332	0.000	41.690	1.357	0.000	70.530	3.955
OCTANES	0.000	23.700	4.879	0.000	5.660	0.202	0.000	39.720	2.276
NONANES	0.000	172.800	39.332	0.000	41.690	1.357	0.000	70.530	3.955
CYCLOPENTANE	0.000	12.800	4.689	0.000	0.730	0.023	0.000	5.800	0.232
N-HEXANE	2.400	297.300	51.822	0.000	154.270	2.967	0.000	13.490	2.751
CYCLOHEXANE	0.000	56.500	14.000	0.000	7.700	0.160	0.000	0.000	0.000
CYCLOHEXENE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BENZENE	0.000	116.300	27.222	0.000	23.800	0.878	0.000	14.100	0.967
TOLUENE	3.100	194.800	41.289	0.000	67.100	2.008	0.000	19.600	2.193
XYLENES	0.000	0.000	0.000	0.000	4.860	0.121	0.000	0.790	0.072
TRIMETHYLBENZENES	0.000	131.700	24.255	0.000	32.830	0.933	0.000	21.630	2.459
CUMENE	0.000	6.400	1.422	0.000	1.130	0.195	0.000	12.630	1.264
NAPHTHALENE	0.000	0.000	0.000	0.000	0.180	0.011	0.000	0.070	0.005
TOTAL HYDROCARBONS	61.100	1747.800	858.356	0.670	1819.000	52.833	3.770	922.800	66.001

COMPONENT GROUP	OVERALL Min	Max	Mean
PROPANE	0.000	106.250	2.393
BUTANES	0.000	2149.550	75.040
PENTANES	0.000	1018.540	53.571
HEXANES	0.000	916.300	28.031
HEPTANES	0.000	172.800	6.170
OCTANES	0.000	39.720	1.716
NONANES	0.000	172.800	6.170
CYCLOPENTANE	0.000	24.310	1.144
N-HEXANE	0.000	297.300	6.214
CYCLOHEXANE	0.000	56.500	1.334
CYCLOHEXENE	0.000	0.960	0.005
BENZENE	0.000	116.300	4.208
TOLUENE	0.000	194.800	6.010
XYLENES	0.000	24.700	0.584
TRIMETHYLBENZENES	0.000	176.800	4.201
CUMENE	0.000	27.100	0.525
NAPHTHALENE	0.000	2.780	0.003
TOTAL HYDROCARBONS	0.000	3614.900	207.004

Table 8 Benzene exposure data summary

OPERATION	No. of Samples	Arithmetic Mean (mg/m^3)	Standard Deviation (mg/m^3)	Geometric Mean (mg/m^3)	Geometric S.D.[b]	Exposure levels (mg/m^3) exceeded by: 10%	5%	1%	Percentages of exposures exceeding: 1 / 3	2.5 / 8	5 / 16	10 / 33	20 / 66	ppm (mg/m^3)
Short-term														
1. Road top <1 hr	142	6.0	6.9	1.6	2.9	14	17	25	62	27	6	1	0	
2. Road bottom <1 hr	59	1.4	1.4	0.27	2.6	3.8	4.3	5.5[a]	12	0	0	0	0	
3. Service Station self-fill	21	4.3	4.1	2.0	3.4	12	13	ID[c]	43	19	0	0	0	
Long-term														
4. Road top >1 hr	63	1.7	4.0	0.30	4.5	3.7	4.7	31[a]	19	2	2	0	0	
5. Road bottom >1 hr	34	1.2	2.6	0.18	5.5	3.3	8.9	15[a]	9	6	0	0	0	
6. Road delivery	29	5.1	18.9	0.23	8.9	4.8	19	ID[c]	14	7	3	3	3	
7. Service Station attendant	13	0.35	0.38	0.060	3.1	0.95	1.4[a]	ID[c]	0	0	0	0	0	
8. Ships closed	9	4.6	6.9	2.2	4.2	16	31[a]	ID[c]	33	22	11	0	0	
9. Ships open	8	1.5	1.6	1.3	4.1	4.2	5.7[a]	ID[c]	13	0	0	0	0	
10. Barges closed	11	4.7	9.8	0.14	54.5	21	37[a]	ID[c]	27	18	9	0	0	
11. Jettymen	21	1.5	1.8	0.43	4.6	5.3	5.8	ID[c]	14	0	0	0	0	
12. Railcar top	32	1.5	2.7	0.15	5.2	7.5	9.0	13[a]	13	6	0	0	0	
13. Drumming	9	27.2	34.6	9.1	2.8	72	200[a]	ID[c]	89	78	67	11	11	
14. Production - onsite	62	0.88	3.9	0.022	13.3	0.83	2.1	24[a]	3	3	3	0	0	
15 Production - offsite	27	0.97	2.8	0.070	6.4	1.5	6.5	ID[c]	7	4	0	0	0	

Notes:

(a) Extrapolated from data distribution on probability graph
(b) GSD is not reliable as data sets contain values of zero
(c) ID - Insufficient data for extrapolation

APPENDIX I - EXPOSURE STATISTICS AND STATISTICAL ANALYSIS OF DATA

In most countries the concept of "compliance" with exposure limits is not defined rigorously. For example. in the UK, exposure limits are defined as "levels which should not normally be exceeded". A set of exposure measurements for a specific operation will typically contain values covering a wide range from zero, i.e. below the limit of detection, to possibly above the exposure limit. Statistical analysis and professional hygiene judgement can assist in the assessment of such a set of data for compliance.

An approach which is commonly followed by professional hygienists is to accept that data are in compliance when not less than 95% of the measurements are below the exposure limit. In simplest terms this can be taken as no more than one in twenty values exceeding the limit. However this simple approach can give rise to problems, for example:

- it may not be possible to collect twenty samples;
- interpretation may be difficult if there are spurious values in the sample set due to contaminated samplers, samples that have been tampered with, samples taken during a spillage or other atypical event, samples taken when wrong operating procedures have been followed, etc.

A better approach is to use a statistical analysis of the data such as probability (or cumulative frequency) plotting. This involves plotting, on special graph paper, the exposure data values arranged in ascending order against their frequency of occurrence (expressed as a cumulative percentage). This cumulative percentage is not based on simple proportion i.e. 1 value = 5% of 20 values, but on a statistically derived weighting.

In practice it is generally found that plotting the log values of the exposures against the cumulative frequency percentages gives the straightest line plot, which implies that the distribution of the data is lognormal rather than normal. Normal distributions (theoretically) contain negative values whereas exposures can obviously only be zero or positive. Lognormal distributions are truncated above zero (as there is no log of zero) and tend to tail off toward higher concentration more than normal distributions.

A lognormal distribution can be characterised by two statistical parameters, the geometric mean (the value above and below which 50% of the data lies) and the geometric standard deviation (the slope of the cumulative frequency plot) which is a measure of the variability of the data. From these two values the best fit line (theoretical distribution) can be drawn. It should be noted however that the value of the geometric standard deviation (GSD) is not very reliable when data contain a significant percentage of zero values. Because there is no log of zero, some positive value must be assigned to zero results, i.e. exposures below the limit of

detection of the method, in order to calculate the GSD. A value of half the detection limit is commonly used. Whatever value is chosen affects the GSD; the lower the chosen value the greater is the GSD.

These plots can be used to predict the probability of exposures exceeding any limit value, either from the plotted data lines, where there are sufficient data, or by extrapolating from either the plotted data line or the "best fit" line.

In practice the 95% "compliance" point is best assessed from the concentration at which the plotted data line (rather than the "best fit" line) crosses the 95th percentile. If the data are insufficient to reach the 95th percentile then either the plotted data line or the "best fit" line can be extrapolated to it, exercising judgement on which appears to be likely to give the most probable value. It is imprudent to extrapolate these lines too far.

The cumulative frequency plot can be used to determine compliance at other percentages or, conversely it can also be used to determine the percentage of exposure values in excess of any particular value.