a survey of european diesel fuel quality

Prepared for the CONCAWE Automotive Emissions Management Group by its Special Task Force, AE/STF-2

W. Dörmer (Chairman)

G. Fiolet
R. de las Heras
P. Hoornaert
Ms. S. Ingram
R. Jörgensen
G. de Vecchi

R.C. Hutcheson (Technical Coordinator)

Brussels
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ABSTRACT

CONCAWE has conducted a survey of diesel fuel quality in fifteen European countries. Over 1300 samples were collected in the period 1991-1993 and analysed. This report summarizes the findings by country. Only limited data were available for fuel composition and are presented in a separate appendix.

KEYWORDS

Diesel fuel, characteristics, composition, Europe, fuel specification, survey

CONTENTS

SUMMARY

CONCAWE has conducted a survey of diesel fuel quality in Europe (15 countries). Over 1300 samples were collected during 1991, 1992 and 1993 and analyzed by member companies or independent laboratories (**Appendix 1**). This report summarizes the findings by country. The following fuel characteristics are reported:

- Density at 15°C [kg/m³]
- Viscosity at 40°C [mm²/s]
- Distillation [°C; vol.%]
- Sulphur [mass%]
- Cetane Index
- Cetane Number
- Cloud Point (CP) [°C]
- Cold Filter Plugging Point (CFPP) [°C]

Only limited data are available for fuel composition and are presented as **Appendix 6.**

1. INTRODUCTION

This report describes the quality of automotive diesel fuel in the European market. It will thus provide a useful reference baseline for ongoing studies (in CONCAWE and elsewhere) which are assessing the implications of adjusting diesel fuel characteristics.

The majority of previous investigations (for example, surveys by Ethyl, Octel, Paramins, etc.) have focused on winter quality product and, whilst of great interest, have been limited in terms of the number of samples analysed. This new survey has the advantage of a larger data base and also includes data for summer grade diesel fuel.

The survey is "historical" and typically covers the 1991/92 and 1992/93 winter months, plus the 1992 and 1993 summer seasons.

The objectives of this report are:

- to determine the quality of automotive diesel fuel marketed in Europe during the sampling period

- to provide comprehensive data on fuel characteristics to assist in the development of sound cost estimates for changes in those parameters.

2. METHODOLOGY

In each country, the diesel fuel samples were taken at various locations, such as refineries, terminals or service stations. These samples were subsequently tested in laboratories run by either the major fuel retailers or by independent laboratories. **Appendix 1** contains an overview of the number of samples taken during the summer or winter period, by country. The report contains analysis results for a total of 1302 fuel samples (582 summer grade; 720 winter grade). The diesel fuel samples were not tested for all the relevant characteristics in every country. **Appendix 2** gives an overview of the fuel parameters tested in individual countries. The test methods used in each country are shown in **Appendix 3**. Surveys carried out by individual CONCAWE member companies were collated by the CONCAWE Secretariat to maintain the confidentiality of the data source and to preserve the anonymity of the fuel samples. They were then transferred to the corresponding overviews by AE/STF-2, a Special Task Force of the Automotive Emissions Management Group.

The complete information on which this report is based represents a very large body of data and is available on 3.5" diskettes from CONCAWE upon request. A small handling charge may be applied. Please contact the Secretariat for further information.

STF-2 evaluated the data provided and drew up appropriate overviews for each country which, in addition to the ranges (min, max.) and average values of the individual parameters, also contain details of the number of samples, and the period during which the samples were taken (**Appendix 4**).

The fuel specification requirements applicable at the time the samples were taken are also included. The ranges and average values for the most relevant fuel parameters for each country are also presented graphically (**Appendix 5**).

At the time of sampling, data relating to composition (aromatic content) of diesel fuels was limited. Although a test method was available, it was not generally recognized or employed. Data from more recent tests for some countries are therefore contained in **Appendix 6**.

The most relevant information concerning:

- sampling/testing
- specifications
- additives
- sales (consumption)

can be found in the "Quality Statement" section for each country. Such information was not made available for Greece and Portugal.

Sales (consumption) quoted in this report are based on information from the International Energy Agency (IEA).[1]

3. QUALITY STATEMENTS

3.1. AUSTRIA

Sampling/Testing

Samples were taken from retail sites all over Austria. In addition, a few samples were drawn from the main ÖMV distribution terminal in Schwechat (near the refinery).

Retail samples were tested by an independent laboratory. Samples from the distribution terminal were tested in the research laboratory of ÖMV. Test methods were according to Austrian national standard ÖNORM C 1104, which were changed in late 1993 to ÖNORM EN 590.

Specifications

By law the Austrian standard is the mandatory specification for diesel fuel.

Additives

About 50% of the fuels marketed included detergent additives of unknown performance.

1992 Sales

2.384 metric tons x 10^6.

3.2. BELGIUM

Sampling/Testing

The diesel fuel samples for this report were taken at service stations. The analyses have been carried out in a CONCAWE member company laboratory.

Specifications

Currently, the national fuel specification NBN T 52-713 is in force. This specification has legal status. In the near future CEN EN 590 will replace the existing specification.

Extract from the national fuel specification NBN T 52-713 (1988)

Cetane number		min. 46
Density at 15°C	kg/l	min. 0.820 max. 0.870
Distillation at 250°C at 350°C	 vol. % vol. %	 max. 65 min. 85
Sulphur	mass%	max. 0.2
CFPP	°C	Winter* max. -15 Summer max. 0
Viscosity at 40°C	mm²/s	max. 4

* Winter period: 1 December to 1 March

Additives

Only a few suppliers were using cetane improvers and/or detergent additives (volume base: 30 to 40%) in their diesel fuel.

1992 Sales

3.610 metric tons x 10^6.

3.3. DENMARK

Sampling/Testing

Data for this report were all collected from terminals in Denmark during 1992.

Specifications

Denmark has no national standard.

Two grades of automotive diesel fuel are available:

CEN diesel and Bus diesel (light diesel). [2]

Bus diesel is normally supplied directly to large customers such as bus and taxi companies. It is not available at service stations.

There is a tax incentive for diesel fuels with a low sulphur content. [2]

Additives

Performance additives were used in about 70% of the fuels but types are unknown.

1992 Sales

1.410 metric tons x 10^6.

3.4. FINLAND

Sampling/Testing

Data for this report were all collected from refineries and terminals in Finland during 1991 - 1993.

Specifications

During this period four grades of automotive diesel fuel were available:

> summer, winter, special winter and arctic, according to "market specifications".

Grades differ in terms of CP, CFPP, density and viscosity.

This survey covers summer and winter grades.

From 01.07.93 a new tax law was applied, giving incentives for "sulphur free" fuel, with a maximum sulphur content of 0.005% mass. [2]

Since 1994, EN 590 has been applied to five qualities ("sulphur free" summer/winter, normal summer:winter and arctic grades) which comply with the "market specification".

Data was not available for viscosity and cold flow properties.

Additives

The use of detergent additives was estimated at 30% of the diesel market.

1992 Sales

1.460 metric tons x 10^6.

3.5. FRANCE

Sampling/Testing

The diesel fuel samples tested for this report were either taken at service stations run by six oil companies (in the vicinity of their respective refineries) or at outlets run by hypermarkets (non-branded) near large cities. The ratio branded/non-branded amongst the samples was 66/33 for summer grade and 78/28 for winter.

Specifications

At the time of sampling, the required cetane level was 48 and the maximum sulphur level was 0.3% mass. Cloud and CFPP were required to have a maximum lower than -5°C for winter grade. EN 590 was introduced on 1 April 94, but all winter grade diesel fuels are marketed with a -5°C cloud point under an industry agreement.

At that time the "Cahier des charges des constructeurs" had been proposed by Renault and Peugeot, but only two companies (branded) were selling labelled diesel fuel.

Additives

Amongst these samples, only one was seen to contain a significant amount of cetane improver. Detergent additives were found systematically in branded samples (35% of the market).

1992 Sales

19.412 metric tons x 10^6.

3.6. GERMANY

Sampling/Testing

The samples of diesel fuels tested for this report were all taken at service stations run by the five major fuel retailers (classified as A) in the vicinity of the corresponding refinery, at service stations run by smaller fuel retailers (classified as B), and at outlets run by discounters (hypermarkets), in areas selected for their high consumer density.

The tests were carried out in laboratories run by the A companies and test results were checked jointly.

Specifications

When the samples were taken, DIN 51 601 specification was in force. Since January 1994, DIN EN 590 has applied. This norm is embodied in the so-called 10. BImSchV (Bundes Immissionsschutzverordnung).

This regulation lays down that any fuels not complying with the limits of DIN EN 590 may not be introduced into the market. Quality compliance is checked by an inspectorate and failure to comply is dealt with accordingly.

Low temperature performance is adjusted seasonally. An overview of the CP and CFPP requirements applying to branded fuels (oil industry exchange agreements) for the specified periods is as follows:

CLASSIFICATION	Period	CP [°C]* max.	CFPP [°C] max.
Summer grade	15.04. to 14.09.	+ 5	- 2
Winter grade	01.11. to 29.02.	- 7	- 22
Intermediate grade	15.09. to 31.10. 01.03. to 14.04.	- 3	- 13

* Oil Industry Exchange Agreement

Additives

The fuels marketed by the five majors all contained their own individual, multi-purpose additive packages. Features of these packages, introduced in 1987, include some, or all, of the following benefits:

- detergents for injector nozzle cleanliness
- cetane improver
- anti-foam
- corrosion inhibitor
- odorants

During the winter period, in addition to flow improvers (max. 500 ppm), the branded fuels contain a minimum of 150 ppm wax anti settling additive (WASA) for improved cold operability.

1992 Sales

19.533 metric tons x 10^6.

3.7. GREECE

No information available.

3.8. ITALY

Sampling/Testing

Samples were taken during January and February 1992 (winter data) and during July and August 1992 (summer data).

All samples came from branded service stations, no samples were taken at terminals or refineries.

Stations are owned and maintained (but not directly operated) by the oil companies. Samples were taken at branded service stations.

Total sales through independent stations is very limited.

The sampling plan is representative of main markets (i.e. large cities) and refineries, or main supply routes. Samples were taken in Turin, Genoa, Milan, Piacenza, Trieste, Venice, Bologna, Florence, Rome, Ancona, Pescara, Taranto, Naples, Palermo, Catania, Cagliari.

Although the total number of samples is roughly proportional to the market share of different companies, samples are not fully sales-weighted in every area, to take account of product exchanges.

Specifications

At the time of sampling the national specification CUNA NC 630-01 was applicable, with the following key characteristics:

- density 805 - 860 kg/m³
- viscosity at 37.8°C 2 - 5.35 mm²/s
- cetane index 48
- cetane number 47
- CFPP (winter) -10°C
- pour point (summer) -6°C
- sulphur 0.30%wt

On 1 October 1993, CEN EN 590 was adopted as UNI-CUNA EN 590.

The following classes were adopted:

- summer, class B (0°C CFPP), 16/3 - 14/11
- winter, class D (-10°C CFPP), 15/11 - 15/3

Additives

It is estimated that about 30% of marketed diesel fuels contained detergent additives.

1992 Sales

14.955 metric tons x 10^6.

Total inland sales through service stations in 1992 were 9.688 metric tons x 10^6.

Note on a particular diesel fuel:

In 1992 one refinery marketed a fuel with distinctive characteristics. This diesel fuel was derived from a highly paraffinic crude. As a consequence, its density was below 820 kg/m³, and its cetane number was above 60. To comply with CEN EN 590, this particular quality was withdrawn from the market.

3.9. THE NETHERLANDS

Sampling/Testing

Most of the diesel fuel samples were taken at service stations in the neighbourhood of refineries. The majority of samples were from major oil companies. Analyses were carried out at either CONCAWE member company or independent laboratories.

Specifications

Only some diesel properties are legally specified. CEN-EN 590 came into force in 1993, but this specification has no legal status.

Additives

Diesel fuel supplied by the major companies often contained detergent additives, particularly when the product was distributed into the retail market. The penetration of detergent additives was estimated at 35% of the total diesel volume.

In addition, some products also contained a cetane improver, resulting in a boost in cetane number of a few points. This is important when interpreting cetane number versus cetane index figures.

During the winter period, some suppliers use a wax anti settling additive (WASA) for improved operability, in addition to flow improvers.

1992 Sales

3.646 metric tons x 10^6.

3.10. NORWAY

Sampling/Testing

Data for this report were all collected from refineries and terminals in Norway during 1992 - 1993.

Specifications

Norway has no national standard.

Two grades of automotive diesel are available:

- summer and winter, according to government regulations
- because of the ambient temperature conditions there are different "climatic grades".

This survey covers the grades with a CFPP specification of:

-11°C (GO-11), - 16°C (GO-16) and - 24°C (GO-24).

The maximum sulphur content is 0.5% mass, but there are tax incentives[2] for sulphur contents between:

0.25 - 0.5 / 0.05 - 0.25 / < 0.05

Data was not available for cetane number.

Additives

Performance additives were present in about 73% of the diesel fuels. The types are not known.

1992 Sales

0.968 metric tons x 10^6.

3.11. PORTUGAL

No information available.

3.12. SPAIN

Sampling/Testing

Quality inspections for the samples included in the report correspond to cargo samples originating in the mainland refineries that supply the unified logistics system (more than 90% of the total market). The product is blended with additives to each company's specification prior to tank car loading, and is distributed and sold under the main brand names.

Imported fuel is not always handled via the unified logistics system.

Specifications

The official product specifications applying at the time of sampling were laid down in R.D. 1485/1987. The main specifications were:

	Summer Grade 1 Apr. - 14 Sept.	**Winter Grade 15 Sept. - 31 March**
Density 15°C, kg/l	0.825 - 0.860	0.825 - 0.860
Kin. Viscosity 40°C mm²/sec. max.		5.2
Distillation		
65% recovered after,°C	250	250
85% recovered before,°C	350	350
FBP, below,°C	380	380
Sulphur,% wt max.	0.3	0.3
Cetane Index, min.	45	45
Cetane Number, min.	50	50
Cloud Point,°C max.	4	- 1
CFPP,°C max.	0	- 8

Additives

Automotive diesel fuel marketed by the main operators using the unified logistic system normally contain additive packages consisting of cetane improvers, corrosion inhibitors, detergents and anti-foam agents. In winter time they generally also include cold flow improvers/wax modifiers. Other additives are also in use.

1992 Sales

9.900 metric tons x 10^6.

3.13. SWEDEN

Sampling/Testing

Data for this report were all collected from refineries and terminals in Sweden during 1992.

Specifications

In addition to two urban grades, Class 1 and Class 2, Sweden has one summer and three winter grades specified according to "SIS 155435" (13.3.91).

This survey covers the urban grades, the summer grade (D-10) and one winter grade (D-32).

The distillation range for Class 1 and 2 are significantly lighter than conventional European diesel fuel. [2]

There is tax relief for both sulphur content and composition. (Aromatic content: Class 1 max. 5% vol., Class 2 max. 20% vol.) [2]

Data were not available for cetane number.

Additives

Detergent additives are not used in the Swedish market.

1992 Sales

1.667 metric tons x 10^6.

3.14. SWITZERLAND

No information available.

3.15. UK

Sampling/Testing

The samples of diesel fuel tested for this report were taken at service stations run by major fuel retailers in the vicinity of the corresponding refinery.

Specifications

When the samples were taken, British Standard, BS2869 Part 1:1988 (Class A1) was applicable.

Since September/October 1994, BSEN590:1993 has been applied. Fuels not meeting the British Standard specification cannot be marketed.

Diesel quality is seasonal, i.e. summer and winter quality. In BS2869 Class A1, Summer and Winter periods apply at distribution terminal/depot level:

Summer = 16 March - 30 September (inclusive)

Winter = 1 October - 15 March (inclusive)

An overview of the Cold Filter Plugging Point (CFPP) specification and informal Cloud Point (CP) limit at the time of data collection are:

	CP (°C)**	**CFPP (°C)**
Summer	-	- 4 maximum
Winter	- 5 maximum	- 15 maximum

** "Informal" limit

In the BS EN 590:1993 specification, summer and winter limits apply at the retail pump.

Summer = 16 March - 21 October (inclusive)

Winter = 22 October - 15 March (inclusive)

Additives

Detergent additives were estimated to be included in 50 to 60% of marketed diesel fuel.

1992 Sales

11.086 metric tons x 10^6.

About 3.435 metric tons x 10^6 were distributed via service stations.

4. CONCLUSIONS

CONCAWE's diesel fuel quality survey provides an overview of relevant fuel parameters in fifteen European countries.

It was not possible to present true sales-weighted average qualities as insufficient samples were taken in some countries. Information on sales can be found under the "Quality Statements" for each country.

Samples were taken and tested in both winter and summer with the exception of Belgium (winter only). The period during which samples were taken is shown in the individual charts and overviews for each country. As a rule, summer fuel samples were taken in 1992 and 1993, and winter fuel samples were drawn in the winter of 1991/92 and 1992/93.

In the Nordic countries (Denmark, Finland, Norway, Sweden) and in Spain, the samples were taken at refineries/terminals. In Austria, Belgium, France, Germany, Italy, the Netherlands and the United Kingdom samples were drawn at retail service stations. In countries where a sufficient number of samples were taken the results provide a reliable overview of the corresponding market situation. In those countries where only a small number of fuel samples were tested (e.g. Greece), doubt must exist as to the real market situation.

As can be seen from the overviews of the fuel characteristics, (**Appendix 4** and **5**) and the composition (**Appendix 6**), diesel fuel qualities by country, and within individual countries, can vary significantly. The reasons are highly complex, but the following provides an outline of the basic difficulties:

- Low temperature performance is an essential feature of diesel fuel specifications and is clearly dictated by climatic conditions for each country in Europe. This has a fundamental effect on the processing routes adopted in individual countries and by individual refineries.

- The crude sources favoured by particular countries/refineries is a complex issue. Basic crude quality has a major impact on resultant diesel fuel characteristics.

- The demand ratio between gasoline, industrial gas-oil, diesel fuel and kerosene also influences diesel quality.

In CONCAWE's estimation, the use of different (albeit approved) test methods when analysing the samples has little influence on the results.

In most countries a major segment of the market enjoys the benefit of multi-functional/detergent additives. The penetration of such fuels in the individual countries is mentioned in **Section 3**, "Quality Statements". Additive type, performance and dosage cannot be established by routine testing.

For most samples (summer and winter quality), the significant spread between Cloud Point (CP) and Cold Filter Plugging Point (CFPP) indicates the use of flow improvers to enhance the cold operability of the fuels.

Wax Anti-Setting Additive (WASA) technology was employed in a number of the fuels. The benefit of the additives cannot be quantified in terms of currently measured fuel characteristics.

In some quality statements the use of cetane improvers is mentioned. Normally an estimation can be made for the use/content of cetane improver by the differences between cetane number and cetane index. That is, significantly higher cetane numbers might indicate the presence of cetane improvers.

The EN 590 specification, which is now being introduced, was not applicable in any of the countries involved at the time the samples were taken.

In this “pre EN” period, national regulations were applied. In countries where there was no legal specification in force, internal specifications drawn up by the fuel producers were used.

Some variation in fuel quality (beyond limits of reproducibility) can be seen in some of the samples. Not all the samples adhered to all the criteria given in the specifications.

In view of the fact that the EN 590 specification has now become binding in many European countries, some convergence in non-climatic fuel properties can be expected.

General Comments on the Results

These data are not sales weighted and this must be considered in any interpretation. This survey gives an overview of diesel fuel quality in Europe in 1992 and 1993, and variations from one country to another result from:

- different levels of specifications:
  - this being particularly true for cold flow properties (sulphur and cetane levels are the most uniform specifications across Europe)
- differences in refinery complexity, crude slate and demand for distillate materials
- the structure of the market.

As specifications, fuel taxes and relative market shares evolve quickly, this type of survey should be run routinely if it is to remain a useful tool for companies involved in CONCAWE activities.

5. REFERENCES

1. IEA/OECD (1994) Oil and gas information 1993. Paris: International Energy Agency

2. CONCAWE (1992 and 1994) Motor vehicle emission regulations and fuel specifications, report 2/92 and 4/94. Brussels: CONCAWE

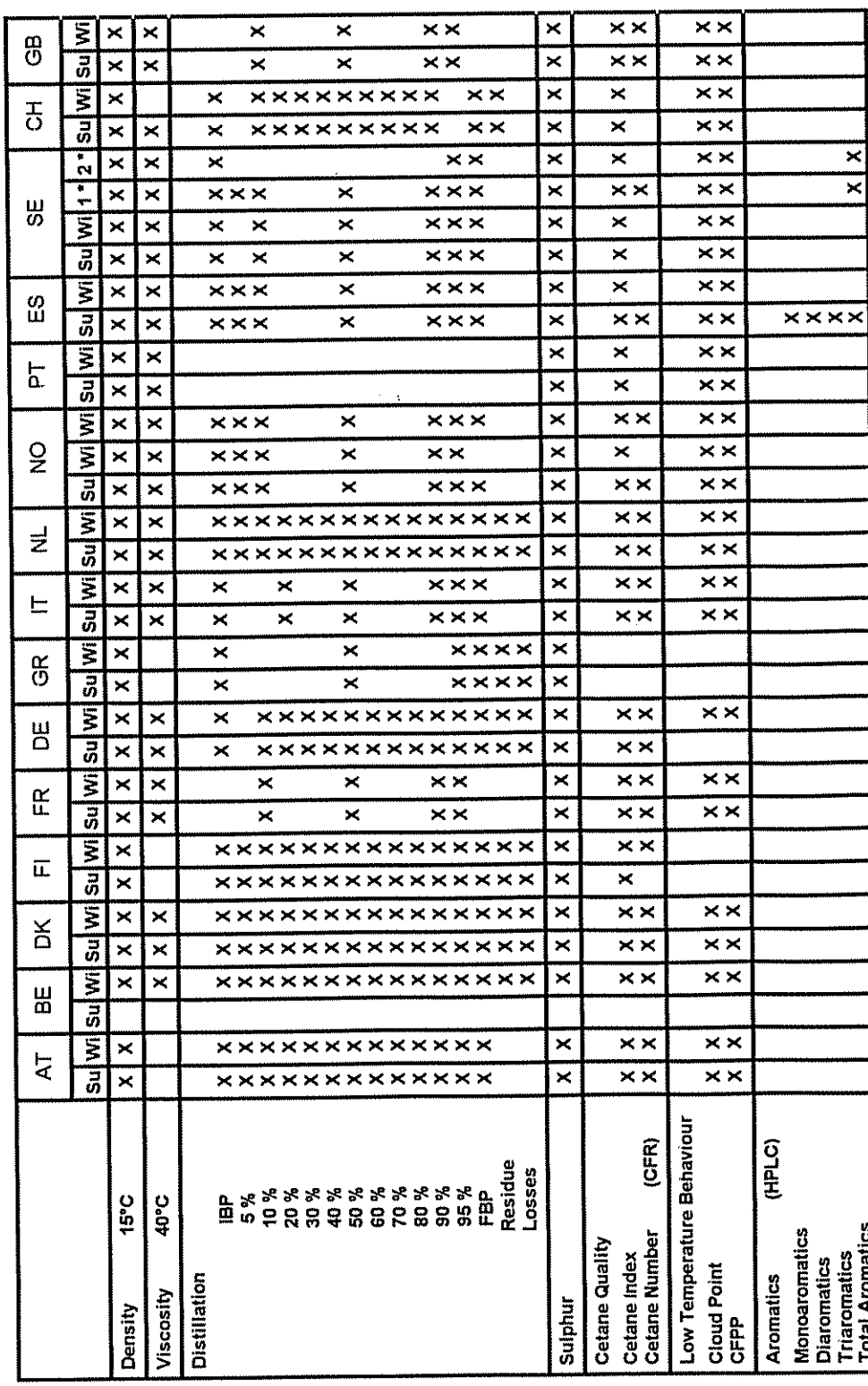
APPENDIX 1 Countries Surveyed and Sample Numbers

Country	No. of samples for summer-grade	No. of samples for winter-grade
Austria	35	18
Belgium	0	7
Denmark	9	15
Finland	4	19
France	33	42
Germany	202	227
Greece	1	2
Italy	135	136
Netherlands	20	33
Norway (page 1)	44	62
Norway (page 2)	0	60
Portugal	6	7
Sweden (page 1)	14	6
Sweden (page 2)	9	16
Spain	35	24
Switzerland	26	13
United Kingdom	9	33
Total	**582**	**720**

In Appendices 2, 3 and 5 the following ISO abbreviations have been employed to identify the countries surveyed:

ABBREVIATION	COUNTRY
AT	Austria
BE	Belgium
DK	Denmark
FI	Finland
FR	France
DE	Germany
GR	Greece
IT	Italy
NL	The Netherlands
NO	Norway
PT	Portugal
ES	Spain
SE	Sweden
CH	Switzerland
GB	United Kingdom

APPENDIX 2 Test Data Available by Country and by Season



	AT		BE		DK		FI		FR		DE		GR		IT		NL		NO		PT		ES		SE			CH		GB	
	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	1 *	2 *	Su	Wi	Su	Wi
Density 15°C	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Viscosity 40°C				X	X	X			X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Distillation																																
IBP	X	X		X	X	X	X	X			X	X	X	X	X	X	X	X	X	X			X	X	X	X		X	X	X		
5 %	X	X		X	X	X	X	X		X	X	X				X	X	X	X	X			X	X		X			X	X		
10 %	X	X		X	X	X	X	X	X	X	X	X			X		X	X	X	X			X	X	X	X		X	X	X	X	X
20 %	X	X		X	X	X	X	X		X	X	X				X	X	X	X	X			X	X		X			X	X		
30 %	X	X		X	X	X	X	X			X	X			X		X	X	X	X			X	X	X	X		X	X	X	X	X
40 %	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X		X			X	X		
50 %	X	X		X	X	X	X	X		X	X	X			X		X	X	X	X			X	X	X	X		X	X	X	X	X
60 %	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X		X			X	X		
70 %	X	X		X	X	X	X	X			X	X			X		X	X	X	X			X	X	X	X		X	X	X	X	X
80 %	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X		X			X	X		
90 %	X	X		X	X	X	X	X		X	X	X			X		X	X	X	X			X	X	X	X		X	X	X	X	X
95 %	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X		X			X	X		
FBP	X			X	X	X	X	X			X	X			X		X	X	X	X			X	X	X	X		X	X	X	X	X
Residue					X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X		X			X	X		
Losses					X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X	X
Sulphur	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cetane Quality																																
Cetane Index	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X			X	X	X	X		X	X	X	X	X
Cetane Number (CFR)	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X			X	X		X			X	X		
Low Temperature Behaviour																																
Cloud Point	X	X		X	X	X			X	X		X			X	X	X	X	X	X			X	X	X	X		X	X	X	X	X
CFPP	X	X		X	X	X			X	X		X			X	X	X	X	X	X			X	X		X			X	X		
Aromatics (HPLC)																							X	X								
Monoaromatics																							X	X								
Diaromatics																							X	X								
Triaromatics																							X	X			X	X				
Total Aromatics																							X	X								

*Note: This quality is marketed through both summer and winter periods.

APPENDIX 3 Parameters Measured/Test Methods

	AT		BE		DK		FI		FR		DE		GR		IT		NL		NO		PT		ES		SE			CH		GB	
	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Su	Wi	Wi	1 *	2 *	Su	Wi	Su	Wi
Density 15°C																															
ASTM D 1298	X	X		X		X									X	X		X		X			X	X	X		X	X	X	X
ASTM D 4052					X		X				X						X		X							X					
DIN 51 757						X		X		X		X						X		X				X	X		X		X		
NFT 60 172									X																						
Viscosity 40°C																															
ASTM D 445	X	X		X		X		X				X				X		X		X				X	X		X		X		X
DIN 51 562 - 1												X																			
NFT 60 100										X																					
Distillation																															
ASTM D 86	X	X		X		X		X				X				X		X		X				X	X		X		X		X
DIN 51 751												X																			
NFM 07 002										X																					
Sulphur																															
ASTM D 1266 (Lamp)		X		X														X						X							
ASTM D 2622 (RFA)	X					X		X									X			X					X			X			
ASTM D 4294						X		X																		X					
ASTM D 3120												X																			
DIN 51 400 - 6 (RFA)												X																			
DIN EN 41 (Wickbold)												X																			
IP 336																															
NFM 07 059									X	X																					
Cetane Quality																															
Cetane Index	X	X		X		X		X		X		X				X		X		X				X		X			X		X
ASTM D 4737															X	X	X	X	X						X		X				
ASTM D 976																															
Cetane Number (CFR)																															
ASTM D 613	X	X		X		X		X		X		X			X	X		X									X				
ISO 5165											X																				
Low Temperature Behaviour																															
Cloud Point																															
ASTM D 2500	X			X		X		X				X			X			X		X				X		X		X		X	
DIN EN 23 015										X																		X			
NFT 60 105												X																			
CFPP																															
DIN EN 116	X			X		X		X				X			X			X		X				X		X		X		X	
IP 309										X																					
NFM 07 042																															
Aromatics **																															
IP 391 draft 5 (HPLC)			X	X							X	X					X	X					X	X				X	X	X	X

* This quality is marked through summer and winter period.

** In B and NL IP 391/90 was used.

APPENDIX 4

Overviews by Country

Austria

	Unit	Summer grade 92 & 93					Winter grade 92/93				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	820.0-860.0	35	830.0	848.0	839.5	820.0-860.0	18	820.0	836.0	833.2
Viscosity 40°C	mm²/s	3.00-8.00					3.00-8.00				
Distillation		*					*				
IBP	°C		35	143	217	171.1		18	96	174	156.4
5 %	°C		19	178	242	201.9		18	182	203	194.1
10 %	°C		19	186	250	211.8		18	193	212	202.3
20 %	°C		19	196	260	227.8		18	205	225	215.3
30 %	°C		19	206	269	243.2		18	218	238	227.4
40 %	°C		19	218	278	258.2		18	230	248	239.2
50 %	°C		19	232	289	273.0		18	244	260	252.0
60 %	°C		19	249	300	287.7		18	259	280	265.9
70 %	°C		19	270	314	304.5		18	276	304	282.3
80 %	°C		19	297	332	324.1		18	296	328	301.1
90 %	°C		19	329	355	349.3		18	320	363	325.6
95 %	°C		19	352	375	367.9		18	337	386	343.6
FBP	°C		29	371	388	377.3		18	351	386	356.2
Residue	Vol. %										
Losses	Vol. %										
Sulphur	mass. %	max. 0.150	35	0.080	0.150	0.119	max. 0.150	18	0.070	0.130	0.116
Cetane Quality											
Cetane Index			4	50.1	56.9	54.0	min. 46.0	2	48.2	50.1	49.2
Cetane Number (CFR)		min. 48.0	35	47.6	54.3	51.2	min. 49.0	18	48.5	53.5	51.0
Low Temperature Behaviour											
Cloud Point	°C		4	+ 2	+ 5	3.5		2	-9	-8	-8.5
CFPP	°C	max. + 5	35	-13	+ 4	-3.3	max. -20	18	-36	-21	-24.4

*Note : percentage recovered at 250°C < 65Vol.%; at 360°C min. 85Vol.% ; at 370°C min. 95Vol.%.

Belgium

	Unit	Summer grade					Winter grade Febr.92				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	820-870					820-870	7	833.7	842.0	836.9
Viscosity 40°C	mm²/s	max.4					max.4	7	2.42	2.91	2.61
Distillation		*					*				
IBP	°C							7	153	185	169.6
5 %	°C							7	188	209	195.7
10 %	°C							7	198	217	204.3
20 %	°C							7	213	233	220.7
30 %	°C							7	232	248	237.6
40 %	°C							7	248	260	253.0
50 %	°C							7	263	272	266.4
60 %	°C							7	277	284	279.1
70 %	°C							7	291	298	293.4
80 %	°C							7	305	313	308.4
90 %	°C							7	326	335	329.1
95 %	°C							7	344	356	348.1
FBP	°C							7	355	365	358.9
Residue	Vol. %							7	1.5	1.7	1.6
Losses	Vol. %							7	0.3	0.5	0.4
Sulphur	mass. %	max. 0.2					max. 0.2	7	0.140	0.180	0.160
Cetane Quality											
Cetane Index								7	49.9	51.9	51.0
Cetane Number (CFR)		min. 46					min. 46	7	48.0	54.5	51.0
Low Temperature Behaviour											
Cloud Point	°C							7	-8	-4	-6.3
CFPP	°C	max. 0					max. -15	7	-29	-18	-22.0

*Note : percentage recovered at 250°C < 65Vol.%; at 350°C min. 85Vol.%.

Denmark

	Unit	Summer/Winter 92 Light Diesel *					Winter grade Febr.92 GO 20				
		Spec.***	n	Min.	Max.	Average	Spec.***	n	Min.	Max.	Average
Density 15°C	kg/m³	820 - 855	9	819.6	852.8	838.9	820 - 860	15	833.9	856.2	845.5
Viscosity 40°C	mm²/s		9	1.83	3.10	2.56		15	2.28	3.40	2.79
Distillation											
IBP	°C		3	170	179	175.0		9	159	176	166.2
5 %	°C		3	187	206	198.7		9	185	206	192.4
10 %	°C		3	191	211	203.7		9	192	213	201.1
20 %	°C		3	194	220	211.3		7	204	223	212.9
30 %	°C		3	203	230	221.0		7	218	236	226.9
40 %	°C		3	210	239	229.3		7	233	250	241.0
50 %	°C		9	220	276	256.1		15	248	283	264.7
60 %	°C		3	233	256	248.3		7	261	280	270.1
70 %	°C		3	251	267	261.3		7	276	298	287.3
80 %	°C		3	274	279	277.0		7	292	314	304.4
90 %	°C		3	298	305	301.0		9	315	354	333.1
95 %	°C	max. 325	9	318	369	342.8	max. 370	15	337	379	358.1
FBP	°C		3	334	342	337.7		15	348	382	369.0
Residue	Vol. %		3	1.5	1.6	1.6		7	1.0	1.5	1.3
Losses	Vol. %		3	2.0	2.0	2.0		7	2.0	2.0	2.0
Sulphur	mass. %	max. 0.050	9	0.030	0.050	0.039	0.200/0.050**	15	0.071	0.180	0.131
Cetane Quality											
Cetane Index		min. 47	3	46.0	50.0	48.4	min. 46	15	46.0	49.4	47.9
Cetane Number (CFR)		min. 50	3	48.6	50.0	49.3	min. 49	9	45.9	50.9	48.5
Low Temperature Behaviour											
Cloud Point	°C		3	-18	-11	-13.2		15	-14	-8	-9.0
CFPP	°C		3	-37	-30	-32.4	max. -20	15	-31	-18	-25.1

*Note: This quality (bus diesel) is marked through summer and winter period.

**Note: Sulphur tax regulations.

***Note: No national standard.

Finland

	Unit	Summer grade 92					Winter grade 91/92 & 92/93				
		Spec.*	n	Min.	Max.	Average	Spec.*	n	Min.	Max.	Average
Density 15°C	kg/m³	820-860	4	838.6	848.6	842.6	810-860	19	817.7	844.1	836.4
Viscosity 40°C	mm²/s	max. 5.2					max. 4.0				
Distillation											
IBP	°C		4	186	197	191.8		18	143	188	169.1
5 %	°C		4	215	222	219		19	179	215	198.8
10 %	°C		4	225	233	229		19	189	221	206.7
20 %	°C		4	238	246	241.3		19	194	232	218.1
30 %	°C		4	250	256	252.8		19	199	239	227.6
40 %	°C		4	261	267	263.8		19	206	247	237.2
50 %	°C		4	271	277	274.5		19	214	255	246.7
60 %	°C		4	283	289	286.5		19	224	263	256.1
70 %	°C		4	297	304	300.3		19	239	275	267.2
80 %	°C		4	313	319	316.0		19	259	290	280.4
90 %	°C	max. 360	4	335	341	338.3	max. 360	19	287	311	298.8
95 %	°C		4	353	361	357.8		19	306	330	315.3
FBP	°C		4	364	376	371.5		19	325	349	337.5
Residue	Vol. %		4	1.5	1.5	1.5		19	0.5	1.5	1.2
Losses	Vol. %		4	0.5	1.0	0.6		19	0.0	1.0	0.3
Sulphur	mass. %	0.20	4	0.008	0.144	0.042	0.20	19	0.022	0.150	0.061
Cetane Quality											
Cetane index		min. 45	4	50.1	54.8	52.4	min. 45	19	45.1	49.1	47.1
Cetane Number (CFR)								5	46.0	50.0	48.6
Low Temperature Behaviour											
Cloud Point	°C	max. - 5					max. -24				
CFPP	°C	max. -15					max. -30				

*Note: Market specification

France

	Unit	Summer grade 92					Winter grade 92/93 & 93/94				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	810.0-890.0	33	833.0	857.0	846.4	810.0-890.0	42	823.5	850.1	836.4
Viscosity 40°C	mm²/s	max. 9.5	33	2.43	4.56	3.53	max. 9.5	14	2.21	2.90	2.53
Distillation											
IBP	°C										
5 %	°C										
10 %	°C		16	189	256	231.1		28	182	249	201.8
20 %	°C										
30 %	°C										
40 %	°C										
50 %	°C		33	260	306	288.6		42	220	297	256.2
60 %	°C										
70 %	°C										
80 %	°C										
90 %	°C		16	346	368	358.3		31	323	359	336.3
95 %	°C		33	360	388	371.8		35	338	379	354.7
FBP	°C										
Residue	Vol. %										
Losses	Vol. %										
Sulphur	mass. %	max. 0.300	33	0.080	0.312	0.220	max. 0.300	42	0.092	0.330	0.242
Cetane Quality											
Cetane Index			33	48.7	55.8	52.9		42	47.3	56.3	50.9
Cetane Number (CFR)		min. 48.0	33	48.7	55.5	51.8	min. 48.0	31	47.2	55.3	50.3
Low Temperature Behaviour											
Cloud Point	°C	—	17	0	+ 5	2.4	max. - 5	28	-9	-1	-5.9
CFPP	°C	max. -2	17	-14	-1	-6.8	max. -15	28	-31	-1	-17.9

Germany

	Unit	Summer grade 92 / 93					Winter grade 92 / 93				
		Spec. *	n	Min.	Max.	Average	Spec. *	n	Min.	Max.	Average
Density 15°C	kg/m³	820.0-860.0	202	815.3	853.2	835.2	820.0-860.0	227	819.5	851.0	830.3
Viscosity 40°C	mm²/s	2.00-4.50	202	2.03	3.71	2.75	2.00-4.50	227	1.72	4.00	2.46
Distillation		**					**				
IBP	°C		202	28	193	166.8		227	56	189	164.2
5 %	°C										
10 %	°C		202	186	237	206.5		227	186	216	200.3
20 %	°C		202	197	251	221.5		227	196	233	213.1
30 %	°C		202	213	262	237.3		227	205	245	226.8
40 %	°C		202	224	277	252.2		227	218	266	240.1
50 %	°C		202	232	292	267.0		227	225	279	253.8
60 %	°C		202	248	310	283.2		227	243	291	268.7
70 %	°C		202	267	327	300.9		227	263	306	284.0
80 %	°C		202	290	345	320.5		227	286	323	303.1
90 %	°C		202	320	368	345.4		227	311	346	327.9
95 %	°C		202	338	387	364.3		227	331	369	348.1
FBP	°C		202	356	396	376.4		227	346	382	362.3
Residue	Vol. %		202	0.5	3.1	1.3		227	0.0	3.0	1.2
Losses	Vol. %		202	0.0	1.0	0.2		227	0.0	1.1	0.3
Sulphur	mass. %	max. 0.200	202	0.060	0.220	0.151	max. 0.200	227	0.070	0.200	0.128
Cetane Quality											
Cetane Index		min. 46.0	202	44.6	63.9	51.7	min. 46.0	227	43.7	56.0	51.0
Cetane Number (CFR)		min. 49.0	202	46.0	62.2	52.7	min. 49.0	227	43.8	56.7	51.7
Low Temperature Behaviour											
Cloud Point	°C	max. +5 ***	—	—	—	—	max. -7 ***	227	-13	-3	-8.0
CFPP	°C	max. 0	—	—	—	—	max.-20	227	-40	-15	-27.6

*Note: DIN EN 590

**Note: percentage recovered at 250°C < 65Vol.%; at 350°C min. 85Vol.% ; at 370°C min. 95Vol.%.

***Note: exchange partners limits

Greece

	Unit	Summer grade 92					Winter grade 92 / 93				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	820.0-860.0	1	842.5	842.5	842.5	820.0-860.0	2	839.1	841.1	840.1
Viscosity 40°C	mm²/s	2.00-4.50					2.00-4.50				
Distillation		*					*				
IBP	°C		1	202	202	202.0		2	189	198	193.5
5 %	°C										
10 %	°C										
20 %	°C										
30 %	°C										
40 %	°C										
50 %	°C		1	296	296	296.0		2	285	291	288.0
60 %	°C										
70 %	°C										
80 %	°C										
90 %	°C										
95 %	°C		1	368	368	368.0		2	362	365	363.5
FBP	°C		1	377	377	377.0		2	374	377	375.5
Residue	Vol. %		1	1.0	1.0	1.0		2	1.0	1.0	1.0
Losses	Vol. %		1	0.5	0.5	0.5		2	0.5	0.5	0.5
Sulphur	mass. %		1	0.300	0.300	0.300		2	0.200	0.300	0.250
Cetane Quality											
Cetane Index		min. 46.0					min. 46.0				
Cetane Number (CFR)		min. 49.0					min. 49.0				
Low Temperature Behaviour											
Cloud Point	°C										
CFPP	°C	+ 5					- 5				

*Note : percentage recovered at 250°C < 65Vol.%; at 350°C min. 85Vol.% ; at 370°C min. 95Vol.%.

Italy

	Unit	Summer grade 92					Winter grade 92				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	805.0 - 860.0	135	817.3	854.0	839.2	805.0 - 860.0	136	813.7	853.4	835.0
Viscosity 40°C *	mm²/s	2 - 5.35	126	2.59	3.92	3.30	2 - 5.35	117	2.25	3.88	3.05
Distillation		**					**				
IBP	°C		135	93	199	169.0		136	119	209	166.8
5 %	°C										
10 %	°C										
20 %	°C		135	197	254	226.7		136	178	241	217.0
30 %	°C										
40 %	°C										
50 %	°C		135	248	294	275.6		136	246	300	266.9
60 %	°C										
70 %	°C										
80 %	°C										
90 %	°C		135	325	371	348.2		136	305	366	340.3
95 %	°C		135	331	390	364.4		107	325	389	355.0
FBP	°C		135	334	404	375.4		136	340	398	369.2
Residue	Vol. %										
Losses	Vol. %										
Sulphur	mass. %	max. 0.3	135	0.060	0.320	0.213	max. 0.3	105	0.050	0.290	0.161
Cetane Quality											
Cetane Index		min. 48.0	135	47.0	58.0	52.6	min. 48.0	136	47.3	60.0	51.8
Cetane Number (CFR)		min. 47.0	134	49.3	62.4	53.6	min. 47.0	76	45.0	55.5	49.6
Low Temperature Behaviour											
Cloud Point	°C		135	-7	+8	2.2		136	-12	+6	-3.0
CFPP	°C		135	-17	+2	-6.5	-10	136	-29	-3	-16.0

*Note: Viscosity is specified at 37.8°C

**Note : percentage recovered at 250°C < 65Vol.%; at 350°C min. 85Vol.%.

Netherlands

	Unit	Summer grade 92					Winter grade 91/92 & 92/93				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³		20	830.7	853.2	841.9		33	833.2	853.2	839.0
Viscosity 40°C	mm²/s		20	2.21	3.64	3.13		26	2.33	3.21	2.63
Distillation		*					*				
IBP	°C		20	89	197	164.3		33	150	193	165.8
5 %	°C		20	171	218	198.0		33	180	212	193.0
10 %	°C		20	189	230	212.2		33	188	223	204.2
20 %	°C		20	208	247	232.2		33	202	238	220.7
30 %	°C		20	224	263	249.7		33	223	255	237.3
40 %	°C		20	241	277	265.2		33	240	269	252.0
50 %	°C		20	256	291	279.3		33	256	282	266.0
60 %	°C		20	271	304	292.9		33	270	293	279.1
70 %	°C		20	288	319	308.5		33	283	306	293.4
80 %	°C		20	305	337	325.5		33	301	322	310.0
90 %	°C		20	334	363	349.6		33	324	355	332.9
95 %	°C		20	354	383	369.3		33	339	364	350.5
FBP	°C		20	366	389	377.3		33	353	374	362.5
Residue	Vol. %		12	0.0	1.0	0.5		25	0.5	1.9	1.0
Losses	Vol. %		12	1.5	1.5	1.5		25	0.5	3.0	1.3
Sulphur	mass. %	max. 0.20	20	0.140	0.210	0.175	max. 0.20	33	0.080	0.205	0.167
Cetane Quality											
Cetane Index			20	48.8	55.5	52.2		31	48.0	53.9	50.3
Cetane Number (CFR)			20	47.3	58.4	51.1		33	44.0	58.5	50.5
Low Temperature Behaviour											
Cloud Point	°C		20	-9	+ 6	1.4		33	-11	-2	-7.3
CFPP	°C		20	-15	-4	-10.3		33	-33	-9	-23.7

*Note : percentage recovered at 250°C < 65Vol.%; at 350°C min. 85Vol.%.

Norway

	Unit	Summer grade 92 GO 11					Winter grade 92 / 93 GO 24				
		Spec.***	n	Min.	Max.	Average	Spec.***	n	Min.	Max.	Average
Density 15°C	kg/m³	min. 820	44	839.4	859.9	852.5		62	828.3	854.9	839.6
Viscosity 40°C	mm²/s		44	2.80	3.81	3.38		62	2.05	3.22	2.46
Distillation											
IBP	°C		42	157	189	169.9		53	151	189	167.0
5 %	°C		22	195	223	211.8		34	188	205	199.0
10 %	°C		22	209	239	227.6		34	193	214	207.2
20 %	°C										
30 %	°C										
40 %	°C										
50 %	°C	max. 290 **	42	273	294	284.0		61	240	274	258.4
60 %	°C										
70 %	°C										
80 %	°C										
90 %	°C	max. 355	41	345	359	350.9		61	306	344	320.1
95 %	°C		21	357	382	368.2		34	318	342	331.9
FBP	°C		2	373	372	377.5					
Residue	Vol. %										
Losses	Vol. %										
Sulphur	mass. %	0,500 *	44	0.110	0.250	0.155	0,500 *	62	0.060	0.200	0.106
Cetane Quality											
Cetane Index		min. 47	44	47.0	52.6	49.6		61	46.4	52.7	48.7
Cetane Number (CFR)			2	51.9	56.4	54.2					
Low Temperature Behaviour											
Cloud Point	°C	max. 0	44	-7	0	-1.0		62	-17	-15	-15.3
CFPP	°C		44	-20	-10	-15.0	max. -24	62	-38	-24	-29.1

*Note: Sulphur tax regulations

**Note: T50 reduced to max. 280°C in 1994

***Note: No national standard

Norway

		Unit	Winter grade 92 / 93 GO 16				
			Spec.**	n	Min.	Max.	Average
Density	15°C	kg/m³		60	832.9	856.1	846.0
Viscosity	40°C	mm²/s		60	2.38	3.43	2.91
Distillation							
	IBP	°C		44	150	192	170.0
	5 %	°C		26	185	223	206.9
	10 %	°C		26	197	235	220.4
	20 %	°C					
	30 %	°C					
	40 %	°C					
	50 %	°C		60	259	285	274.0
	60 %	°C					
	70 %	°C					
	80 %	°C					
	90 %	°C		58	327	379	338.0
	95 %	°C		26	341	383	355.4
	FBP	°C		2	376	385	380.5
	Residue	Vol. %					
	Losses	Vol. %					
Sulphur		mass. %	0.500 *	60	0.090	0.240	0.135
Cetane Quality							
Cetane Index				60	47.4	54.1	49.9
Cetane Number	(CFR)			6	46.8	54.5	51.6
Low Temperature Behaviour							
Cloud Point		°C		54	-8	-7	-7.2
CFPP		°C	max. -16	54	-29	-17	-20.9

*Note: Sulphur tax regulations

**Note: No national specification

Portugal

	Unit	Summer grade 92 / 93					Winter grade 92 / 93				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	820.0-860.0	6	845.9	855.4	850.6	820.0-860.0	7	836.4	855.4	846.3
Viscosity 40°C	mm²/s	2.00 - 4.50	4	3.48	3.89	3.65	2.00 - 4.50	5	3.06	3.71	3.29
Distillation		**					**				
IBP	°C										
5 %	°C										
10 %	°C										
20 %	°C										
30 %	°C										
40 %	°C										
50 %	°C										
60 %	°C										
70 %	°C										
80 %	°C										
90 %	°C										
95 %	°C	max. 370					max. 370				
FBP	°C										
Residue	Vol. %										
Losses	Vol. %										
Sulphur	mass. %	max. 0.300	6	0.290	0.300	0.298	max. 0.300	7	0.290	0.300	0.298
Cetane Quality											
Cetane Index		min. 46.0	6	50.0	54.0	52.0	min. 46.0	7	51.0	54.0	52.7
Cetane Number (CFR)		min. 49.0					min. 49.0				
Low Temperature Behaviour											
Cloud Point	°C		4	-6	+ 5	1.8		7	+ 1	+ 5	3
CFPP	°C	0/-5/-10 *	6	-8	+ 2	-4.2	0/-5/-10 *	7	-9	-6	-7.9

*Note: CFPP seasonal limits : 1. Apr. - 14. Oct. / March & Nov. / 1. Dec. - 28. Feb.

**Note : percentage recovered at 250°C < 65Vol.%; at 360°C min. 85Vol.%.

Spain

	Unit	Summer grade 92 & 93					Winter grade 91 / 92				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	825.0-860.0	35	827.2	860.0	848.2	825.0-860.0	24	827.0	859.6	847.9
Viscosity 40°C	mm²/s	max. 5.20	35	2.90	4.00	3.55	max. 4.30	24	2.47	3.94	3.19
Distillation		*					*				
IBP	°C		8	176	223	191.4		3	198	205	201.3
5 %	°C		8	200	242	221.5		3	215	225	220.7
10 %	°C		9	221	250	235.1		3	226	237	231.7
20 %	°C										
30 %	°C										
40 %	°C										
50 %	°C		35	269	296	285.0		24	254	292	272.3
60 %	°C										
70 %	°C										
80 %	°C										
90 %	°C		9	337	356	345.7		3	338	348	341.7
95 %	°C		8	356	370	364.8		3	344	359	352.3
FBP	°C		29	363	380	374.0		24	353	377	366.5
Residue	Vol. %										
Losses	Vol. %										
Suiphur	mass. %	max. 0.300	35	0.100	0.310	0.256	max. 0.300	24	0.060	0.300	0.228
Cetane Quality											
Cetane Index		min. 45.0	35	47.0	57.8	51.4	min. 45.0	24	46.2	53.0	49.2
Cetane Number (CFR)		min. 50.0	5	52.1	55.8	54.4	min. 50.0				
Low Temperature Behaviour											
Cloud Point	°C	max. +4	29	-1	+4	2.8	max. -1	24	-4	-1	-1.7
CFPP	°C	max. 0	29	-7	0	-2.3	max. -8	24	-18	-8	-11.8

*Note : percentage recovered at 250°C < 65Vol.%; at 350°C min. 85Vol.% ; at 370°C min. 95Vol.%.

Sweden

	Unit	Summer grade 92 D-10					Winter grade 92 D 32				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	820 - 860	14	842.9	856.2	850.0	800 - 840	6	820.7	833.5	828.4
Viscosity 40°C	mm²/s	2.0 - 4.5	14	3.03	3.68	3.41	1.5 - 4.0	5	1.90	2.08	1.99
Distillation											
IBP	°C		4	158	173	167.0		3	131	168	154.3
5 %	°C										
10 %	°C		14	206	230	222.6	min. 180	6	189	207	198.3
20 %	°C										
30 %	°C										
40 %	°C										
50 %	°C		10	279	296	287.6		6	227	244	236.2
60 %	°C										
70 %	°C										
80 %	°C										
90 %	°C		14	280	356	329.4		5	294	305	298.8
95 %	°C	max. 370	14	339	370	355.9	max. 340	5	310	323	314.8
FBP	°C		8	352	375	363.1		3	328	341	333.7
Residue	Vol. %										
Losses	Vol. %										
Sulphur	mass. %	max. 0.2	14	0.040	0.070	0.059	max. 0.2	6	0.030	0.060	0.052
Cetane Quality											
Cetane Index		min. 46	14	49.0	53.0	50.7	min. 46	4	46.7	48.6	47.6
Cetane Number (CFR)		min. 49					min. 48				
Low Temperature Behaviour											
Cloud Point	°C	max. 0	14	-3	0	-0.8	max. -22	6	-24	-20	-22.3
CFPP	°C	max. -10	14	-18	-12	-14.8	max. -32	6	-34	-32	-33.0

Sweden

	Unit	Summer/Winter 92 Class 1 * Spec.	n	Min.	Max.	Average	Summer/Winter 92 Class 2 * Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	800 - 820	9	801.2	812.3	804.2	800 - 820	16	801.7	819.7	815.2
Viscosity 40°C	mm²/s	1.2 - 4.0	7	1.81	2.07	1.90	1.2 - 4.0	16	1.49	1.90	1.73
Distillation											
IBP	°C	min. 180	9	187	211	201.0	min. 180	16	181	193	188.8
5 %	°C		2	197	217	207.0					
10 %	°C		2	198	220	209.0					
20 %	°C										
30 %	°C										
40 %	°C										
50 %	°C		2	228	237	232.5					
60 %	°C										
70 %	°C										
80 %	°C										
90 %	°C		2	268	270	269.0					
95 %	°C	max. 285	9	279	284	281.5	max. 295	15	252	285	270.0
FBP	°C		2	289	292	290.5		11	271	300	290.0
Residue	Vol. %										
Losses	Vol. %										
Sulphur	mass. %	0.001 **	7	< 0.010	< 0.010	< 0.010	0.005 **	16	< 0.010	< 0.010	< 0.010
Cetane Quality											
Cetane Index		min. 50	9	50.1	58.3	53.9	min. 47	16	45.5	52.0	48.8
Cetane Number (CFR)		min. 50	2	55.3	55.6	55.5	min. 47				
Low Temperature Behaviour											
Cloud Point	°C	0	7	< -22	< -22	< -22	0	16	< -22	< -22	< -22
CFPP	°C	-10	7	< -32	< -32	< -32	-10	16	< -32	< -32	< -32

*Note: This quality is marked through summer and winter period.

**Note: All samples Class 1 and 2 have sulphur content < 0.010 mass.%

Switzerland

	Unit	Summer grade 92 / 93					Winter grade 92 / 93				
		Spec.	n	Min.	Max.	Average	Spec.	n	Min.	Max.	Average
Density 15°C	kg/m³	820.0-860.0	26	809.1	842.2	825.8	820.0-860.0	13	820.3	838.8	828.5
Viscosity 20°C *	mm²/s	2.00-4.50	13	1.84	2.59	2.11	2.00-4.50				
Distillation		*					*				
IBP	°C		26	151	187	167.8		13	154	172	161.9
5 %	°C										
10 %	°C	min. 180	26	187	221	201.0	min. 180	13	189	213	197.4
20 %	°C		26	200	235	214.5		13	203	228	212.9
30 %	°C		26	209	248	227.4		13	215	242	227.1
40 %	°C		26	219	265	240.6		13	225	257	240.8
50 %	°C		26	230	279	254.1		13	238	272	254.6
60 %	°C		26	243	293	268.6		13	253	287	269.0
70 %	°C		26	255	309	285.3		13	270	304	285.3
80 %	°C		26	270	328	305.0		13	291	322	304.2
90 %	°C	max. 360	26	294	353	330.5	max. 360	13	317	346	328.2
95 %	°C										
FBP	°C		26	339	378	358.4		13	344	371	355.8
Residue	Vol. %		26	1.7	2.3	2.0		13	0.9	3.0	1.9
Losses	Vol. %										
Sulphur	mass. %	max. 0.200	26	0.004	0.168	0.079	max. 0.200	13	0.044	0.181	0.127
Cetane Quality											
Cetane Index		min. 48.0	26	48.9	56.5	52.7	min. 48.0	13	49.7	54.1	51.6
Cetane Number (CFR)		min. 48.0					min. 48.0				
Low Temperature Behaviour											
Cloud Point	°C	-6	26	-22	+ 1	-9.2	-6	13	-17	-2	-9.8
CFPP	°C	-8	26	-28	-9	-19.0	-15 **	13	-23	-10	-19.2

*Note : Viscosity is specified at 20°C ; in all other countries viscosity is specified at 40°C, with the exception of Italy (37.8°C).

**Note : At temperatures lower -15°C there is a need for better quality

Great Britain

	Unit	Summer grade 92					Winter grade 91/92 & 92/93				
		Spec. *	n	Min.	Max.	Average	Spec. *	n	Min.	Max.	Average
Density 15°C	kg/m³	835.0-865.0	9	840.8	857.3	851.3	835.0-865.0	33	837.4	856.6	846.4
Viscosity 40°C	mm²/s	2.50-5.00	9	2.83	4.35	3.60	2.50-5.00	33	2.61	3.55	2.97
Distillation											
IBP	°C										
5 %	°C										
10 %	°C		9	218	262	233.8		33	206	244	219.6
20 %	°C										
30 %	°C										
40 %	°C										
50 %	°C	max. 310	9	271	300	286.7	max. 310	33	267	291	278.0
60 %	°C										
70 %	°C										
80 %	°C										
90 %	°C		9	332	357	347.5		33	329	342	334.7
95 %	°C		9	351	374	363.8		33	345	358	350.7
FBP	°C										
Residue	Vol. %										
Losses	Vol. %										
Sulphur	mass. %	max. 0.3	9	0.146	0.256	0.200	max. 0.3	33	0.103	0.297	0.196
Cetane Quality											
Cetane Index		min. 48/50 *	9	48.7	54.0	52.3	min. 48/50 *	33	46.5	62.0	52.4
Cetane Number (CFR)		min. 46 *	9	47.8	56.9	51.4	min. 46 *	33	46.0	53.6	50.5
Low Temperature Behaviour											
Cloud Point	°C	max. +3 **	9	-6	+4	1.2	max. - 5 *	33	-7	-2	-5.0
CFPP	°C	max. -4	9	-22	-2	-10.3	max. -15	33	-24	-14	-18.1

*Note: see quality statements for UK.

**Note: Oil Industry "exchange limits"

APPENDIX 5

Key Parameters

The following ISO abbreviations have been employed to identify the countries surveyed:

ABBREVIATION	COUNTRY
AT	Austria
BE	Belgium
DK	Denmark
FI	Finland
FR	France
DE	Germany
GR	Greece
IT	Italy
NL	The Netherlands
NO	Norway
PT	Portugal
ES	Spain
SE	Sweden
CH	Switzerland
GB	United Kingdom

The vertical bars in the charts in **Appendix 5** and **Appendix 6** represent the following summary data:

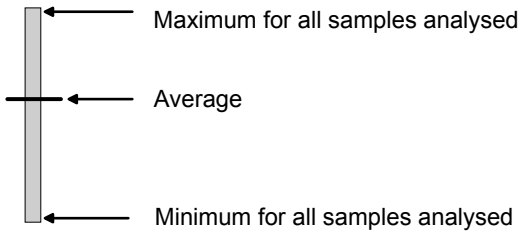


Figure 1 Density (kg/m^3)

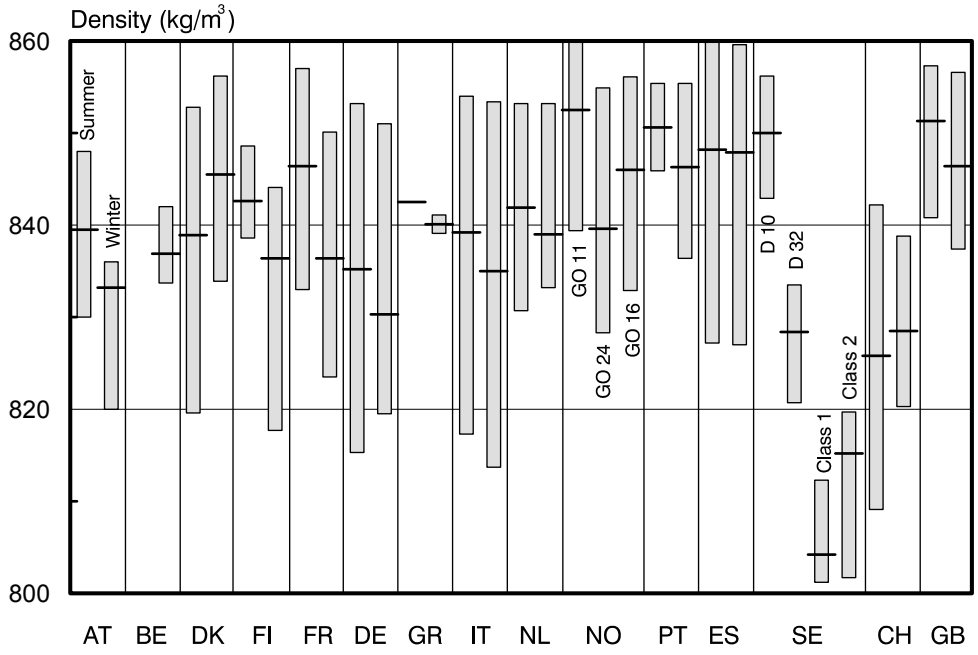


Figure 2 Viscosity (mm^2/sec)

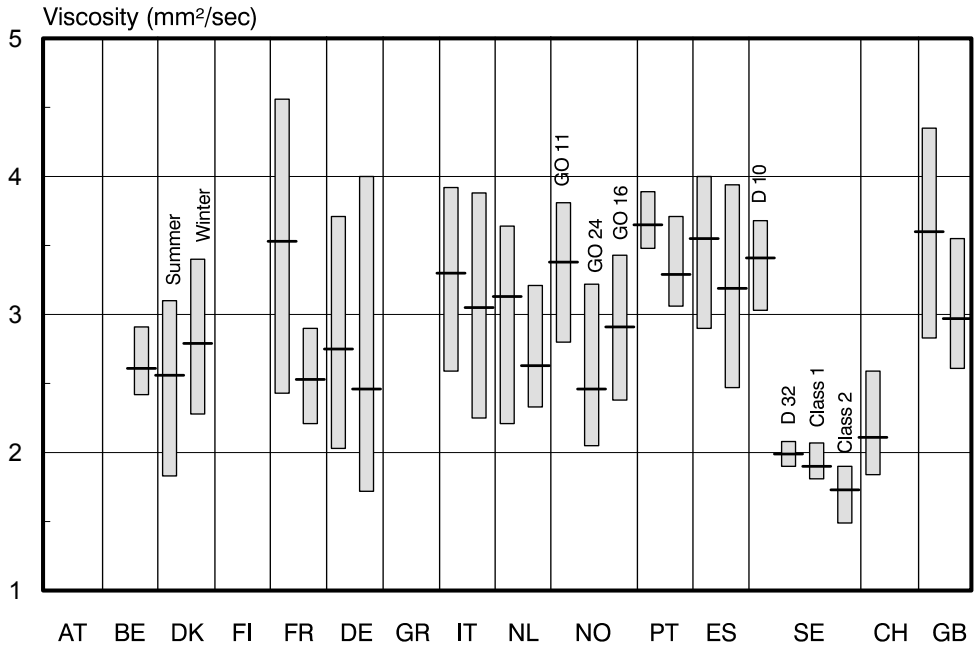


Figure 3 Distillation:
Temperature (°C) at which 10% is evaporated

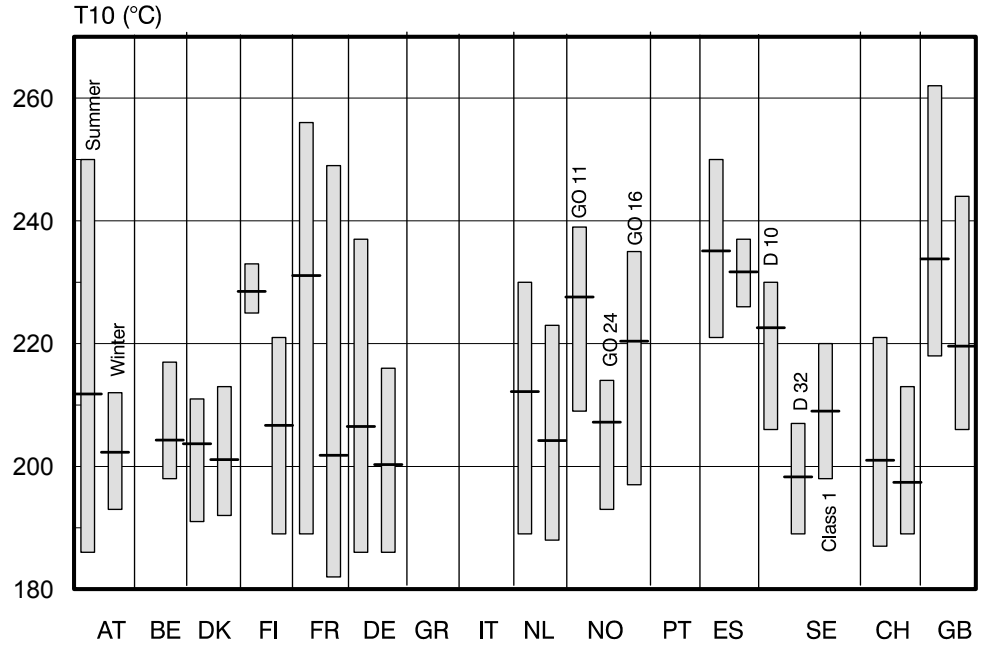


Figure 4 Distillation:
Temperature (°C) at which 50% is evaporated

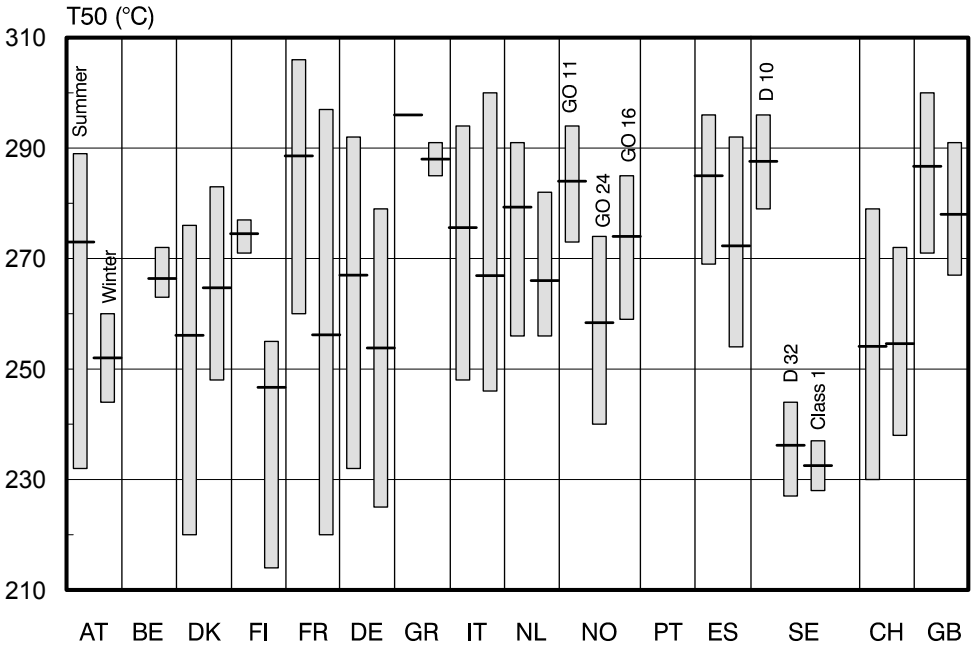


Figure 5 Distillation:
Temperature (°C) at which 90% is evaporated

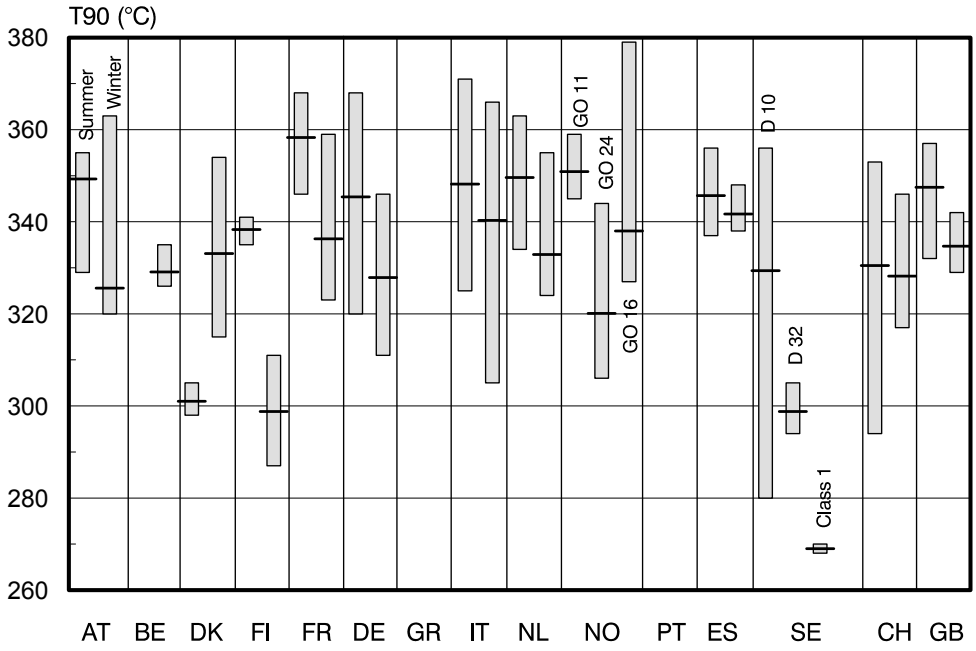


Figure 6 Distillation:
Temperature (°C) at which 95% is evaporated

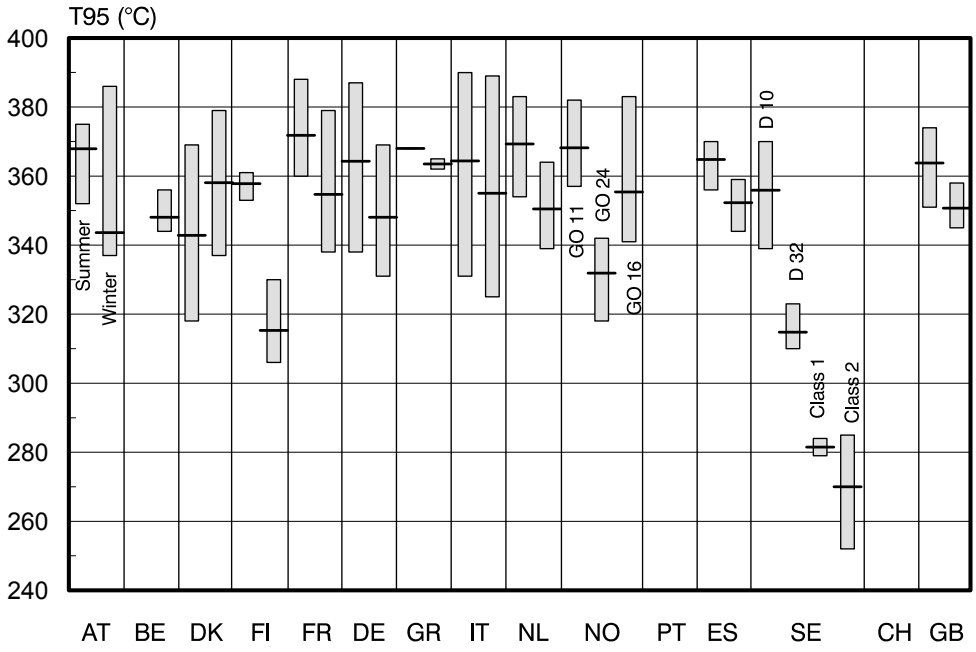


Figure 7 Sulphur Content (% mass)

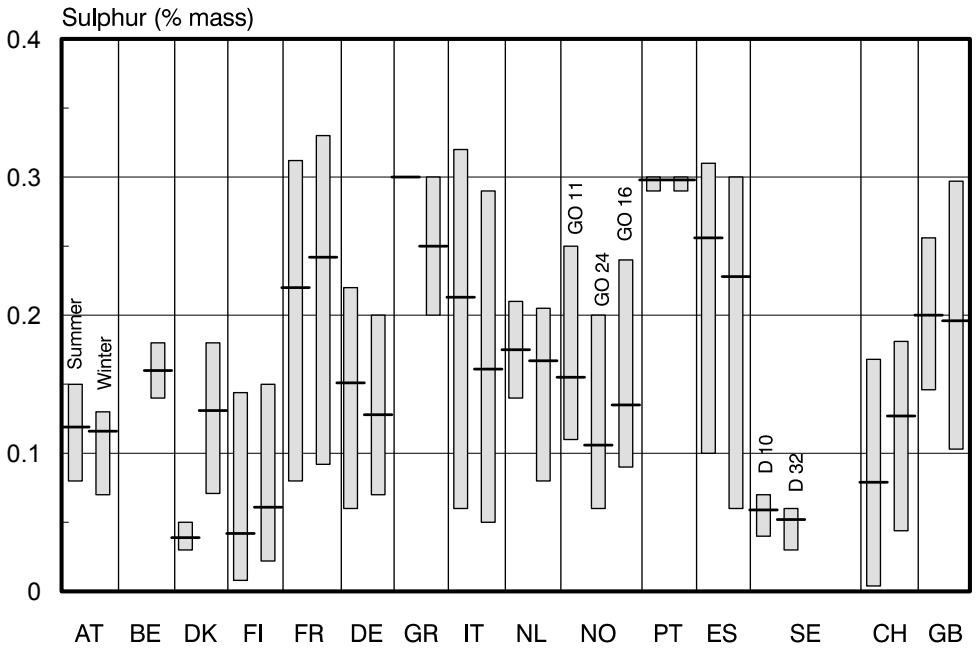


Figure 8 Cetane Index

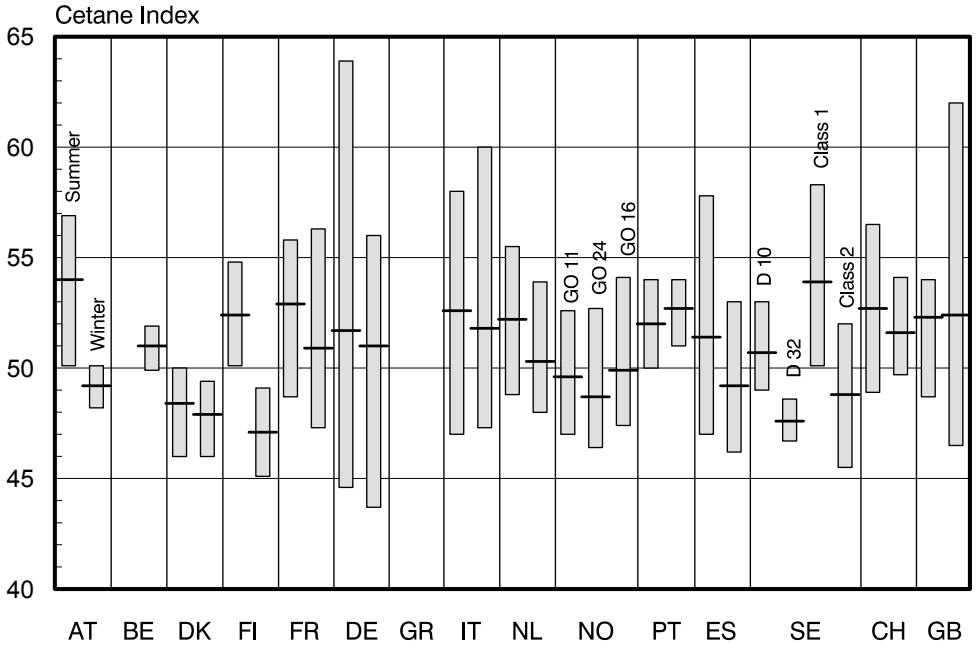


Figure 9 Cetane Number

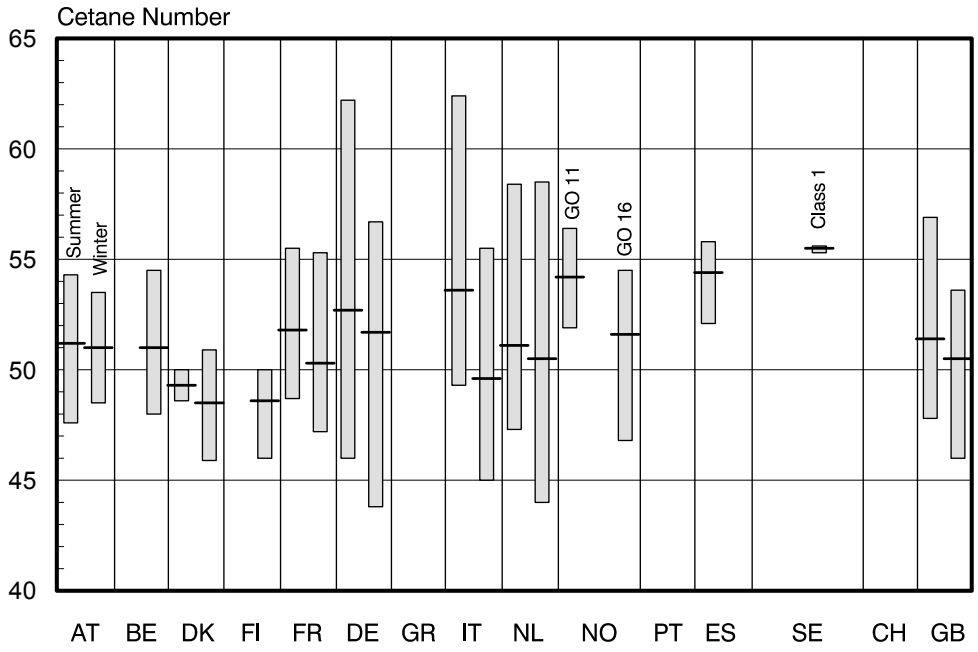


Figure 10 Comparison between cetane number and cetane index average values

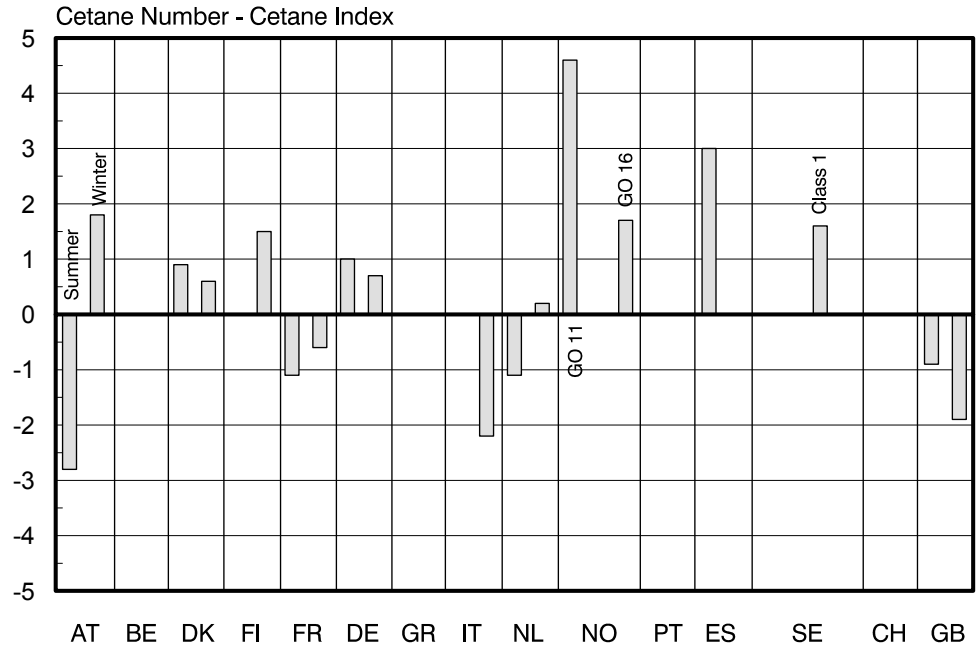


Figure 11 Cloud Point (°C)

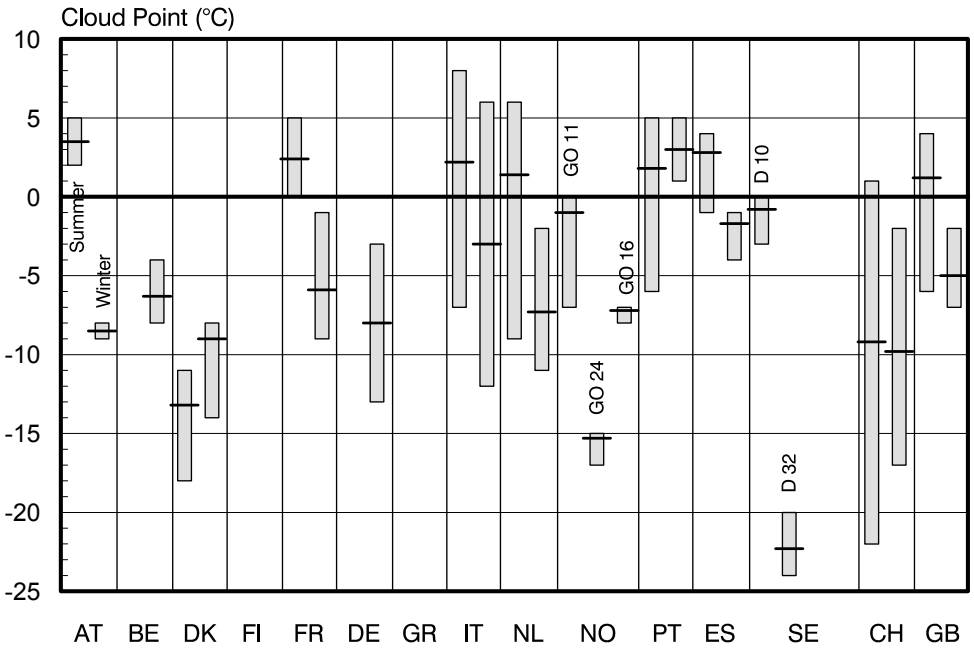
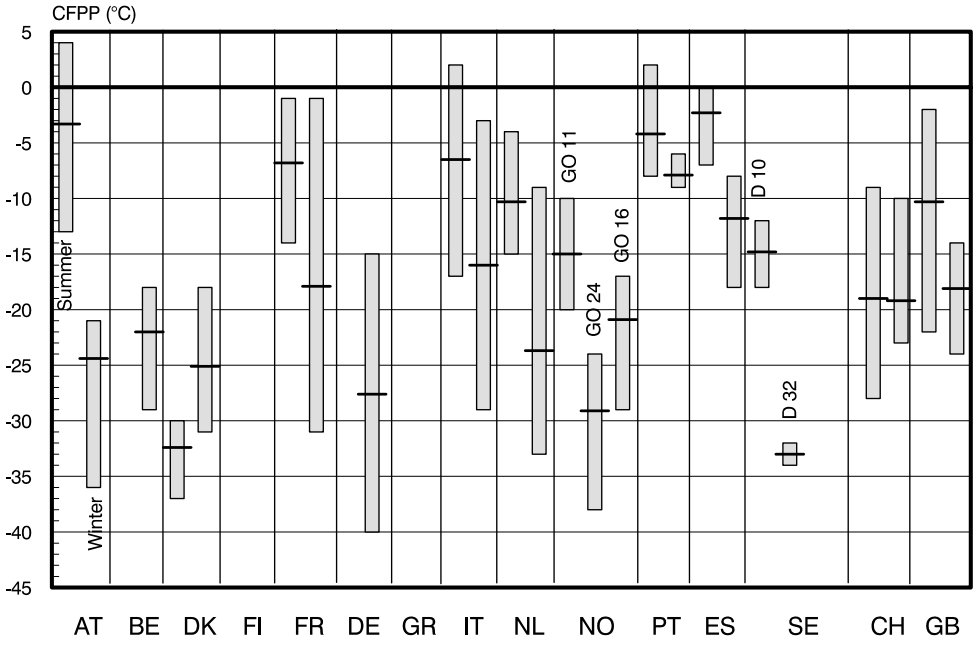


Figure 12 Cold Filter Plugging Point (°C)



APPENDIX 6

Diesel Fuel Composition

Table A6.1 Aromatics Content (HPLC - IP 391 draft 5)

	Unit	BE	DE	IT	NL	ES	SE	GB
Period of sampling		Summer 1994	Summer 1994	Summer 1994	Su 93 Su 94 Wi 93/94 Wi 94/95	Su 92 Su 93	Su / Wi 1992	Summer 1993
Number of samples		9	39	59	42	6	25	9
Monoaromatics	Vol. %							
min.			15.8	7.5	14	19.6		16.6
max.			23.1	28.4	25.6	27		22.4
Average			19	16.2	19.6	22.8		19.3
Diaromatics	Vol. %							
min.			3	0.8	1.8	4.4		5.4
max.			7.8	8.4	10.3	9		8.1
Average			4.7	2.8	5.1	6.5		7.1
Tri +	Vol. %							
min.		0.2	0.4	0.1	< 0.1	0.5		1.4
max.		0.4	2.7	1.5	0.6	1.3		2.9
Average		0.3	1.3	0.3	<0.2	0.8		2.1
Total Aromatics	Vol. %							
min.		11.8	19.9	11.7	17.6	24.7	0.8	24.6
max.		24.8	29.9	35	33.8	35.7	19.7	33.2
Average		19.6	25	19.2	24.6	30.1	12.1	28.6

Figure 13 Aromatics Content (HPLC - IP 391 draft 5)