TRADING STANDARDS

Fuel Quality Monitoring Programme

Test Results 2016–17

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

New Zealand Government

TRADING STANDARDS

ABOUT THIS REPORT

By Trading Standards
Ministry of Business, Innovation
and Employment

15 Stout Street
PO Box 10729
Wellington 6011

Phone: 0508 627 774
Email: tradingstandards@mbie.govt.nz
www.tradingstandards.govt.nz

ISSN: 2253-170x (Print)

ISSN: 2253-1718 (Online)

DISCLAIMER

Contents

Executive Summary

The Fuel Quality Monitoring Programme (**the Programme**) is administered by the Trading Standards which is an operational unit within the Ministry of Business, Innovation and Employment.

Trading Standards (**TS**) maintains a comprehensive programme of sampling and assessing the quality of retail fuel in New Zealand and monitoring its compliance with the specifications set out in the relevant Engine Fuel Specifications Regulations (**the Regulations**). Currently, the Regulations made in 2011 and amended on 2 October 2017, are in force[1].

The main focus of the Programme is to monitor the quality of the fuel sold by retail fuel companies nationwide. It employs a statistically-based sampling scheme to ensure an acceptable probability of detecting non-compliance is maintained. The Regulations specify limits on a number of properties for premium and regular petrol grades, diesel and biofuels such as biodiesel and ethanol.

A key element of the Programme is to sample and test the quality of fuels as they are sold to consumers, i.e. sampling is done from dispenser nozzles at the retail point of sale.

The sampling and testing programme is undertaken independent of the Fuel Industry and being focussed on retail sales, it complements the extensive sampling and testing that the Fuel Industry itself carries out at various stages during the manufacture and supply processes. This provides confidence to consumers and all stakeholders around the quality and composition of petrol, diesel and biofuels.

This report is intended to give an overview of the results of the Programme from 1 July 2016 to 30 June 2017. During this period retail fuel samples were collected and tested from 115 of the approximately 1,200 fuel service stations in New Zealand.

Analysis of sampling and testing conducted during the period of this report has confirmed that on the whole, fuel sold in New Zealand was of good quality and compliant with specifications prescribed in the Regulations. In some instances samples were initially found to be marginally outside specifications but on subsequent investigation and analysis of the results they were found to be within established tolerance limits. These instances relate to MON number and ethanol content in premium petrol, as well as flash point and cetane index in diesel.

In one particular case, a suspect non-compliant sample was detected during the reporting period which related to diesel where the water content was found to be 262 mg/kg at the tolerance limit of 259 mg/kg. However, further testing and analysis in collaboration with the company involved did not reveal any suspect elements. So whilst the result remains anomalous it was included in the report.

This report also covers the results of sampling and testing of fuel from the emerging market for biofuel. When non-retail sale products are utilised as components for retail market products TS monitors their quality too because they are categorised by the Regulations. Some biodiesel samples intended for non-retail sale were initially found to be non-compliant before supply to customers. None of the potentially non-compliant biofuels identified by sampling and testing entered the retail fuel supply chain and they were subject to remedial action by the producers. The suspect non-compliant properties are discussed in the biofuel section of this report.

For further explanation or to comment on the reported results please contact the Ministry:

Tel: 0508 627 774 or
Email: tradingstandards@mbie.govt.nz

1 http://www.legislation.govt.nz/regulation/public/2011/0352/latest/DLM4044701.html

Introduction

MBIE has national regulatory responsibility for a number of infrastructure areas that are fundamental to consumer safety, supporting consumer and business confidence and facilitating domestic and international trade.

TS is administering these areas which include:

- **Legal Metrology (Trade Measurement)**
- **Consumer Product Safety**
- **Auctioneers Register**
- **Motor Vehicle Traders Register** and
- **Fuel Quality Monitoring (FQM)** – maintaining and administering a programme to monitor and ensure the quality and compliance of New Zealand's retail fuel supply with the Regulations.

In the fuel quality monitoring area activities include:

- Sampling, testing and analysing fuel quality including routine samples taken in accordance with a statistical sampling plan and samples taken as part of targeted projects or in response to complaints or emerging issues;
- Investigating consumer and trader complaints and responding to enquiries;
- Advising on and facilitating improvement of fuel industry 'best practice';
- Developing and conducting projects in response to emerging issues;
- Contributing to work on regular amendments and updates to the Regulations;
- Maintaining strong and effective relationships (as the lead regulator) with fuel company technical managers, fuel retailers, industry associations and stakeholders within NZ and internationally;
- Representing New Zealand on international standards committees relating to fuel quality.

These activities and the Programme are funded from a proportion of the *Petroleum or engine fuel monitoring levy* of 0.2 cents for each litre of petroleum or engine fuel that is supplied in accordance with the Energy (Petroleum or Engine Fuel Monitoring Levy) Regulations 2015[2].

The main focus of the Programme is to sample and test the quality of fuels as they are sold to consumers, i.e. sampling is done from dispenser nozzles at the point of sale. TS employs a statistically-based sampling scheme to ensure an acceptable probability of detecting non-compliance is upheld. The Regulations specify limits for a number of critical properties of premium and regular petrol grades, diesel and biofuels such as biodiesel and ethanol blends.

This report sets out the results of the Programme from 1 July 2016 to 30 June 2017.

The key principles and structure of the Programme remain the same as in previous years. References to legislation related to engine fuel quality may be found on the Ministry web site[3] or in previous FQM Programme annual reports for the period from 2008 to 2016.

Collection of fuel samples during this period was carried out under the direction of TS. The samples were then tested by Independent Petroleum Laboratory Ltd and the results subsequently analysed by TS.

Any non-compliance or abnormalities identified through testing were subject to analysis and follow-up investigation by TS. The focus of any investigation is to confirm the validity of the results, identify any potential issues and implement an appropriate and timely response if required. Attention is also given to ensuring the underlying cause of any non-compliance is understood and remedied to prevent recurrence.

The samples were collected from 11 designated regional areas nationwide (see following Table) serviced by specific fuel supply terminals. The samples were taken from various fuel service stations according to a plan based on a statistical

2 http://www.legislation.govt.nz/regulation/public/2015/0304/latest/whole.html
3 http://www.tradingstandards.govt.nz

model which takes into account each retail fuel company's market share in that area.

In total, 115 sample sets were collected from retail sites and each set included samples of regular and premium grade petrol and a sample of diesel. The number of samples collected and tested this year was similar to the previous years.

Additional resources were also allocated to projects focused on investigating specific issues. In particular, a project focused on dry vapour pressure in petrol was continued in response to detection of several non-compliant samples during previous years. Vapour pressure is measured as an important indicator of volatility of petrol which is critical to the operation of spark ignition engines with respect to both performance and emissions. The presence of ethanol or other oxygenates may affect these properties and, as a result, performance and emissions as well.

A limited number of additional tests were added to the routine list of tests conducted. This included a test on appearance for diesel which is not specified in the Regulations. This testing was added to the routine list of diesel properties tested to assess the level and nature of potential presence of water and other contaminants.

A number of retail sites in New Zealand offer ethanol blended petrol with an ethanol content from 70 to 85% labelled as E85. This fuel is mainly used for motor vehicle racing. While fuel for motor racing is exempt from the Regulations there are flexible-fuel vehicles on roads in New Zealand which are able to use E85. Since E85 dispensers at these sites are accessible to the public, and therefore the product available to retail customers, it was deemed prudent to sample and test the product.

Alongside the routine sampling and testing of fuel, TS checks local wet stock management processes at the service stations forecourts looking at established practices otherwise known in the industry as 'housekeeping'. This relates to the maintaining of the underground storage tanks (UST), minimizing fuel contamination and maximizing fuel system cleanliness.

Adopting reliable wet stock management systems and practices[4] can help improve fuel quality, prolong equipment life, and reduce corrosion and owner's operating expenses. TS plans to continue keeping this local site management focus in the coming year and work with the fuel supply companies to ensure that they maintain 'best practice' and follow proper procedures to ensure

4 http://m.business.govt.nz/worksafe/information-guidance/all-guidance-items/hsno/guidance-docs-epa/certifying-your-service-station.pdf

that quality and composition of fuel is maintained right throughout the supply chain.

Statistical analysis of the Programme data from previous years with regard to estimating the proportion of non-compliance detected has allowed Trading Standards to estimate the proportion of potentially suspect non-compliant samples that would be found across the whole retail fuel sector.

A key assumption in this analysis was that the true proportion of suspect non-compliances can be taken as constant across terminals and brands. Taking this assumption into account it was concluded that no increase in the total number of routine samples is needed compared to that in the previous three to four years to retain an appropriate ongoing level of confidence.

The seasonal and regional distribution of fuel 'sample sets' is shown in the table below.

The results of subsequent testing of these 'sample sets', have been reported in accordance to their relevant specification limits set out in the Regulations. Testing tolerance limits were derived according to the ISO Standard 4259:2006[5] as described in previous annual test result reports. Accordingly, the tolerance limit for each property is derived through the calculated tolerance margin. Further, the 'corrected tolerance limit' in this report is defined for two test results under the repeatability conditions (Section 7.2.3, EN ISO 4259:2006).

Terminal/Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Whangarei	0	1	0	1	1	0	0	0	2	0	1	0	6
Auckland	2	4	2	3	2	2	2	3	2	2	3	2	29
Mt Maunganui	1	2	1	2	1	0	3	0	2	4	0	0	16
New Plymouth	0	0	0	1	0	0	1	0	0	0	1	0	3
Napier	2	0	0	1	1	0	1	0	0	0	0	0	5
Wellington	0	1	0	0	3	3	0	2	1	2	2	2	16
Nelson	0	1	0	0	0	1	1	0	0	0	3	1	7
Lyttelton	2	0	1	0	0	1	1	2	2	1	0	1	11
Timaru	2	0	0	0	0	0	0	1	2	2	1	0	8
Dunedin	0	0	2	0	0	1	0	0	1	1	2	1	8
Bluff	0	0	2	1	1	0	0	0	0	1	0	1	6
TOTAL	9	9	8	9	9	8	9	8	12	13	13	8	115

Conclusion

The Programme has confirmed that throughout the year the retail fuel supplied in New Zealand was of good quality, fit for purpose and compliant with the performance and quality specifications prescribed in the Regulations.

In this report, the anonymity of the source of the samples is maintained due to the commercial sensitivity of this information.

5 BS EN ISO 4259:2006, BS 2000-367:2006 *Petroleum products - Determination and application of precision data in relation to methods of test. The current version ISO 4259-1:2017 was released in November 2017 i.e. after the period of testing samples included in this report has ended.*

Petrol

Research Octane Number (RON) and Motor Octane Number (MON)

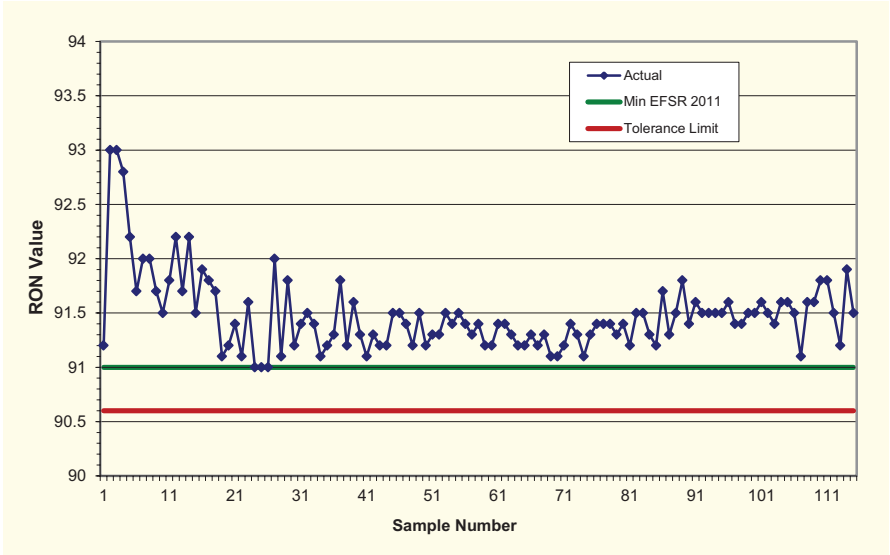
RON 91

The test method ASTM D2699[6] is prescribed in the Regulations for definition of RON. In total, 115 samples of regular petrol were collected and tested. Fig. 1a and 1b below show the testing results for RON and MON respectively.

All samples were found to be above or on the minimum specification limit of 91.0 for RON. Only samples 24, 25 and 26 were found to be on the specification limit.

Here and below: The abbreviation 'EFSR' stands for the specification limit prescribed in the Regulations. Each individual result is independent from others although they are connected in the graphs for the ease of interpretation.

Figure 1a: Test Results for Petrol RON 91, Year 2016-17

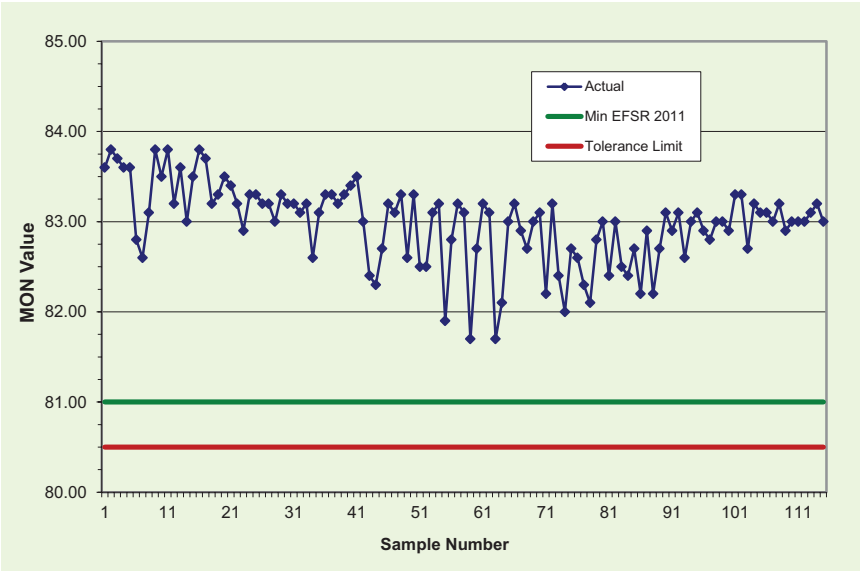


6 ASTM D2699–17 *Standard Test Method for Research Octane Number of Spark-Ignition Engine Fuel*

The test method ASTM D2700[7] is prescribed in the Regulations for definition of MON. All samples were found to be above the minimum specification limits of 81.0 for MON.

All samples were found to be compliant with the Regulations.

Figure 1b: Test Results for Regular Petrol MON, Year 2016-2017

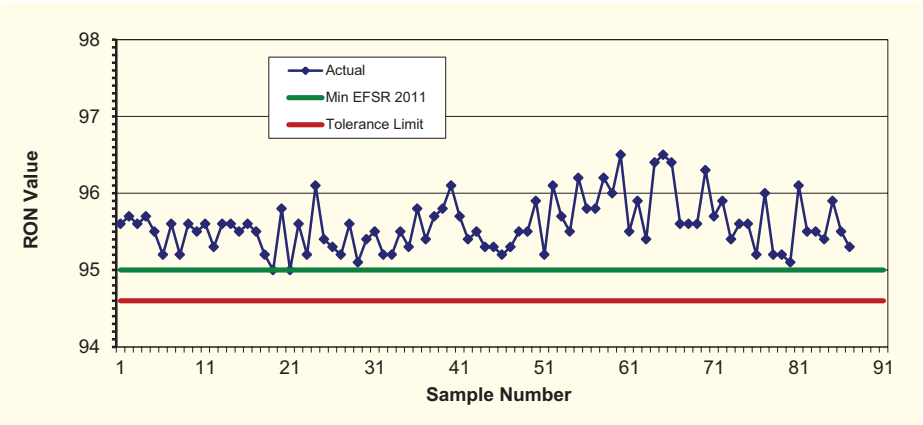


RON 95

In total, 87 samples of premium grade petrol with RON 95, were collected and tested. Fig. 2a and 2b below show the testing results for RON and MON respectively.

All samples were found to be above or on the minimum specification limit of 95.0 for RON. Samples 19 and 21 were found to be on the specification limit.

Figure 2a: Test Results for Petrol RON 95, Year 2016-2017



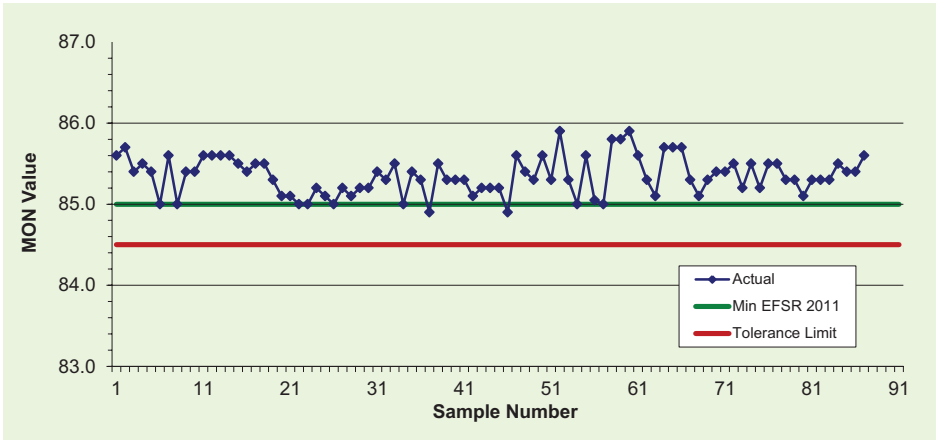
7 ASTM D2700-17 *Standard Test Method for Motor Octane Number of Spark-Ignition Engine Fuel*

All samples except three were found to have MON above or on the minimum specification limit of 85.0 for premium petrol. Eight samples: 6, 8, 22, 23, 26, 34, 54, and 57, were found to be on the specification limit. Samples 37 and 46 were found to be below the specification limit with testing results for MON of 84.9. Also, the result for Sample 56 was initially found to be 84.9. On investigation in each instance the test was repeated by the same operator, with

- 84.9 being the average of two results, 84.9 and 84.9 for Sample 37,
- 84.9 being the average of two results, 84.9 and 84.8 for Sample 46,
- 85.05 being the average of two results, 84.9 and 85.2 for Sample 56

The average figures for samples 37 and 46 were above the testing tolerance limit of 84.6 therefore all these samples were treated as compliant.

Figure 2b: Test Results for MON, Premium Petrol RON 95, Year 2016-2017



RON 98

No minimum value is specified in the Regulations for premium petrol with RON 98. This fuel is advertised as having properties that are superior or in addition to the regulated limits. In particular, with an "advertised RON 98 minimum" which is referred to in Fig. 3a, it must conform, according to Section 11 of the Regulations, to those advertised properties when tested using the test methods specified in Schedule 1 in the Regulations.

This advertised limit is also enforceable under the provisions of the Fair Trading Act 1986 in relation to possible mis-description. On that basis it is also deemed that the actual figures of RON must not be lower than 98.

For premium petrol with RON 98, a minimum limit for MON is neither specified in the Regulations nor advertised. In the absence of a specified minimum limit for MON the limit for premium petrol has been used as a benchmark.

In total, 25 samples of petrol with RON 98 were collected and tested. Fig. 3a and 3b below show the testing results for RON and MON respectively.

All samples with the advertised RON of 98.0 were found to be above the advertised minimum limit.

No minimum MON is specified for premium petrol with RON 98. All samples were found to have MON above the specification limit of 85.0 for premium petrol.

Figure 3a: Test Results for Petrol RON 98, Year 2016-2017

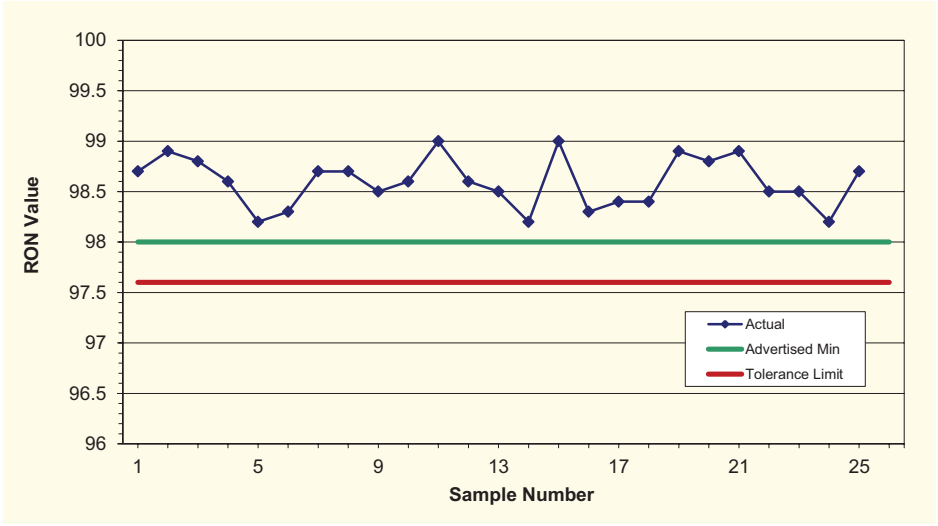
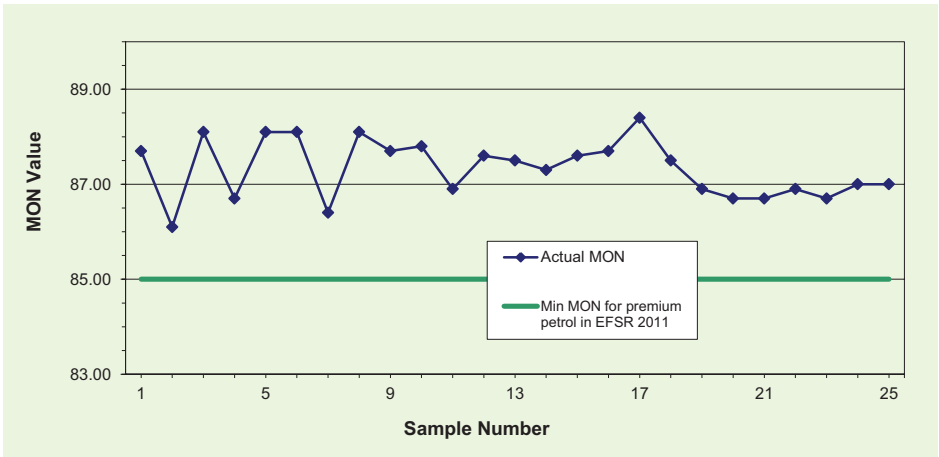


Figure 3b: Test Results for MON, Premium Petrol RON 98, Year 2016-2017



Evaporation Percentage

The test method ASTM D86[8] is prescribed in the Regulations for definition of the volume percentage of evaporated petrol at the three fixed temperatures: at 70°C, 100°C and 150°C. Respectively, there are three categories for evaporation percentage limits in the Regulations: E70, E100 and E150.

These categories are analysed below separately for regular petrol (RON 91) and for premium petrol (RON 98 data is included with RON 95 data).

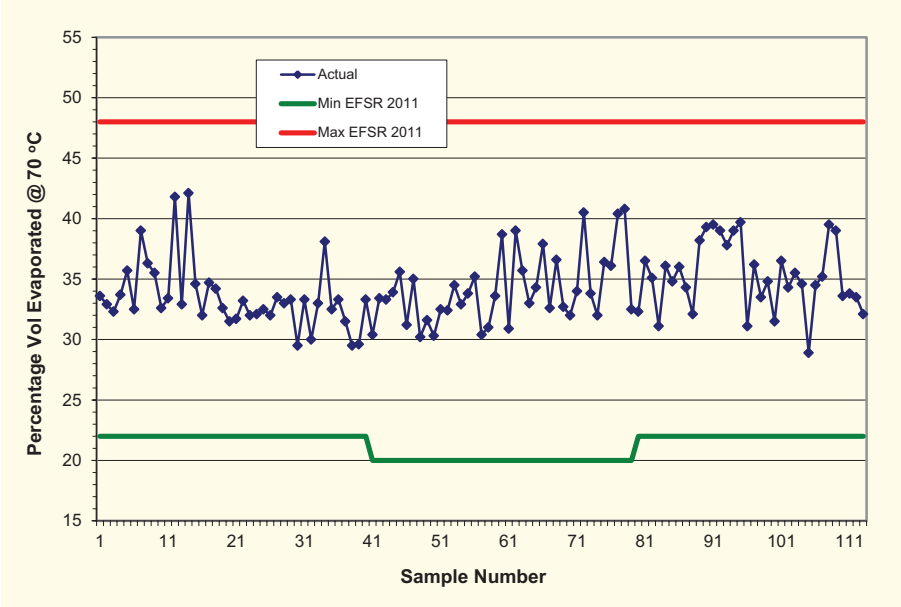
RON 91

Percentage Volume Evaporated at 70°C

For petrol not containing ethanol, the minimum specification limit is 22% (a minimum of 20% E70 permitted for the summer season – see Footnote 1 in Schedule 1, the Regulations) and maximum specification limit is 48% while the relevant minimum tolerance limits are 20.5% (18.5% in summer) and 49.2% respectively.

All samples were found to be within the prescribed specification limits above the minimum limit of 22% at all seasons including the summer period when the specified minimum limit for E70 is permitted to be 20% (see Fig. 4a).

Figure 4a: Test Results for E70, RON 91, Year 2016-2017

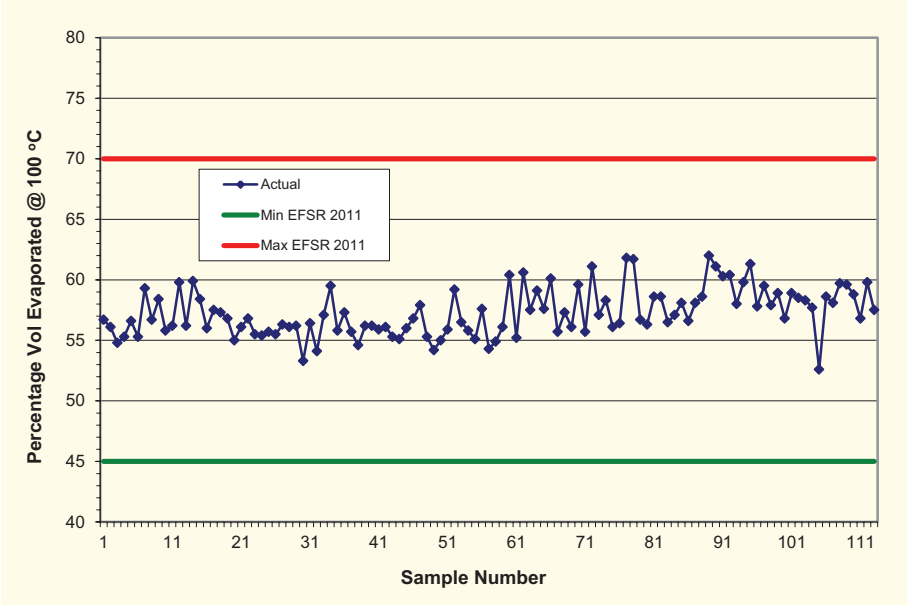


8 ASTM D86-17 *Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure*

Percentage Volume Evaporated at 100°C

All samples were found to be well within the specification limits from 45% to 70%. The minimum tolerance limit is 43.8% and maximum tolerance limit is 70.9% (not shown in Fig. 4b).

Figure 4b: Test Results for E100, RON 91, Year 2016-2017

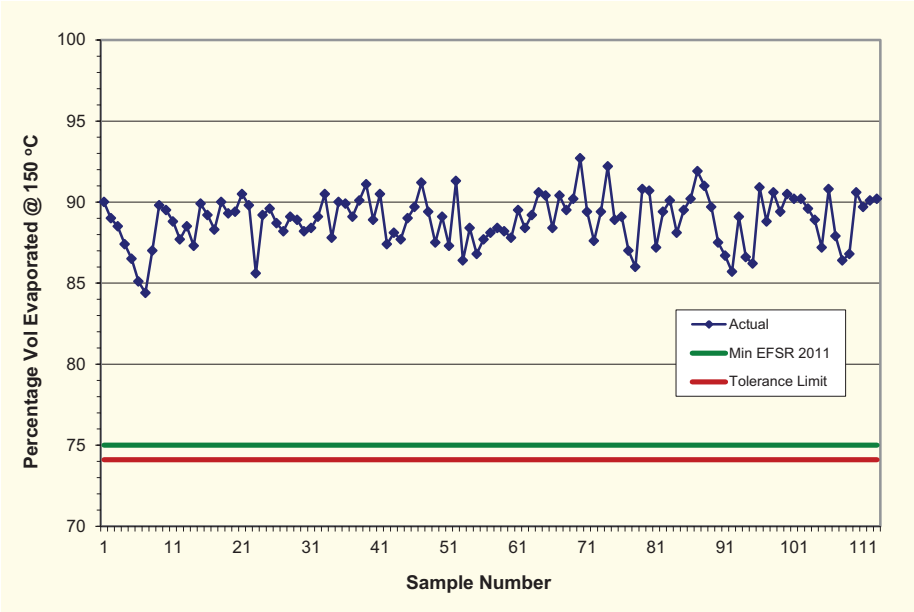


Percentage Volume Evaporated at 150°C

All samples were found to be well above the minimum specification limit of 75%.
The minimum tolerance limit is 74.1%.

No maximum is prescribed by the Regulations for this property.

Figure 4c: Test Results for E150, RON 91, Year 2016-2017



RON 95 & 98

Percentage Volume Evaporated at 70°C

For premium petrol not containing ethanol, as in case of regular petrol, the minimum specification limit is 22% (a minimum of 20% E70 permitted for the summer season – see Footnote 1 in Schedule 1, the Regulations) and maximum specification limit is 48% while the minimum tolerance limit is 20.5% (18.5% in summer) and maximum tolerance limit is 49.2%.

The majority of results were found to be within the specification limits of 22% to 48% with the exception of a number of ethanol blended samples. According to the Regulations (Footnote 2 in Schedule 1), the maximum allowed percentage of volume evaporation at 70°C (E70) is increased by 1% per each 1% volume of ethanol in the blend.

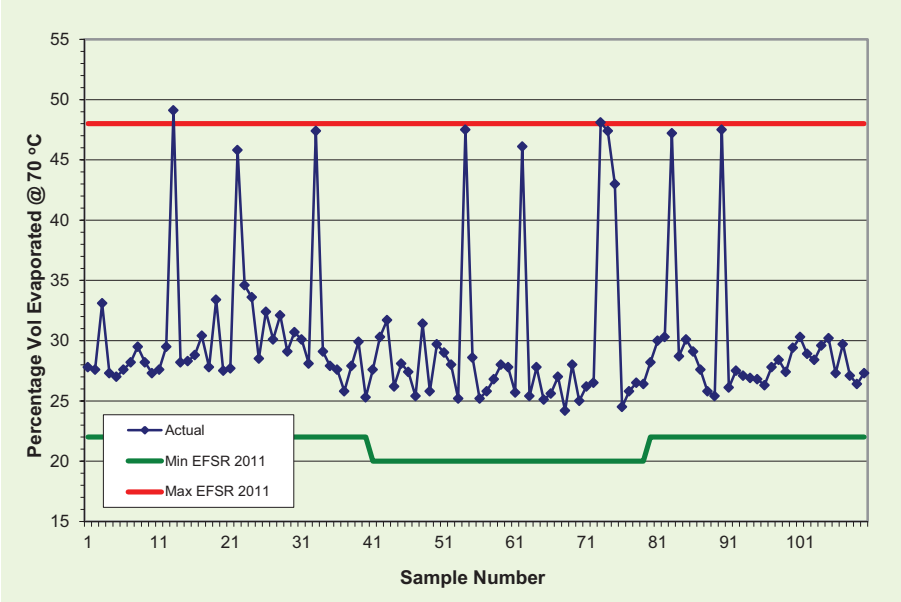
All E70 results for premium petrol samples with ethanol, are set out in a Table 1 below.

As in the case with regular petrol (see above), all samples were found to be within the prescribed specification limits with the minimum limit of 22% at all seasons including the summer period when the specified minimum limit for E70 is permitted to be 20%.

Table 1:

Sample	Ethanol Content, % Vol	Maximum E70 allowed, % Vol	E70 actual, % Vol
13	9.84	58	49.1
22	9.81	58	45.8
33	10.00	58	47.4
54	9.94	58	47.5
62	10.19	58	46.1
73	10.39	58	48.1
74	10.23	58	47.4
75	8.96	57	43.0
83	9.53	58	47.2
90	9.73	58	47.5

Figure 5a: Test Results for E70, RON 95 & 98, Year 2016-2017



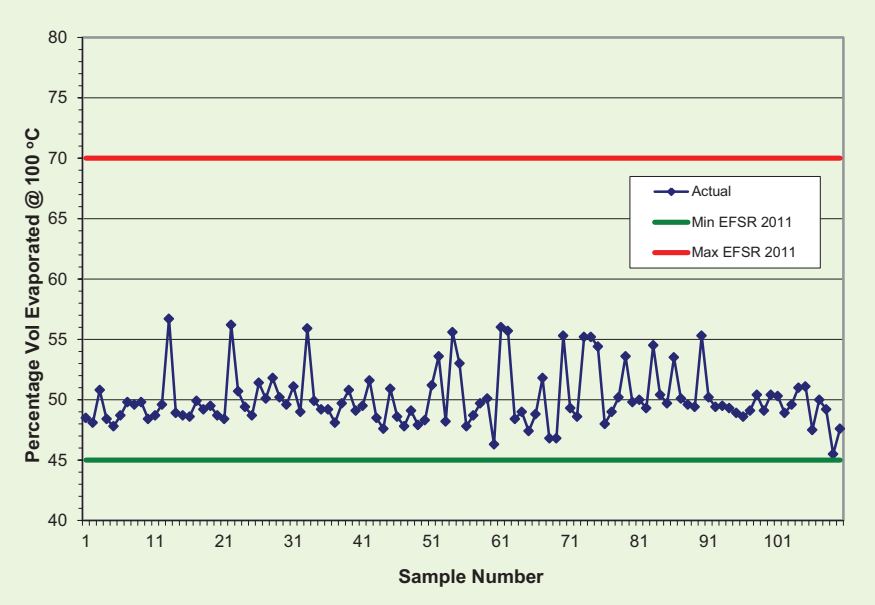
The maximum specification limit for Samples 13 and 75 is 58% so the results are within the specification (see Table 1 above).

Percentage Volume Evaporated at 100°C

All samples were found to be within the specification limits from the minimum of 45% to the maximum of 70%. Sample 109 was found to be the lowest, 45.5%.

As in case of regular petrol, the tolerance limits are 43.8% and 70.9% respectively.

Figure 5b: Test Results for E100, RON 95 & 98, Year 2016-2017



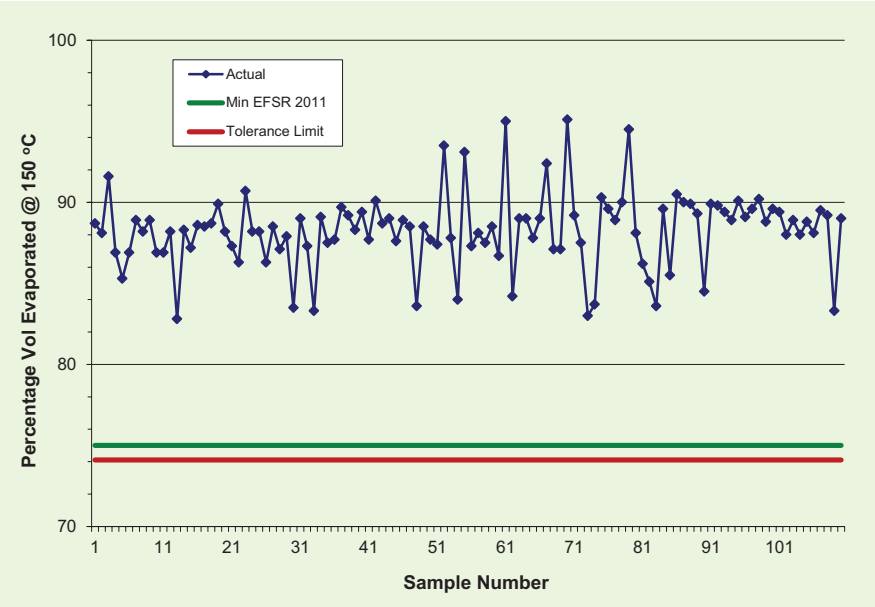
Percentage Volume Evaporated at 150°C

All samples were found to be well above the minimum specification limit of 75%.

As in case of regular petrol, the minimum tolerance limit is 74.1%.

No maximum is prescribed by the Regulations for this parameter. All samples were found to be well above 80% (Fig. 5c).

Figure 5c: Test Results for E150, RON 95 & 98, Year 2016-2017



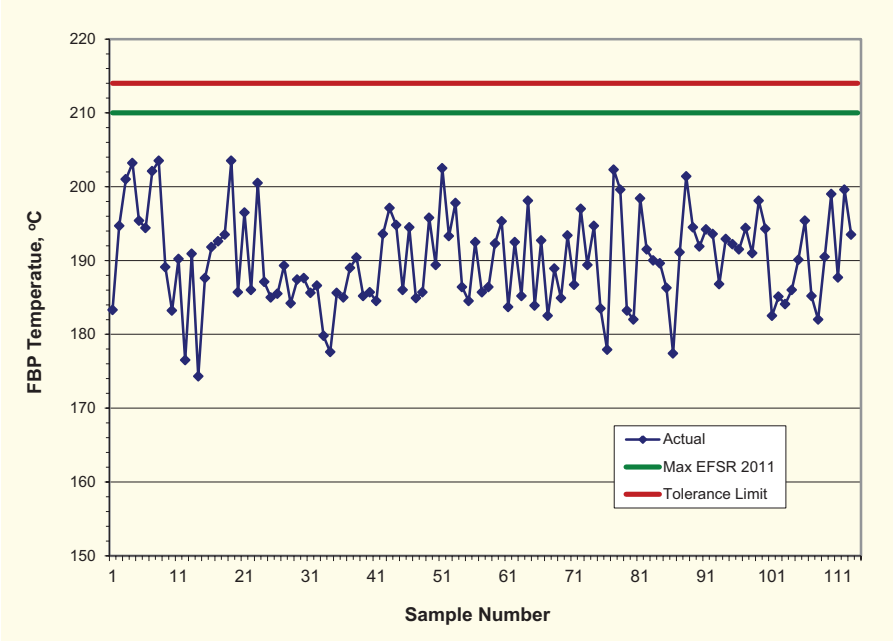
Final Boiling Point (FBP)

The test method ASTM D86[9] is prescribed in the Regulations for distillation end point (or 'final boiling point') in petrol.

All samples were found to be within the specification maximum limit of 210°C for both regular and premium grades (Fig.6). The tolerance limit is 214°C.

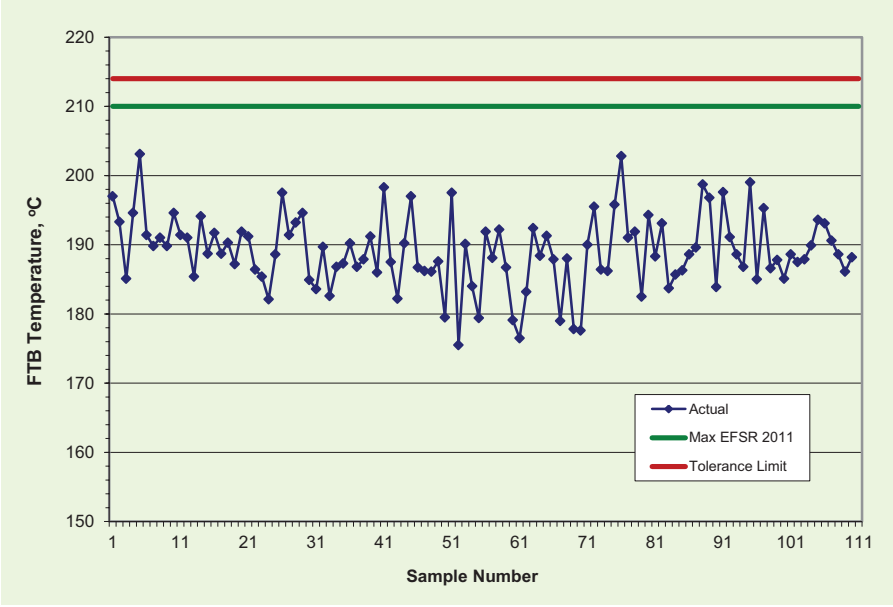
The largest figures for final boiling point were found to not exceed 204°C.

Figure 6a: Test Results for Final Boiling Point, RON 91, Year 2016-2017



The two largest figures for final boiling point were also found to not exceed 204°C.

Figure 6b: Test Results for Final Boiling Point, RON 95 & 98, Year 2016-2017



9 ASTM D86-17 *Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure*

Residue

All samples were found to be well within the limits for both regular and premium grades (Fig. 7).

Distillation residue, according to the standard ASTM D86[10] is usually expected to be in a certain range and serves primarily for indication of the viability of the distillation process. So it should be interpreted as one of the process control parameters and on these grounds residue, understandably, does not have values of repeatability and reproducibility listed in the Standard. Therefore no tolerance limit for residue could be defined due to the absence of data for the reproducibility of this parameter in ASTM D86. Fortunately, residue content was found to be well below the specified maximum limit of 2% volume. The highest figure for residue of 1.3% was found for Sample 4 of regular petrol. All other results for both regular and premium petrol were found to be not higher than 1.2%.

Figure 7a: Test Results for Residue, RON 91, Year 2016-2017

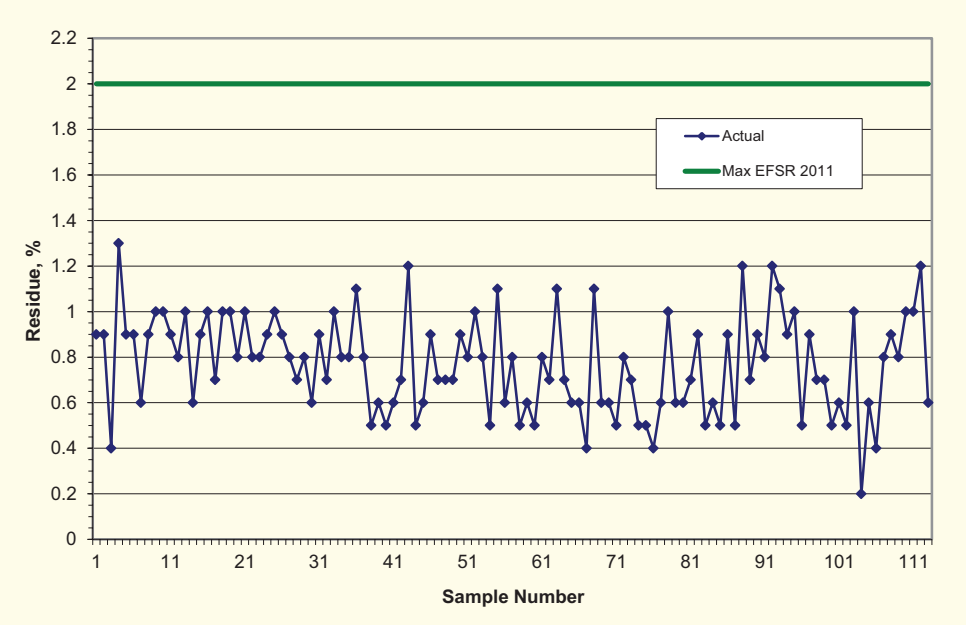
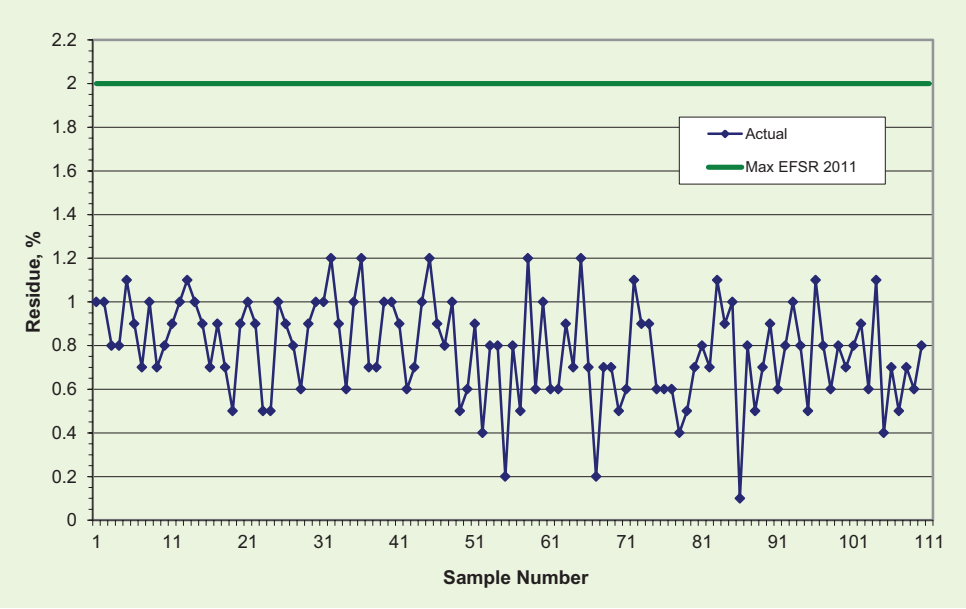


Figure 7b: Test Results for Residue, RON 95 & 98, Year 2016-2017



10 ASTM D86-17 *Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure*

Dry Vapour Pressure Equivalent

The test method ASTM D5191[11] is prescribed in the Regulations for vapour pressure in petrol.

All samples tested for Dry Vapour Pressure Equivalent (DVPE) were found to be above the prescribed minimum limit of 45 kPa.

The cumulative results for the maximum limit are presented below in a simplified way by combining the lowest prescribed maximum limits for all seasons in one graph. Generally, if results were below the lowest maximum limit established for an area then they definitely complied with the Regulations in all other areas.

For the period of summer in Schedule 1 (season definitions in Section 5, the Regulations) from 1 December to 31 March inclusive, the lowest maximum limit of pressure 65 kPa is prescribed for Auckland and Northland. This is shown on the Fig. 8 by a square dip.

The top line before and after the dip, is the next lowest maximum, 80 kPa, which is prescribed for the North Island, for the autumn and spring seasons. The vapour pressure must be tightly controlled at high temperatures to reduce the possibility of hot fuel handling problems, such as vapour lock or excessive evaporative emissions. Vapour lock is a problem that may occur when the liquid fuel converts into gas while still in the car fuel system. This could disrupt the operation of the fuel pump, causing loss of feed pressure and may result in loss of power or complete stalling. At lower temperatures, a sufficiently high vapour pressure is needed to allow ease of starting and good warm-up performance. Therefore, both minimum and maximum vapour pressures are specified.

The maximum limits prescribed for winter in all three designated regions are equal to or above 90 kPa and not shown in the graph.

Each sample within the relevant season which appeared to be above the lowest maximum limit line was individually analysed.

Tolerance limits related to the maximum specification limits are not shown since they are only approx. 2% above each relevant limit.

RON 91

In various periods, several samples were initially found to be above the lowest maximum at the time. However, all they were subsequently found to be within the specification limits for their region and season.

Of those, firstly, Sample 14 was found to be 81.6 kPa i.e. well within[12] the maximum limit of 95 kPa for winter in South Island.

Next, Samples: 45, 47, 62, 65, and 73, were found to be in the range from 65.5 kPa to 72.0 kPa i.e. within the maximum limit of 75 kPa for summer in South Island.

Finally, Samples: 56, 66, and 78, were found to be in the range from 65.0 kPa to 65.3 kPa i.e. within the maximum limit of 70 kPa for summer in the rest of North Island.

RON 95 & 98

All samples were found to be within the specification limits for premium petrol (Fig. 8b). However, as in case with regular petrol, in various periods, several samples were initially found to be above the lowest maximum at the time.

Of those, four samples: 2, 8, 12, 15, 16, and 17, which were found to be in the range from 80.1 kPa to 82.1 kPa, were well within the regional maximum limits for winter 90 kPa for North Island.

There were also nine samples found to be above the lowest maximum in the summer period.

Samples: 42, 44, 46, 54, 64, and 72, which were found to be in the range from 65.0 kPa to 68.4 kPa, were well within the maximum limit of 75 kPa for South Island in summer.

Finally, three other samples, 73, 74, and 75, which were found to be, respectively, 66.0, 65.8, and 69.0 kPa, were ethanol blends (see Table 1 above). They were found to be within the seasonal maximum limits of 72 kPa and 77 kPa for 10% ethanol blends, respectively, for Auckland and for the rest of North Island.

11 ASTM D5191-15 *Standard Test Method for Vapor Pressure of Petroleum Products (Mini Method)*

12 *'Well within the limit'* in this Report means a compliant result which is away from the prescribed limit farther than three tolerance margins. Here, the limit is 90 kPa so that minus three tolerance margins gives 85.8 kPa.

Figure 8a: Test Results for DVPE, RON 91, Year 2016-2017

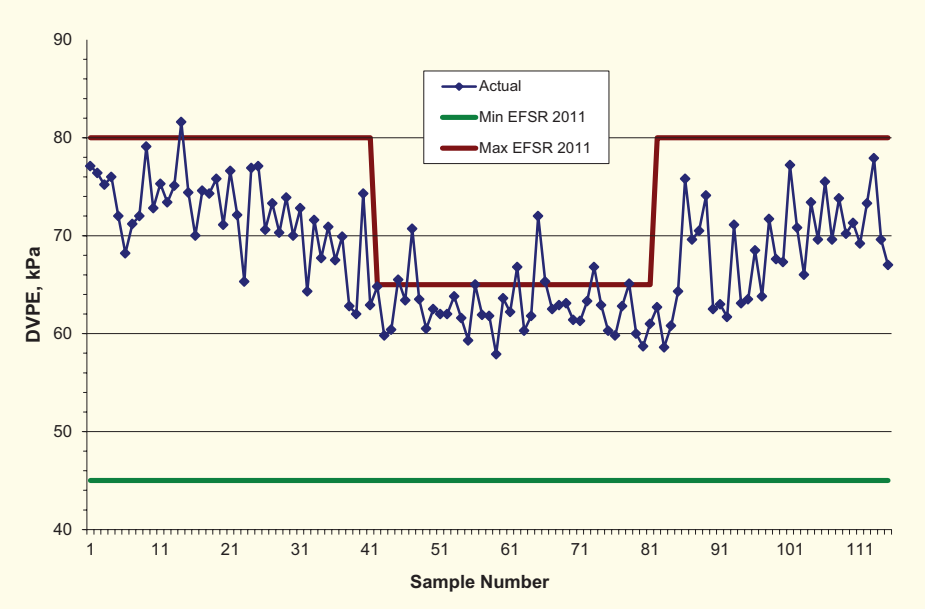
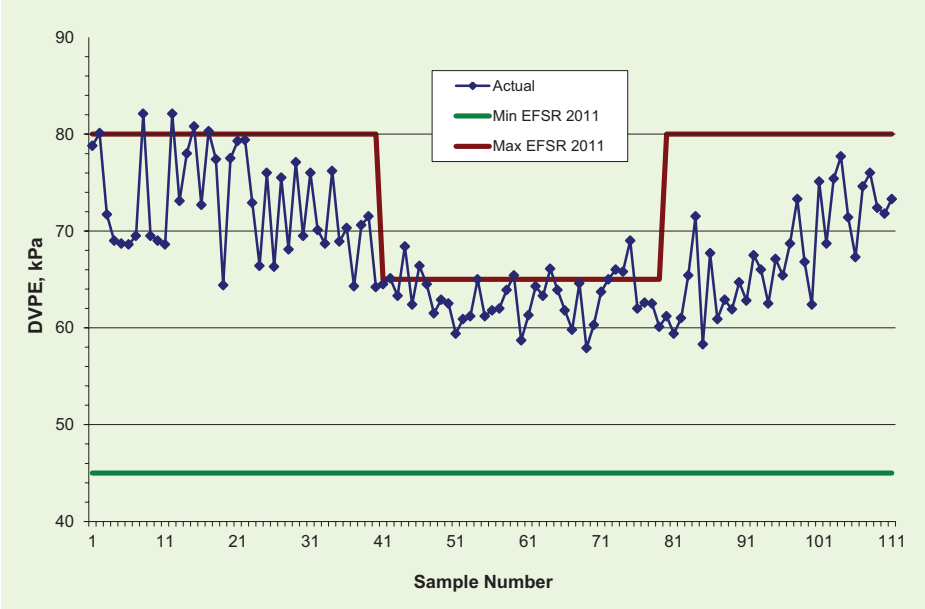


Figure 8b: Test Results for DVPE, RON 95 & 98, Year 2016-2017



Flexible Volatility Index

The Flexible Volatility Index (FVI) is a derived parameter which is calculated from the measured value of DVPE (see above) and the value of E70, as

FVI = DVPE + (0.7 x E70)

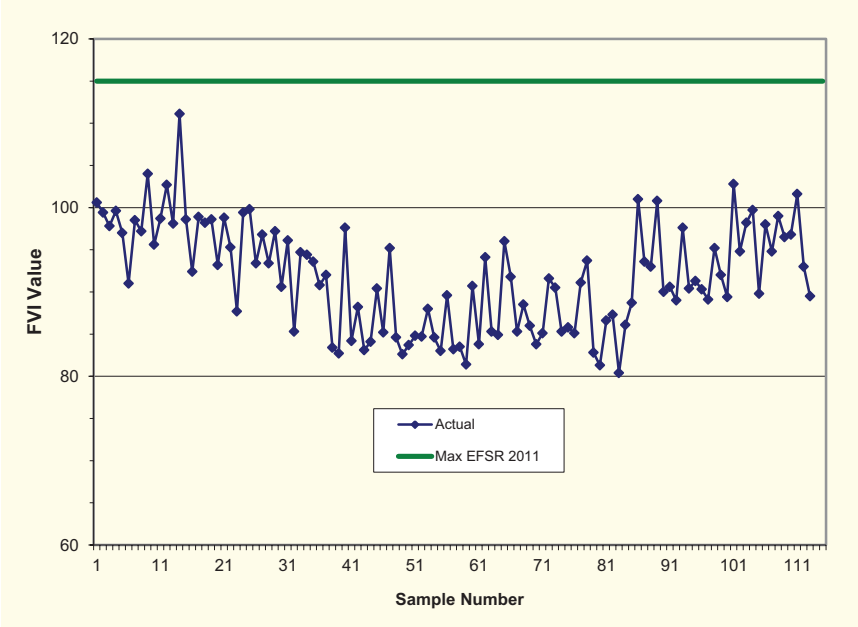
FVI serves as an indicator of the hot running performance (the tendency for vapour lock).

No definition of the FVI value is given in the related ASTM Standards prescribed in the Regulations (D86 and D5191[13]) and as a consequence no reproducibility value is identified. As a result of this the FVI serves only as a helpful indicator but cannot be used in a strict compliance analysis.

RON 91

All samples were found to be within the specification maximum limit of 115.0.

Figure 8c: Results for Flex. Vol. Index, RON 91, Year 2016-2017

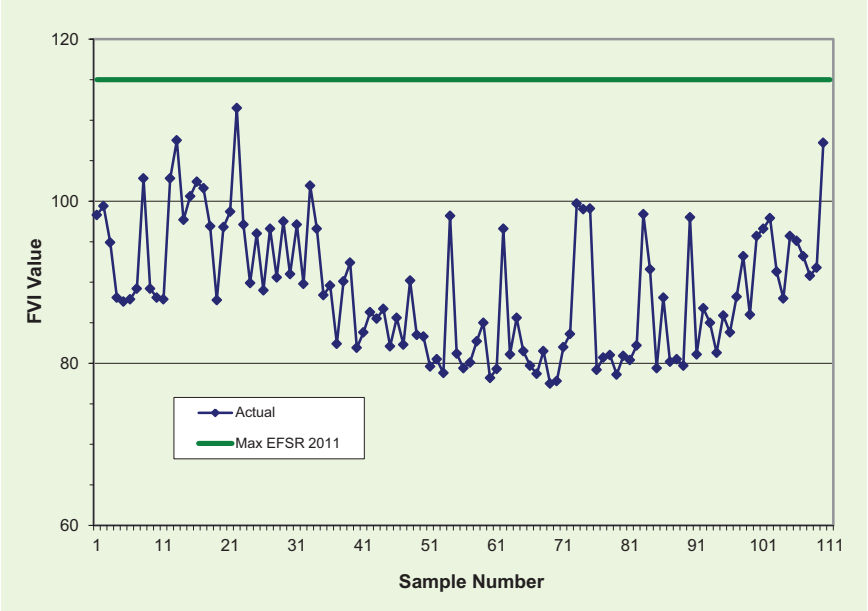


13 ASTM D5191 - *15 Standard Test Method for Vapor Pressure of Petroleum Products (Mini Method)*

RON 95 & 98

All samples were found to be within the prescribed maximum limit of 115.0.

Figure 8d: Results for Flex. Vol. Index, RON 95 & 98, Year 2016-2017



Sulphur

The scope of the test method IP 497[14] prescribed in the Regulations, is from 5 to 60 mg/kg. Accordingly, the lowest line of testing results by this method is 5 mg/kg where the actual figures were found to be on or below this indicative level at the specified maximum limit of 50 mg/kg with the tolerance limit of 56 mg/kg.

The ASTM standard D5453[15] which is also prescribed in the Regulations along the IP 497, give results down to a fraction of 1 mg/kg although it was used by the testing laboratory only in a few instances.

14 IP497 EN ISO 20884:2011 *Petroleum products - Determination of sulfur content of automotive fuels. Wavelength-dispersive X-ray fluorescence spectrometry*

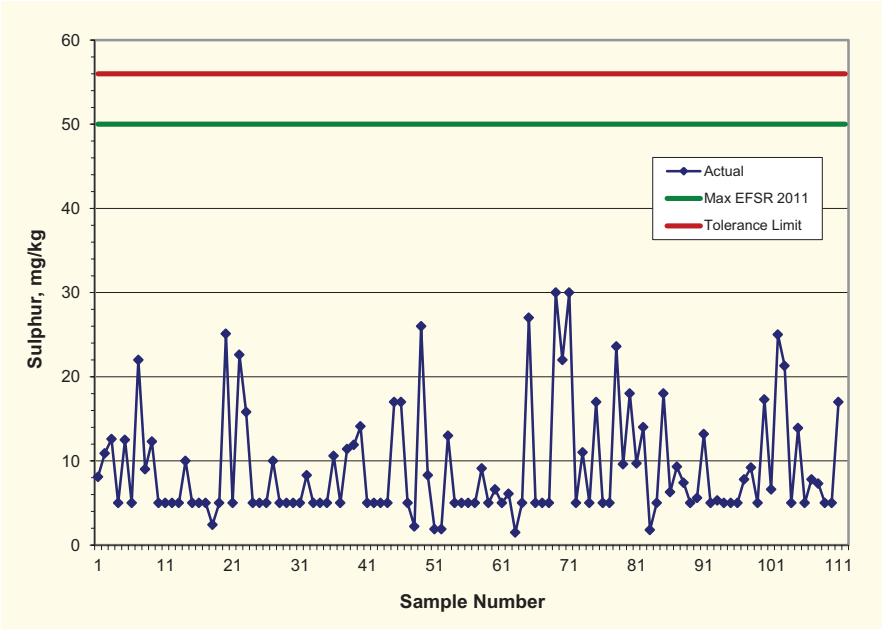
15 ASTM D5453–16e1 *Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence*

RON 91

All samples for regular petrol were found to be within the prescribed maximum limit.

All results were found to be not more than 30 mg/kg.

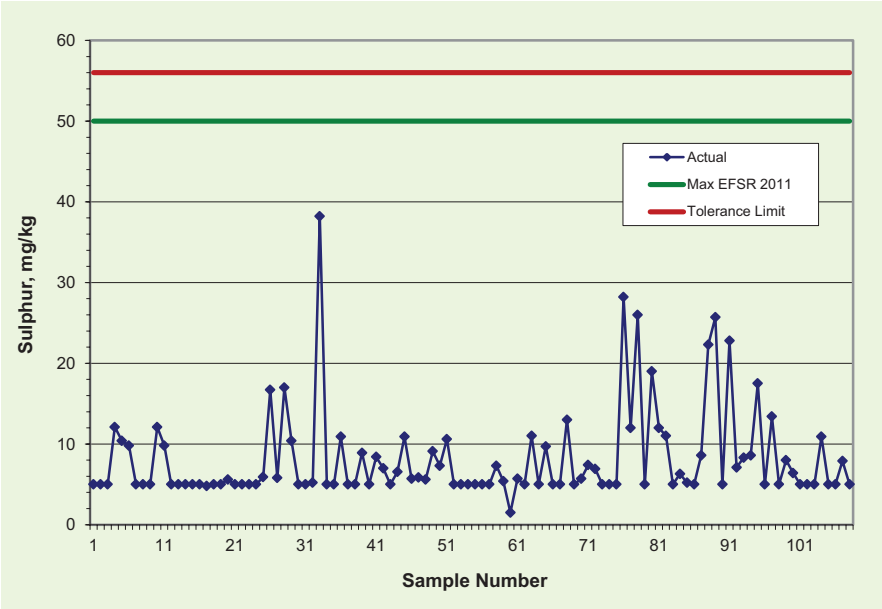
Figure 9a: Test Results for Sulphur, RON 91, Year 2016-2017



RON 95 & 98

All results for premium petrol were found to be well within the prescribed maximum limit not exceeding 30 mg/kg except one result of 38.2 mg/kg for imported petrol.

Figure 9b: Test Results for Sulphur, RON 95 & 98, Year 2016-2017



Benzene and Total Aromatics

The test method ASTM D5580[16] is prescribed in the Regulations for aromatic compounds including benzene.

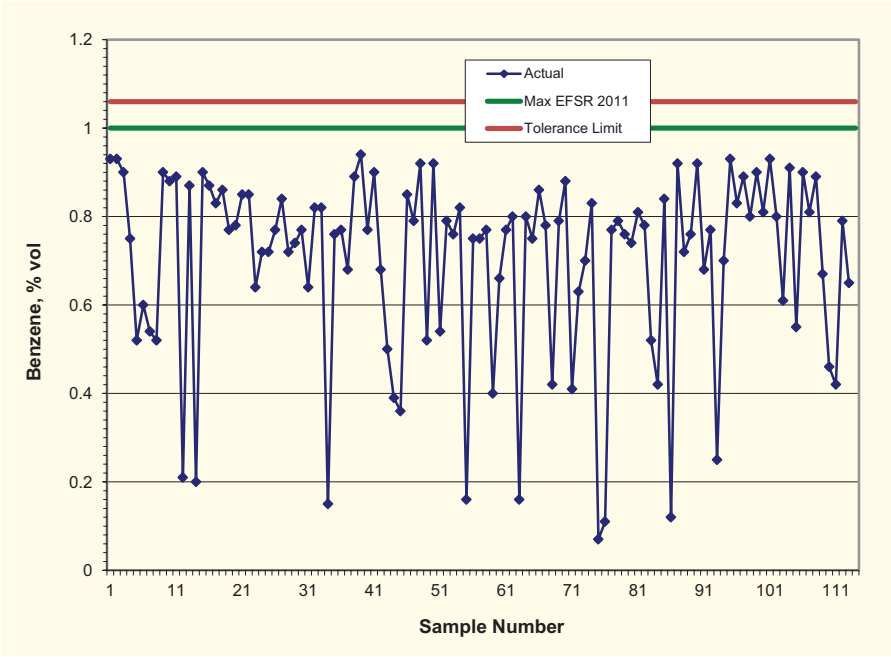
All samples were found to be within the prescribed maximum limits, for both benzene (maximum 1% vol) and total aromatic compounds (45% vol maximum cap) for regular as well as premium grade of petrol with the tolerance limits, respectively, of 1.06% for benzene and of 46.03% for the maximum cap in total aromatics.

RON 91

All results for benzene content in regular petrol were found to be below 0.95% with the largest figure of 0.94% for Sample 39 (Fig.10a).

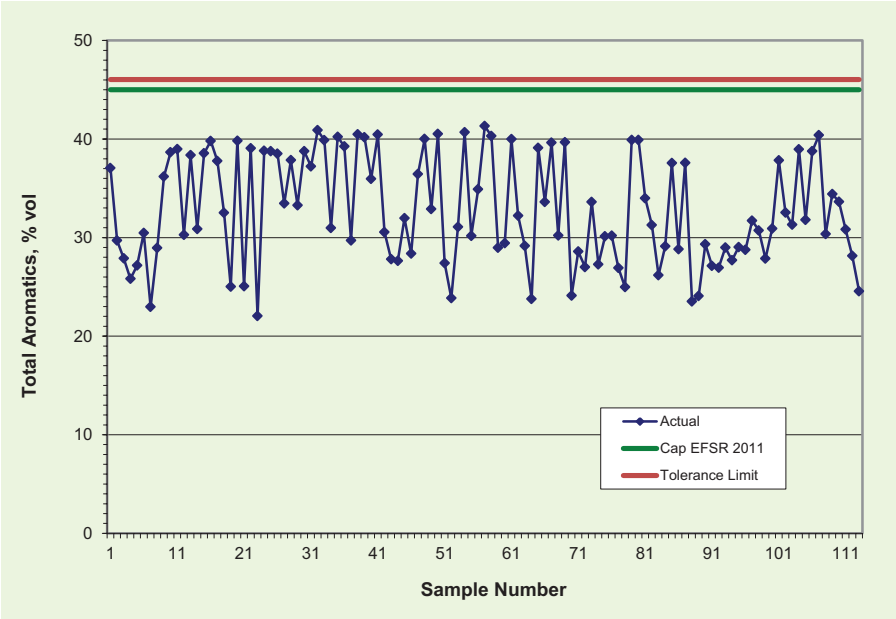
All results on total aromatics were found to be below 42% with the largest figure of 41.31% for Sample 57 (Fig. 10b).

Figure 10a: Test Results for Benzene, RON 91, Year 2016-2017



16 ASTM D5580-15 *Standard Test Method for Determination of Benzene, Toluene, Ethylbenzene, p/m-Xylene, o-Xylene, C9 and Heavier Aromatics, and Total Aromatics in Finished Gasoline by Gas Chromatography*

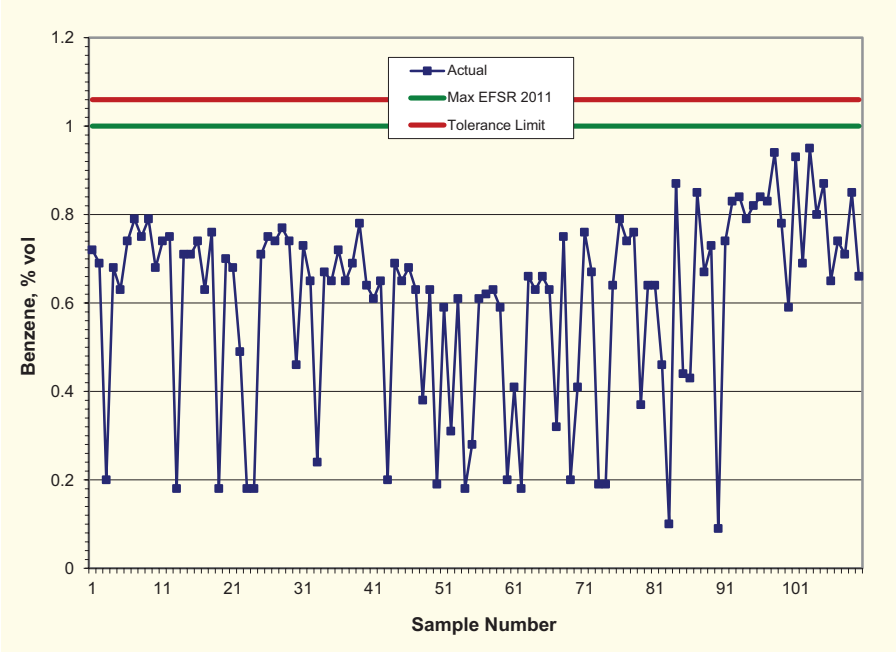
Figure 10b: Test Results for Total Aromatics, RON 91, Year 2016-2017



RON 95 & 98

All samples of premium petrol were found to be well within the prescribed maximum limit for benzene with largest results not higher than 0.90% except three samples: 98, 101 and 103, which were found to be in the range from 0.93 to 0.95%.

Figure 10c: Test Results for Benzene, RON 95 & 98, Year 2016-2017

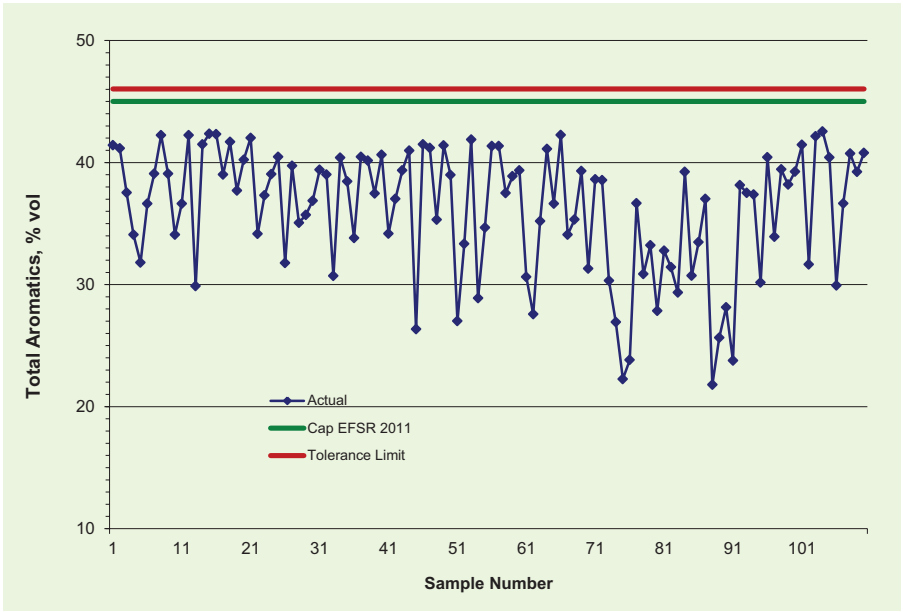


For premium petrol, all results on total aromatics were below 43% with the largest result on total aromatics was found to be 42.55% for Sample 104 (Fig. 10d).

According to Section 19 of the Regulations, actual amounts of petrol which were produced or imported, must be accounted, to calculate 'pool average' figures for the total aromatic compounds for each calendar month. The pool average specification for total aromatics is 42% vol maximum.

Data on 'pool average' was collected from five major fuel retail companies and from The New Zealand Refining Company Ltd for the one year period ending on 30 June 2017. The actual results were found to be within the required limits. Due to the commercial sensitivity of the calculation process, the actual results were not included in this report.

Figure 10d: Test Results for Total Aromatics, RON 95 & 98, Year 2016-2017



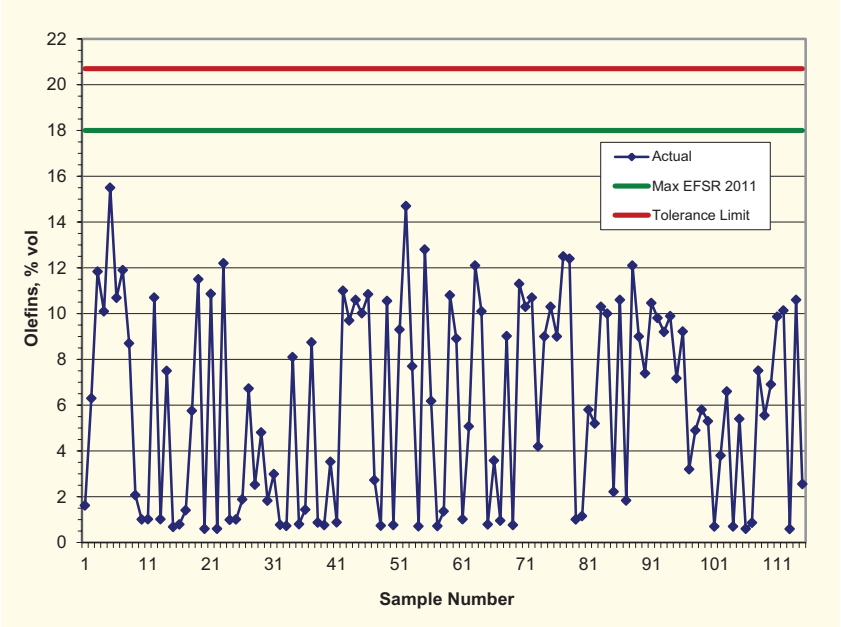
Olefins

The test method ASTM D1319[17] is prescribed in the Regulations for olefins content. All samples were found to be within the specification maximum limit of 18% vol with the tolerance limit of 20.7%.

RON 91

For RON 91, all results were found to be below 15% (Fig. 11a) except Sample 5 which was found to be 15.5%.

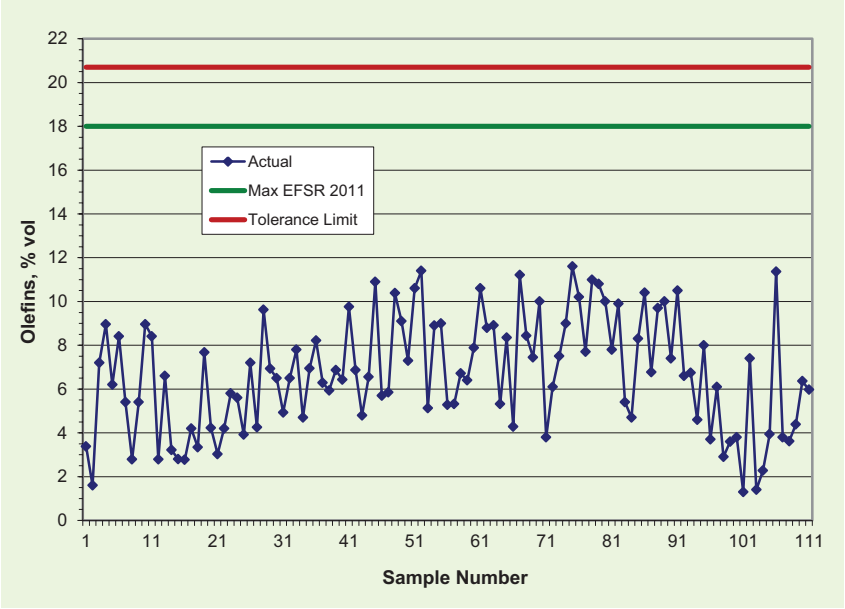
Figure 11a: Test Results for Olefins, RON 91, Year 2016-2017



RON 95 & 98

For premium petrol, all results were also found to be below 12% (Fig. 11b).

Figure 11b: Test Results for Olefins, RON 95 & 98, Year 2016-2017



17 ASTM D1319-15 *Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption*

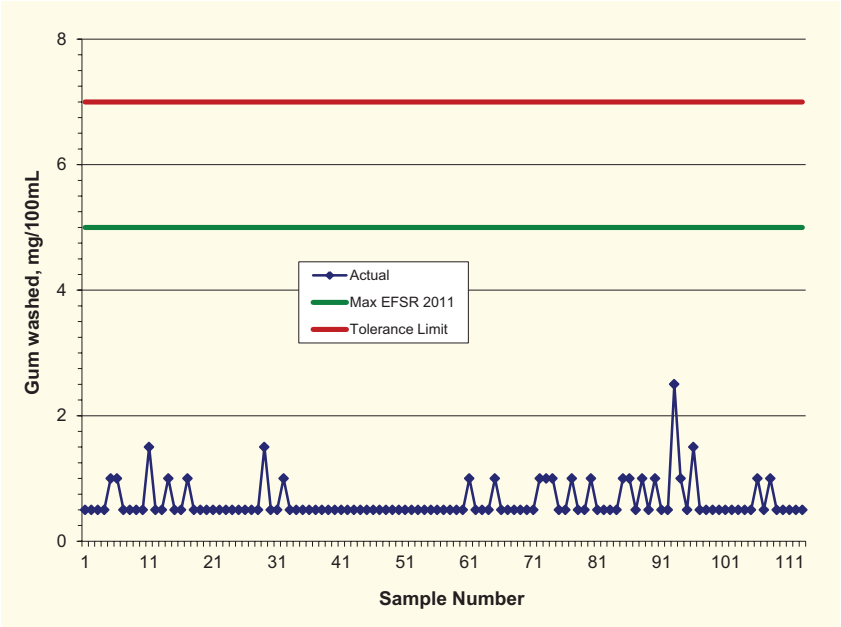
Existent Gum (solvent washed)

The threshold of the test method ASTM D381[18] prescribed in the Regulations, is 0.5 mg/100mL. Accordingly, the lowest line of testing results as prescribed by this method is 0.5 mg/100mL where the actual figures were found to be on or below this indicative level at the specified maximum limit of 5 mg/100mL. The tolerance limit is 7.0 mg/100mL.

For regular petrol, all results except one were found to be not higher than 1.5 mg/100mL with the largest result of 2.5 mg/100mL for Sample 93 (Fig. 12a).

RON 91

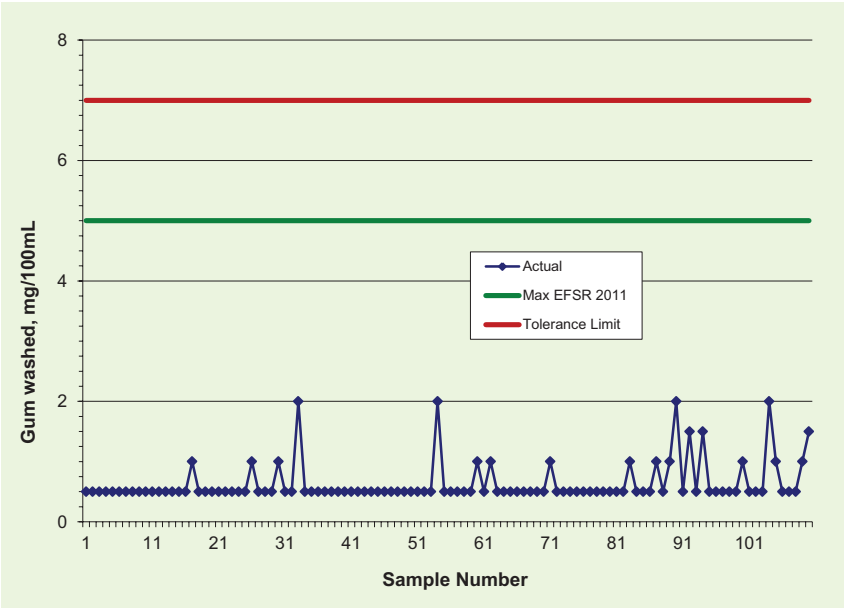
Figure 12a: Test Results for Gum, RON 91, Year 2016-2017



RON 95 & 98

For premium petrol, all results were found to be not higher than 2 mg/100mL (Fig. 12b).

Figure 12b: Test Results for Gum, RON 95 & 98, Year 2016-2017



18 ASTM D381-17 *Standard Test Method for Gum Content in Fuels by Jet Evaporation*

Other Specification Parameter Testing

Testing and analysis, at a lower frequency, was also conducted on other parameters and properties prescribed in the Regulations. This included screening for the content of contaminants which are not expected to be present in fuel: lead, manganese and phosphorus. This is done by means of an initial identification of their presence on the threshold of resolution by each relevant method. These tests' results have not been included in this report as they were usually found to be below the threshold and well within the specification limits.

The ethanol content in petrol blends was also tested and found to be within the testing tolerance limit. All results for samples with ethanol content up to 10%[19], are set out in a Table 1a below.

Six of them were found to be within the prescribed limit for ethanol blends. Samples 33, 62, 73 and 74 were tested for ethanol content twice by the same operator each, with

- 10.00% being the average of two results, 10.03 and 9.98%, for Sample 33,
- 10.19% being the average of two results, 10.26 and 10.13%, for Sample 62,
- 10.39% being the average of two results, 10.37 and 10.41%, for Sample 73,
- 10.23% being the average of two results, 10.26 and 10.20%, for Sample 74,

at the testing tolerance limit of 10.49%. These four samples were found to be below the testing tolerance limit so, according to the established policy, they were deemed to be compliant.

Table 1a

Sample	13	22	33	54	62	73	74	75	83	90
Ethanol Content, % Vol	9.84	9.81	10.00	9.94	10.19	10.39	10.23	8.96	9.53	9.73

Summary for Petrol Test Results

The number of suspected non-compliance cases was low and there were no repeated cases of suspected non-compliance identified.

Three suspect non-compliant samples detected related to samples of premium petrol where the Motor Octane Number (MON) on investigation was found to be below the specified minimum limit of 85.0 with an actual figure each of 84.9. One of the samples after the repeated testing was found to be compliant. Two other samples were found to be outside specification after subsequent additional testing and analysis however the average of 84.9 was above the testing tolerance limit of 84.6 therefore the products were deemed to be compliant in all three instances.

There were other four suspected non-compliance cases related to samples of premium petrol where the ethanol content on investigation was found to be above the specified limit of 10% with actual figures from 10.03% to 10.37%. After subsequent additional testing and analysis, one of these samples was found to be on specification while three other samples were found to be outside specification with the average figures from 10.19 to 10.39%. Since these three average results were within the testing tolerance limit of 10.49% the products were deemed to be compliant in all three instances.

19 ASTM D4815-15b *Standard Test Method for Determination of MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C1 to C4 Alcohols in Gasoline by Gas Chromatography*

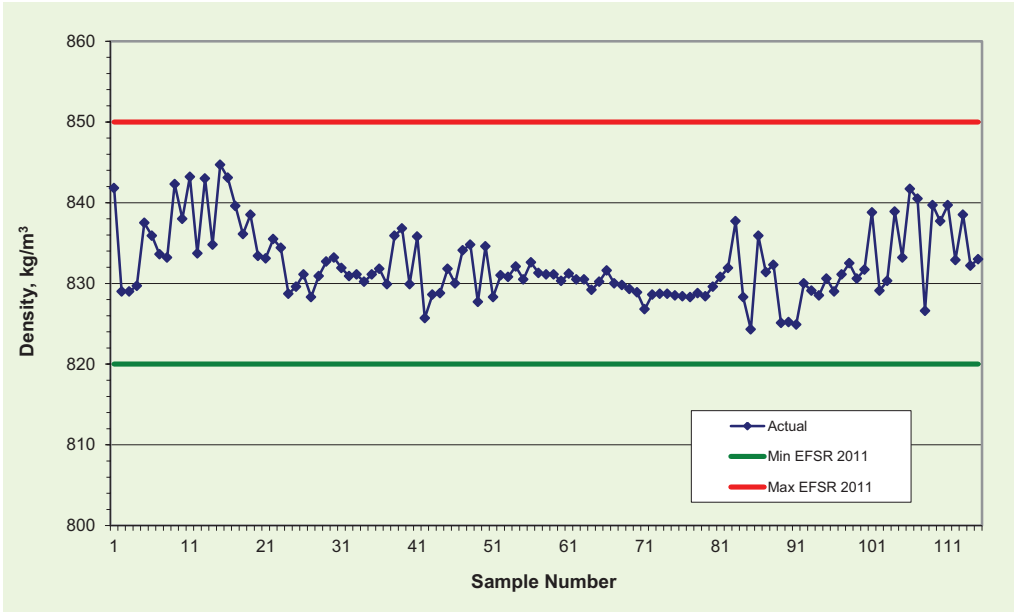
Diesel

Density

Density of diesel at 15°C can be tested according to ASTM D1298[20] or ASTM D4052[21] prescribed in the Regulations. Respectively, there are two pairs of tolerance limits identified using the two methods for the minimum limit of 820 kg/m^3 and for the maximum limit of 850 kg/m^3.

All results were found to be well within the specification limits with the minimum figure of 824.3 kg/m^3 for Sample 85 at the minimum tolerance limit of 819.3 kg/m^3 and the maximum figure of 844.7 kg/m^3 for Sample 15 at the maximum tolerance limit of 850.7 kg/m^3.

Figure 13: Test Results for Density, Diesel, Year 2016-2017



20 ASTM D1298-12b *Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method*
21 ASTM D4052-11 *Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter*

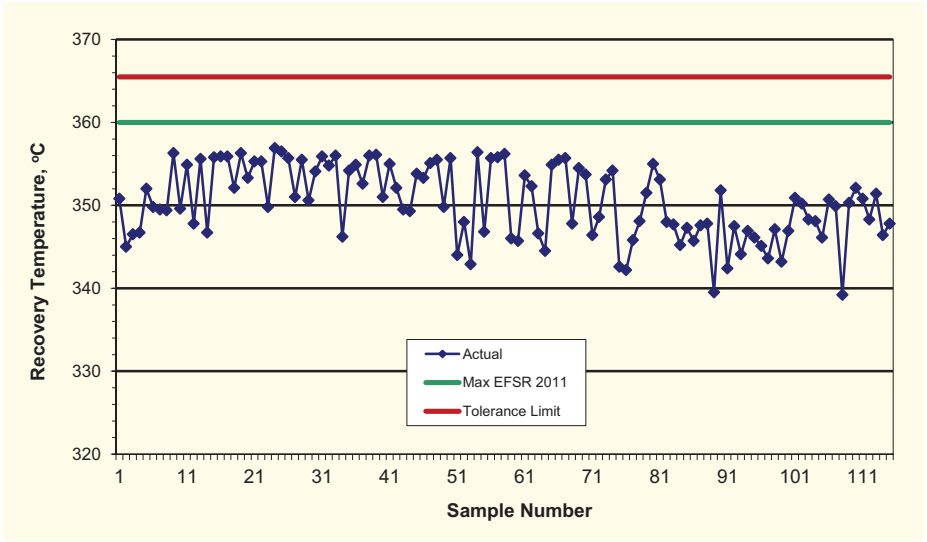
Distillation

The Distillation test means definition of temperature (°C) at which 95% volume recovered. The temperature should be tested by ASTM D86[22] prescribed in the Regulations.

All samples were found to be below the specification maximum limit of 360°C for distillation at 95% volume recovered (T95), actually, they were found to be below 357°C (Fig. 14) at the tolerance limit is 365.5°C.

Sample 108 was found to be the lowest with the actual figure of 339.2°C although there is no prescribed minimum limit for this property.

Figure 14: Test Results for Distillation 95% Vol Recovered, Diesel, Year 2016-2017



22 ASTM D86-17 *Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure*

Cetane Index

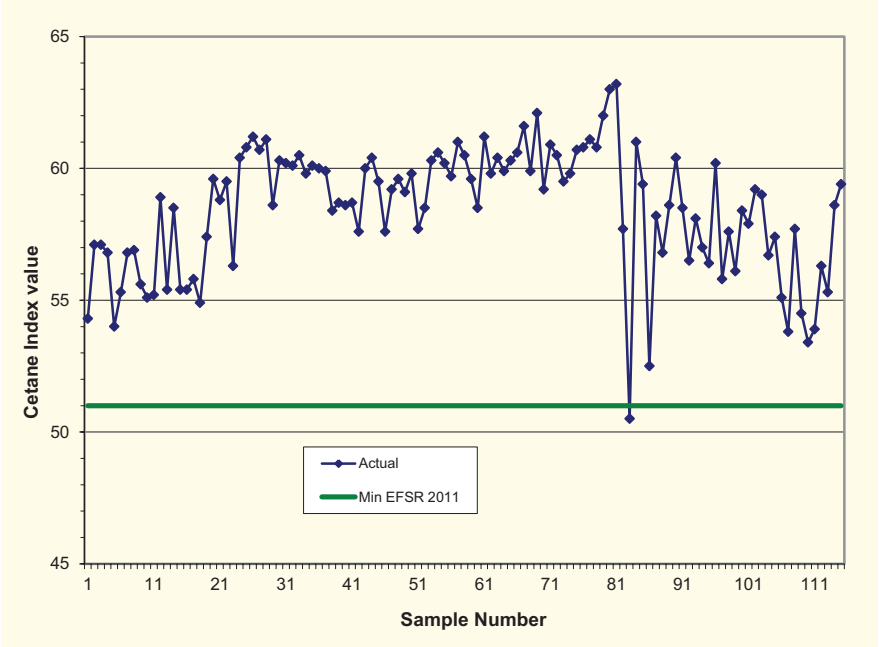
The cetane index, according to ASTM D4737[23] prescribed in the Regulations, is not tested for but calculated from density and distillation recovery temperature measurements. The calculated cetane index is a tool for estimating cetane number when a test engine for determining cetane number is not available and/or cetane improvers are not used.

All samples except one were found to be above the minimum limit of 51 (Fig.15).

Sample 83 was found to be below the specified minimum with the actual figure of 50.5.

Since the reproducibility for cetane index is not defined in the ASTM D4737, it is impossible to exactly define a tolerance limit. However, the Standard specifies that 'the expected error of prediction of Procedure A will be less than ±2 cetane numbers for 65% of the distillate fuels evaluated'. On these grounds, an estimate for the tolerance limit would be derived as 49.8. The tests of properties from which the cetane index is derived were repeated twice with the resulting figures for cetane index of 50.6 received twice in the two repeated sets of tests. An average figure of approx. 50.6 received from three sets of tests is above the derived tolerance limit so the sample was deemed to be compliant.

Figure 15: Test Results for Cetane Index, Diesel, Year 2016-2017



23 ASTM D4737-16 *Standard Method for Calculated Index by Four Variable Equation*

Water

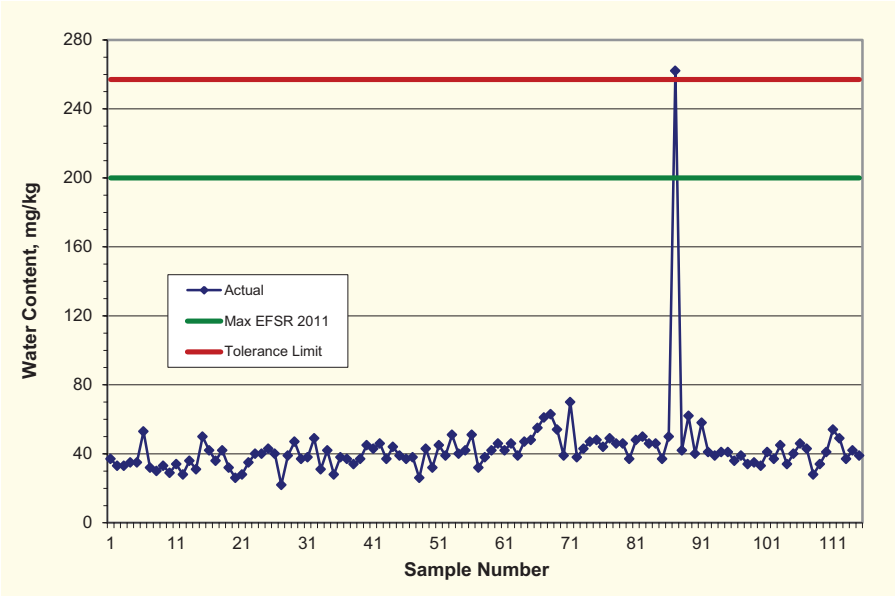
The test for water content is done according to IP 438[24] which determines the total water present in diesel sample held either in solution or in solution and free water.

Water is soluble to some extent in hydrocarbons. The amount of water that is held in solution will be dependent on the temperature and the composition of the hydrocarbon. At typical ambient temperatures in New Zealand the expected concentration of water dissolved in diesel, is around 30 to 40 mg/kg.

The water content in all the tested samples except one was found to be well within the specification limit of 200 mg/kg with actual testing results not exceeding 60 mg/kg. Sample 87 was initially found to be 229 mg/kg with a copious amount of free water present at an appearance test, including droplets up to a few mm in diameter. On investigation the test repeated by the same operator on a different testing instrument, returned the figure of 265 mg/kg. After subsequent additional testing and analysis, an average of three results by two operators was found to be 262 mg/kg for the product from same testing vessel. Since the average result was found to be above the maximum tolerance limit of 259 mg/kg the product was deemed to be non-compliant. In addition another test of a product from the original supply vessel returned the water content figure of 338 mg/kg. It was not clear where any potential contamination might have occurred.

After further analysis of the sampling process, no reason or cause was identified for suspecting contamination during the sample collection operation. Following advice from Trading Standards, the company involved has completed their own internal investigation. The outcome is that the samples with high water content do not represent the actual product in UST. Sampling of the same site was done a few months later with testing results which did not reveal any suspect property. So the initial result remains anomalous but was included in the report due to the fact that there is no reason to discard it according to the established procedure.

Figure 16: Test Results for Water in Diesel, Year 2016-2017

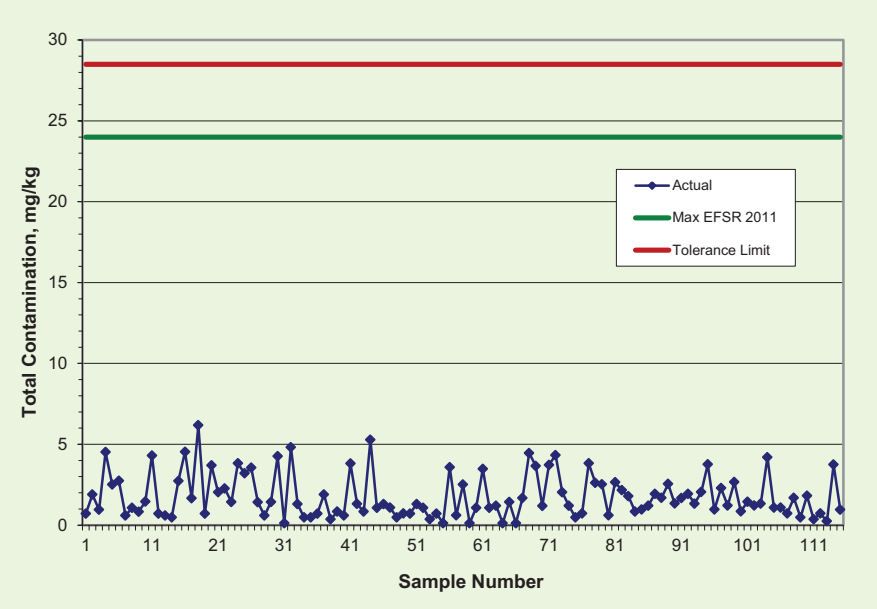


24 BS EN ISO 12937:2001, BS 2000-438:2001. *Petroleum products. Determination of content. Coulometric Karl Fischer titration method*

Total Contamination

The total contamination should be tested by IP440[25] prescribed in the Regulations. All samples were found to be well below the maximum limit of 24 mg/kg specified in the Regulations (Fig. 17). The tolerance limit is 28.5 mg/kg.

Figure 17: Test Results for Total Contamination, Diesel, Year 2016-2017



25 BS EN 12662:2014, BS 2000-440:2014. *Liquid petroleum products. Determination of total contamination in middle distillates, diesel fuels and fatty acid methyl esters*

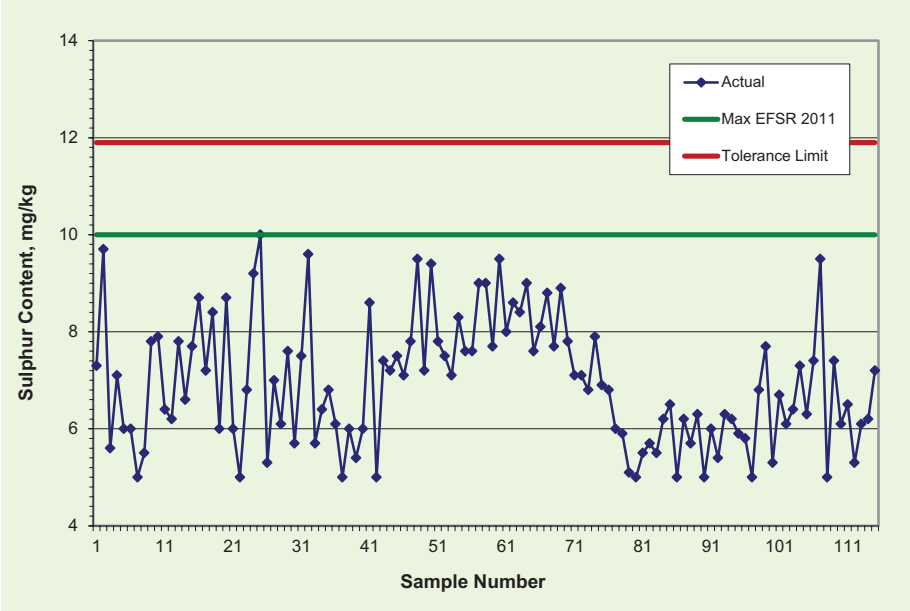
Sulphur

Sulphur content can be tested according to IP 497[26] or ASTM D5453[27] prescribed in the Regulations. Respectively, there are two slightly different tolerance limits identified for the two methods: 11.8 mg/kg for IP497:2011 and 11.9 mg/kg for D5453-12.

All samples were found to be below the maximum limit of 10 mg/kg specified in the Regulations (Fig. 18).

Sample 25 was tested by IP497 and was found to be on the specification limit.

Figure 18: Test Results for Sulphur, Diesel, Year 2016-2017



26 IP 497 ISO 20884:2011: *Petroleum products — Determination of sulfur content of automotive fuels — Wavelength-dispersive X-ray fluorescence spectrometry*

27 ASTM D5453-16e1 *Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence*

Cloud Point

Cloud point of diesel should be tested according to ASTM D5773[28] prescribed in the Regulations.

The cumulative results for Cloud Point (CP) are presented below by combining the lowest prescribed maximum limits for each season in one graph (Fig.19). Generally, if results were below the lowest maximum limit established for an area they definitely complied with the Regulations in all other areas.

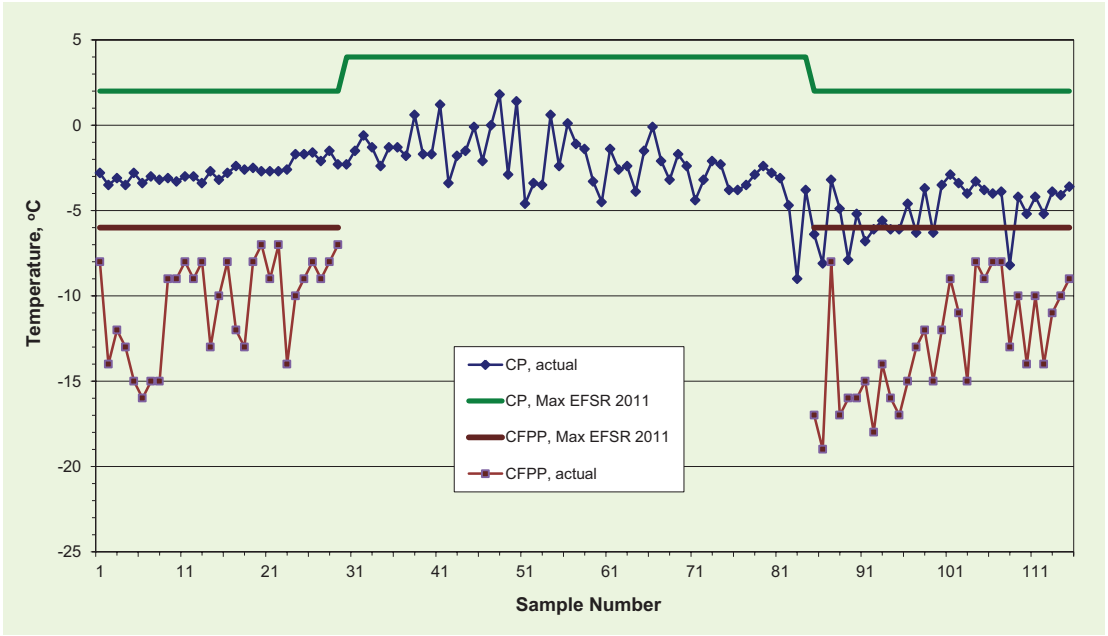
For the period of summer in Schedule 2 (season definitions in Section 5, the Regulations) from 15 October to 14 April inclusive, the lowest maximum limit of CP +4°C is prescribed for all New Zealand excluding Auckland and Northland.

The bottom line before and after the pedestal, is the next lowest maximum, +2°C, which is prescribed for all New Zealand in winter, from 15 April to 14 October inclusive. The maximum limit prescribed for summer in Auckland and Northland, is +6°C and not shown in the graph. All tolerance limits are 0.5°C above each specified limit.

All samples within the relevant seasons appeared to be below the lowest maximum limit. Sample 48 returned the highest testing result for summer, +1.8°C, at the maximum limit of +4°C.

The lowest figure for CP was found to be –9.0°C for Sample 83 from South Island.

Figure 19: Test Results for Cloud Point and Cold Filter Plugging Point, Diesel, Year 2016-2017



28 ASTM D5773-15 *Standard Test Method for Cloud Point of Petroleum Products (Constant Cooling Rate Method)*

Cold Filter Plugging Point

Cold filter plugging point of diesel should be tested according to IP309[29] prescribed in the Regulations.

The test results for Cold Filter Plugging Point (CFPP) are set out on the same graph as that for CP (Fig.19). This gives an advantage to see the data 'at glance' and compare the two sets where necessary.

CFPP is defined only for the winter season with maximum limit of –6°C.

All samples were found to be below the maximum limit specified in the Regulations for the winter season.

Sample 86 was found to have the lowest CFPP of –19°C with a result for CP of –8.1°C.

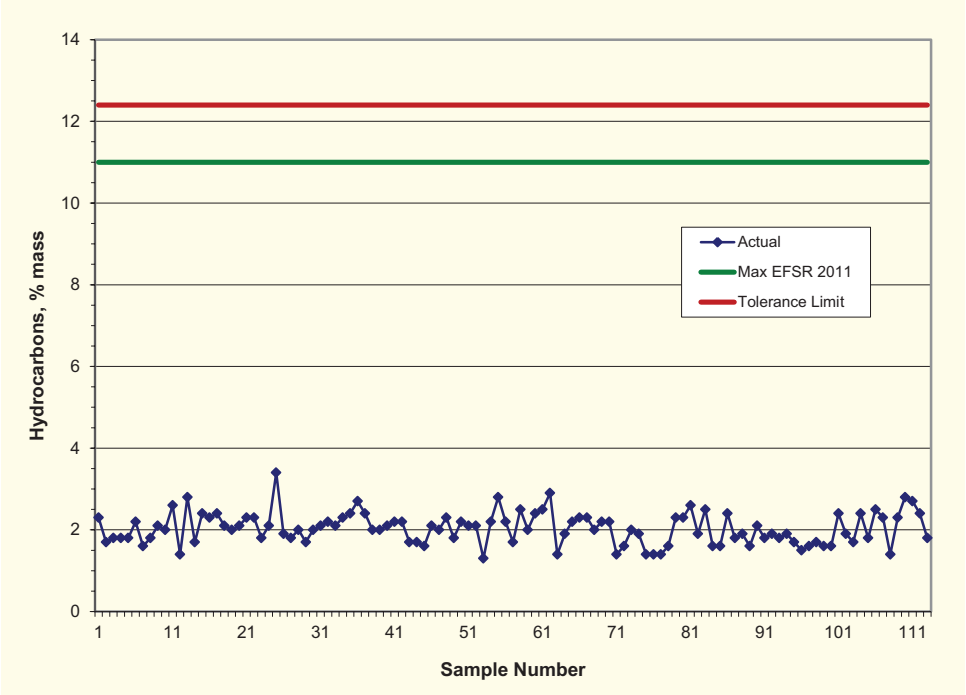
Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons should be tested by IP391[30] prescribed in the Regulations.

All samples were found to be well below the maximum limit of 11% specified in the Regulations.

All testing results were found to be below 4% at the tolerance limit of 12.4%.

Figure 20: Test Results for Polycyclic Aromatic Hydrocarbons, Diesel, Year 2016-2017



29 BS EN 116:2015, BS 2000-309:2015 *Diesel and domestic heating fuels. Determination of cold filter plugging point. Stepwise cooling bath method*

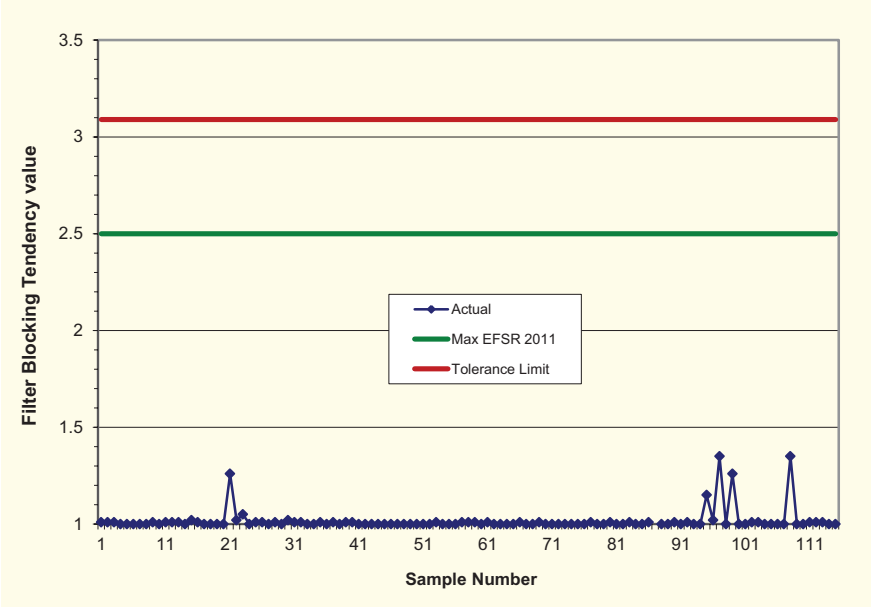
30 BS EN 12916:2006, BS 2000-391:2006 *Petroleum products. Determination of aromatic hydrocarbon types in middle distillates. High performance liquid chromatography method with refractive index detection*

Filter Blocking Tendency

Filter blocking tendency can be tested by IP387[31] or ASTM D2068[32] prescribed in the Regulations.

All samples were found to be within the specified maximum limit of 2.5 for filter blocking tendency at the tolerance limit of 3.09. Further, all actual figures except two were in the range from 1.00 to 1.30 while Samples 97 and 108 were found to be both the largest with the actual figure of 1.35.

Figure 21: Filter Blocking Tendency, Diesel, Year 2016-2017



31 IP 387:2017 *Determination of filter blocking tendency*
32 ASTM D2068-17 *Standard Test Method for Determining Filter Blocking Tendency*

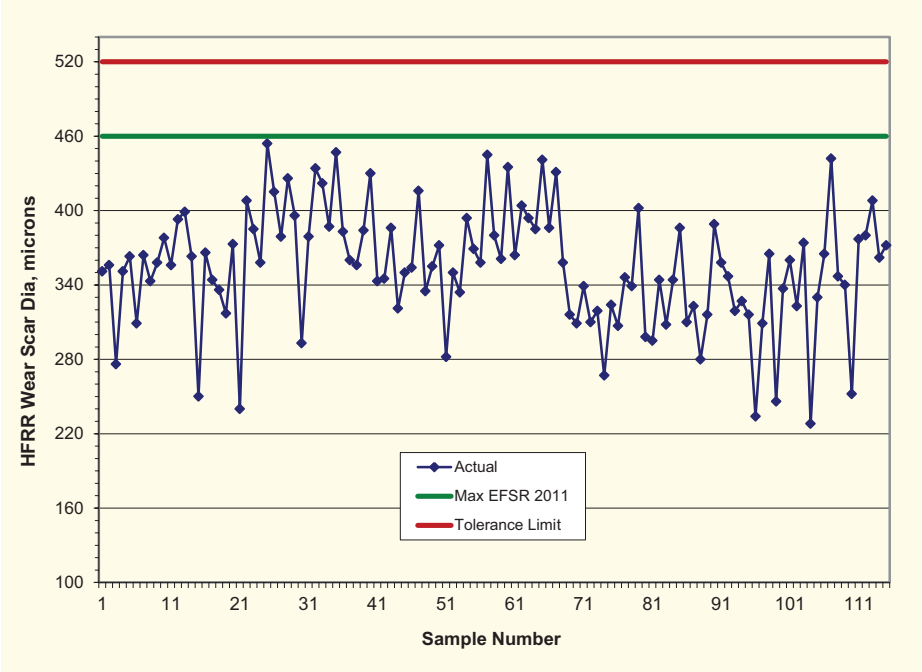
Lubricity

Lubricity should be tested by IP450[33] prescribed in the Regulations.

All samples were found to be below the specification maximum limit for the lubricity identified as a diameter of the wear scar produced on an oscillating ball from contact with a stationary plate immersed in the fluid. The diameter is usually measured in microns: the specification maximum limit is 460 µm. The tolerance limit is 520 µm.

Sample 25 was found to be the closest to the specification limit with the actual figure of 454 µm.

Figure 22: Test Results for Lubricity, Diesel, Year 2016-2017



33 BS 2000-450:2000 *Methods of test for petroleum and its products. Diesel fuel. Assessment of lubricity using the high-frequency reciprocating rig (HFRR). Test method*

Flash Point

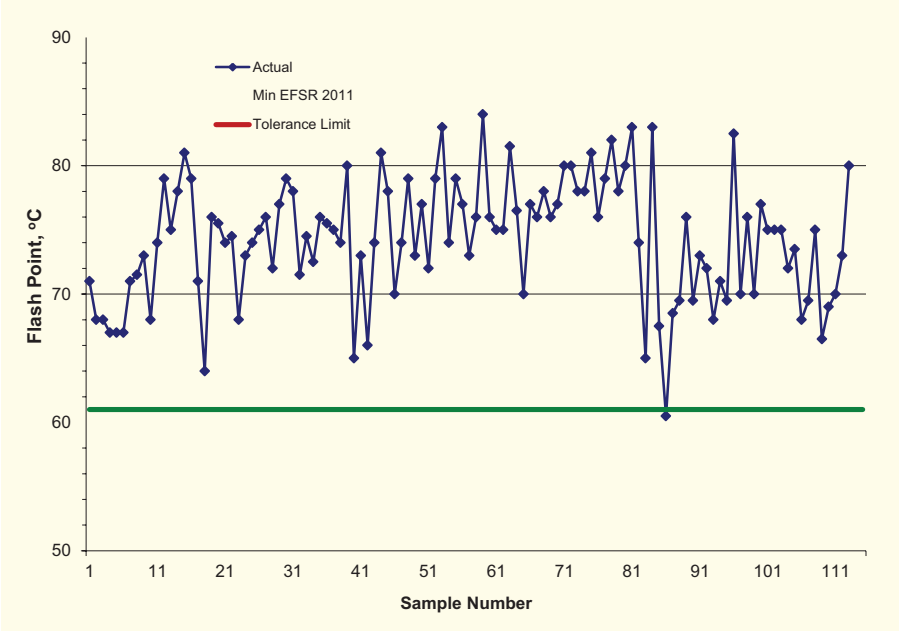
Flash point should be tested by ASTM D93[34] prescribed in the Regulations.

All samples except one were found to be well above the specified minimum limit of 61°C for flash point of diesel. The tolerance limit is 58.6°C.

Sample 86 was initially found to be 60.5°C at the tolerance limit of 58.6°C for a single test.

The tests repeated by the same operator returned the same figure of 60.5°C, with the repeatability condition obviously satisfied, r=1.7°C. A corrected tolerance limit for two results is also approx. 58.6°C. On investigation it was found that the average of 60.5°C was above the testing tolerance limit so, according to the established policy, Sample 16 was deemed to be compliant.

Figure 23: Test Results for Flash Point, Diesel, Year 2016-2017



34 ASTM D93-16a *Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester*

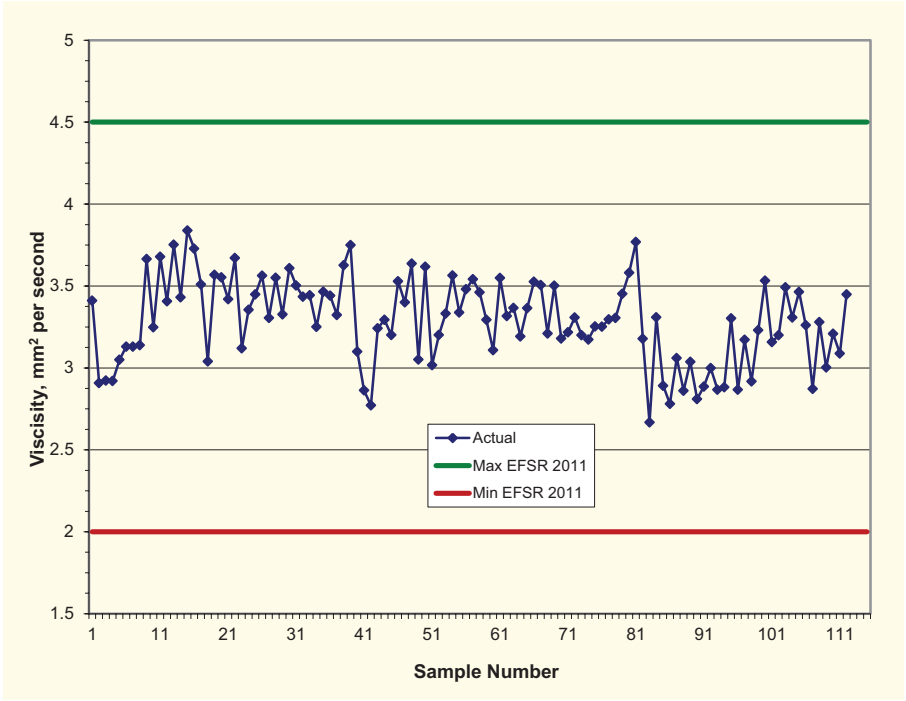
Viscosity

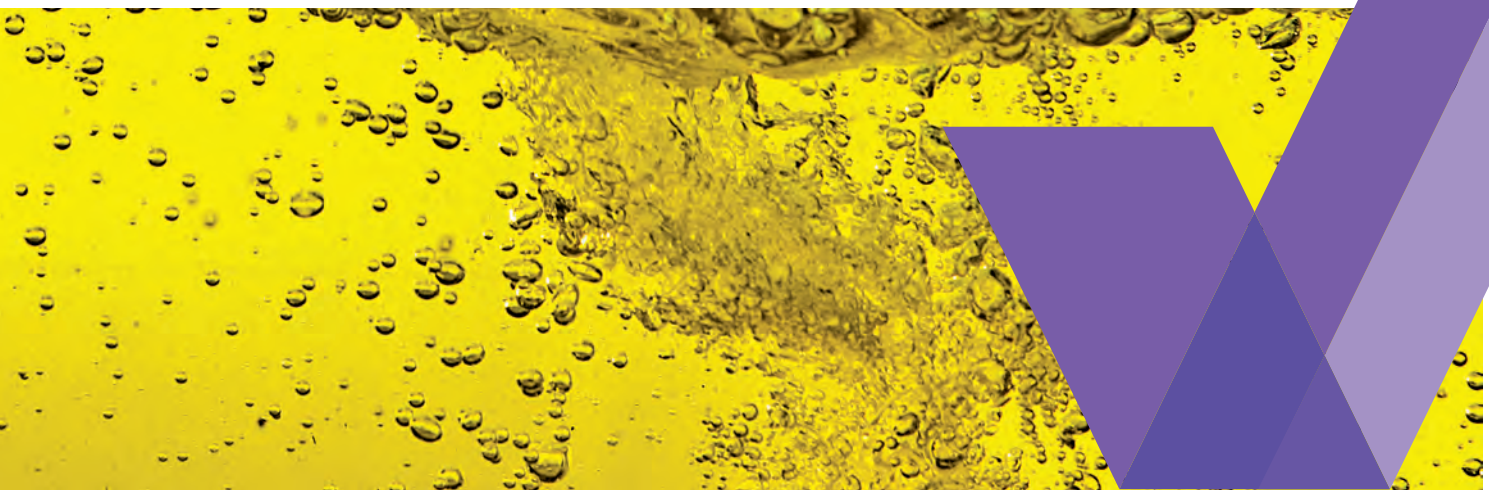
The viscosity should be tested at 40°C by ASTM D445[35] prescribed in the Regulations.

All samples were found to be well above the specified minimum limit of 2.0 mm^2 per second and below the specified maximum limit of 4.5 mm^2 per second for viscosity of diesel.

The vast majority of the test results were in the range between 3.0 and 4.0 mm^2 per second with the minimum result of 2.667 mm^2 per second for Sample 83 and the maximum result of 3.838 mm^2 per second for Samples 15. The minimum tolerance limit is 1.974 mm^2 per second and the maximum tolerance limit is 4.559 mm^2 per second (not shown on Fig.24).

Figure 24: Test Results for Viscosity, Diesel, Year 2016-2017





35 ASTM D445-17a *Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)*

Summary for Diesel Test Results

There were three suspected non-compliance cases.

One suspect non-compliant sample detected during the period of this report related to a sample of diesel where the cetane index on investigation was initially found to be marginally below the specified limit of 51 with an actual figure of 50.6. This sample was found to be compliant after subsequent additional testing and analysis.

Another suspect non-compliant sample related to a sample of diesel where the water content was initially found to be 229 mg/kg with a copious amount of free water present at an appearance test, including droplets up to a few mm in diameter. After subsequent additional testing and analysis, an average of three results by two operators was found to be 262 mg/kg for the product from same testing vessel. Since the average result was found to be above the maximum tolerance limit of 259 mg/kg the product was deemed to be non-compliant.

However, after further analysis of a sampling process, no reason was identified for suspecting a contamination during the sample collection operation. Sampling from the same site was done by TS officials a few months later with testing results which did not reveal any suspect property. So the initial result remains anomalous but was included in the report as per the established reporting practices.

Finally, one suspect non-compliant sample related to a sample of diesel where the flash point on investigation was initially found to be below the specified limit of 61°C with an actual figure of 60.5°C. This sample was found to be outside specification after subsequent additional testing and analysis however the average of 60.5°C was above the corrected tolerance limit of 58.6°C therefore the product was deemed to be compliant.

This year, testing diesel for appearance according to the ASTM standard D4176[36] which is not listed in the Regulations, was continued. This was done in order to maintain confidence that water in bulk and/or other contamination, if present, would be identified. No test results except one described above were found to be suspect on appearance.

36 ASTM D4176-14 *Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)*

Biofuels

Summary of Testing

Various fuels such as biodiesel as well as ethanol blended petrol, were tested throughout the period of this report. As in previous annual reports, the actual results are not shown due to the commercial sensitivity of the data.

Retail Fuel Sampling and Testing

BIODIESEL B5

This blend was tested ten times throughout the year at retail sites. The product falls into the category of diesel by definition in the Regulations, with FAME (Fatty Acid Methyl Esters) content up to 5%. All samples were found compliant with the relevant specifications in the Regulations.

ETHANOL BLENDED PETROL E3 AND E10

This year, a project on ethanol blended petrol was continued with the intention to verify that blended petrol was within specifications. It was focussed on dry vapour pressure in particular because some samples had in the past been found outside specification. Nine samples of regular petrol blended with ethanol and labelled as E3 and 17 samples of premium petrol blended with ethanol and labelled as E10, were sampled and tested from the retail sites of two fuel retail companies.

The overall result of this project was that the dry vapour pressure was found within the prescribed specifications, for all the samples.

ETHANOL BLENDED PETROL E85

Four retail sites in New Zealand now offer fuel ethanol i.e. blend with an ethanol content from 70 to 85% labelled as E85. This product is mainly intended for motor sport cars and its dispenser is distinctively labelled to differentiate the product from traditional retail fuels. Fuel for motor vehicle racing is exempt from the Regulations although there are flexible-fuel vehicles on roads in New Zealand which are able to use E85.

As mentioned earlier in the report, since the E85 dispensers at these sites are accessible to the public, and therefore the product available to retail customers, it was deemed prudent to test its properties.

Currently, parameters for E85 blends are not specified in the Regulations although they are currently under consideration by the government to be included in the updated Regulations. Since this type of fuel is specified by the Standard ASTM D5798[37] this standard was temporarily chosen as an indicative standard for the list of properties to be tested. Nine samples taken during the report period were all except one found to be within the prescribed maximum specifications according to ASTM D5798, with the ethanol content from 84.08% to 85.44%, with the provisional tolerance limit of 85.64%. This information was analysed with a provision to adopt specification limits which would be prescribed in the updated Regulations. Since 2 October 2017, the amended Regulations are in force with the maximum ethanol content of 85.0%.

37 ASTM D5798-15 *Standard Specification for Ethanol Fuel Blends for Flexible-Fuel Automotive Spark-Ignition Engines*

Non-Retail Fuel Sampling and Testing

When non-retail sale products are utilised as components for retail market products TS monitors their quality too because they are categorised by the Regulations. The Ministry continues working with the industry to help in understanding and development of acceptable biodiesel that meets the country's needs.

This year, the Ministry continued sampling and testing biodiesel, in particular, B100 (pure biodiesel) and B10 (10% blend with mineral diesel). Biodiesel B100 was tested according to the requirements of Schedules 3 in the Regulations while B10 blend was tested according to the Regulation 17.

In total, six samples of biodiesel were collected from production plants or non-retail refuelling sites and tested. These include three samples of B100, two samples of B10 and one sample of B20.

BIODIESEL B100

Problems with accurate measurement of FAME content remained in the focus of the testing programme. The Ministry in collaboration with IPL continues to contribute to the on-going review of the standard by international standard committees such as CEN and ISO. One sample out of three was found to be below the specified minimum limit but within the tolerance limit. Another sample was found to be slightly below the tolerance limit and after repeated testing its average was found to be 94.0% at the tolerance limit of 94.1%. In the recent past, total contamination had often been found above the specified maximum limit. This year total contamination was found to be on specification in two out of three instances.

Further, glycerides content was once found to be above the specified maximum limit but within the testing tolerance limit.

Finally, water content and total contamination were found to be above the specified maximum limits in one of the samples. After repeated testing of both parameters it was found that the average figures in both instances appear to be above the testing tolerance limit. Respectively, water was found to be 666 mg/kg at the tolerance limit of 590 mg/kg and total contamination was found to be 48 mg/kg at the tolerance limit of 28 mg/kg.

Corrective actions were implemented by the producer in the instance when the parameters were found beyond the prescribed specifications.

BIODIESEL B10 AND B20

These blends were considered to be a final product supplied to customers and therefore the properties listed in Regulation 17 were tested along with a few additional properties such as the filter blocking tendency. Filter blocking tendency is deemed to be an essential parameter for the product to be 'fit for purpose'.

Two samples of B10 and one sample of B20 were collected either at the plant dispenser or at the non-retail point of sale.

In all instances the FAME content was found to be within the stated maximum.

Further, acid value was once found for B10 sample to be above the specified maximum limit of 0.14 with the initial figure of 0.18 mgKOH/g. After repeated testing the average acid value was found to be 0.21 at the tolerance limit of 0.19 mgKOH/g so the sample was deemed to be non-compliant. However, further research with regard to acid value of B100 component as well as that of mineral diesel component have not revealed a source of this anomalous figure. Further testing of other samples returned results within the specification.

An encouraging fact is that filter blocking tendency for all B10 and B20 samples was found to be close to the minimum figure of 1.00 indicating no blocking with the largest figure of 1.02 for one of the B10 samples, at the maximum limit of 2.5.

All findings on suspect non-compliance however marginal they were discussed with the producers in detail and adjustments to the production processes were identified and implemented.

ETHANOL COMPONENT E100

Denaturated ethanol E100 for blending with petrol, was tested twice this year from a storage terminal. Both samples were found to be fully within the specified limits.

Note: The specifications for properties of biofuels are still under review and development by the international standardisation committees (CEN and ASTM technical committees in particular). The Ministry continues to monitor and contribute to this work to ensure New Zealand has sufficient technical knowledge in this area and our perspectives and issues are represented and considered internationally.


bio
fuel