TRADING STANDARDS

Fuel Quality Monitoring Programme

Test Results 2020–21

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

TRADING STANDARDS

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Executive Summary

The Fuel Quality Monitoring Programme (**the Programme)** is administered by 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, and then on 26 August 2022, 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 and content 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 independently 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 2020 to 30 June 2021. It is a technical report that provides useful information for fuel industry stakeholders and researchers. During this period fuel samples were collected and tested from 118 of the approximately 1,200 fuel service stations in New Zealand including 98 routine sample sets as well as ad hoc samples *e.g.* samples taken following complaints, as well as from some commercial sites and storage terminals.

Analysis of sampling and testing conducted during the period of this report has confirmed that overall, fuel sold in New Zealand was of good quality and compliant with specifications prescribed in the Regulations.

There was only one instance when a sample at the retail site was found beyond specification. However, there were no instances when a petrol or diesel sample would have been identified as non-compliant according to the requirements of the Regulations. All results for samples from retail sites were recognised to be compliant.

Some biodiesel B100 samples intended for non-retail supply were initially found to be non-compliant before the delivery of blended fuel to customers. Non-compliant biofuel identified by sampling and testing were subject to remedial action by the producer.

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

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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 responsible for administering a number of these areas[2], including Fuel Quality Monitoring (FQM) which is focused on maintaining 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* that is supplied in accordance with the Energy (Petrol, Engine Fuel, and Gas) Levy Regulations 2017[3].

This report sets out the results of the Programme from 1 July 2020 to 30 June 2021.

The main focus of the Programme is to sample and test the quality of fuels as they are sold to consumers in the retail market, *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.

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 website or in previous FQM Programme annual reports.[4]

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 model which takes into account each retail fuel company's market share in that area. In total, 98 sample sets were collected from retail sites and each set, as a rule, included samples of regular and premium grade petrol and a sample of diesel. At some sites, premium petrol was not available during sample collector visits.

2 http://www.tradingstandards.govt.nz
3 http://www.legislation.govt.nz/regulation/public/2019/0139/latest/LMS212394.html
4 http://fuelquality.tradingstandards.govt.nz/about-us/fuel-quality-monitoring-annual-reports/

The regional distribution of fuel 'sample sets' is shown in the table below:

Terminal/Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Whangarei	0	0	0	1	0	1	1	1	0	0	0	1	5
Auckland	1	3	1	2	2	3	2	0	2	2	1	3	22
Mt Maunganui	1	2	3	1	0	2	0	0	3	2	2	2	18
New Plymouth	0	0	1	0	0	0	0	0	0	0	1	2	4
Napier	0	0	0	1	2	0	0	1	0	0	0	0	4
Wellington	2	0	1	2	1	0	1	1	1	1	1	2	13
Nelson	2	0	1	0	0	1	1	0	0	1	2	1	9
Lyttelton	1	2	1	1	2	1	0	1	0	1	1	0	11
Timaru	2	0	0	0	1	1	0	0	0	0	0	0	4
Dunedin	0	1	0	0	1	0	0	1	0	1	0	1	5
Bluff	0	1	0	1	0	0	0	0	0	0	0	1	3
TOTAL	9	9	8	9	9	9	5	5	6	8	8	13	98

This report also covers the results of sampling and testing of biofuel that is featuring for some fuel supply companies. 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, for example intended for non-retail sale, were initially found to be suspect non-compliant before supply of blended fuel to customers (see section on Biofuels). Potentially non-compliant biofuels identified by sampling and testing were subject to remedial action by the producers. The suspect non-compliant properties are discussed in the biofuel section of this report.

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 the potential presence of water and other contaminants that can be visually assessed.

Alongside the routine sampling and testing of fuel, TS monitors local wet stock management processes and procedures 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 (*e.g.* from water ingress), monitoring stock levels and maximizing fuel system cleanliness.

Adopting reliable wet stock management systems and practices can help improve fuel quality, prevent contamination, prolong equipment life, and reduce corrosion and thereby the 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 as specified in their quality management systems to ensure that quality and composition of fuel is maintained right throughout the supply chain.

An analysis of the Programme data from previous years allows us to assume that the true proportion of suspect non-compliances can be taken as constant across terminals and brands. (Otherwise, the system would require taking into account specifically elevated risks, particular sources of possible non-compliance and/or unique circumstances which would distinct some areas as more prone to appear out of specification.)

The results of subsequent testing of fuel samples have been reported in accordance with their relevant specification limits set out in the Regulations. In accordance with the provisions of ISO Standard 4259[5], there are tolerances set out under the testing regime which allow for results fall slightly outside the specified limits.

5 BS EN ISO 4259-2:2017 *Petroleum and related products - Precision of measurement methods and results. Part 2: Interpretation and application of precision data in relation to methods of test.*

Conclusion

The Programme has confirmed that throughout the reported period 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 and as with previous reports, the anonymity of the source of the samples is maintained due to the commercial sensitivity of this information.

Petrol

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

The test method ASTM D2699[6] is prescribed in the Regulations for definition of RON while the test method ASTM D2700[7] is prescribed for definition of MON.

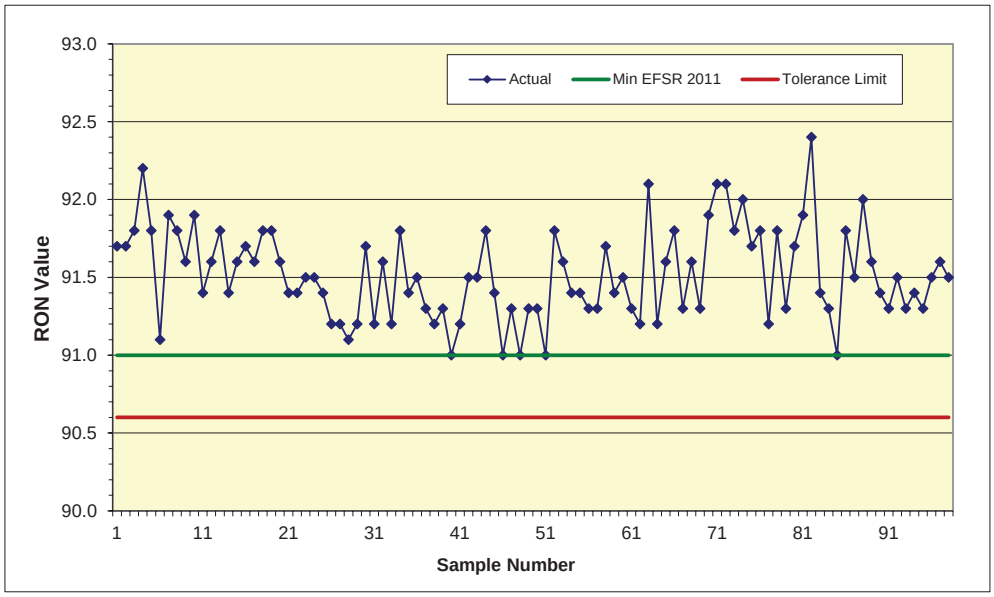
RON 91

In total, 98 samples of regular petrol were collected, all of these were tested for RON and were within minimum specification limit. Fig. 1a below shows the testing results for RON. Five samples had the result 91.0 which is the minimum specification limit of 91.0 for RON.

Here and below:
The abbreviation 'EFSR' stands for the specification limit prescribed in the Regulations.

Here and below:
Each individual result is independent from others although they are connected in the graphs for the ease of interpretation.

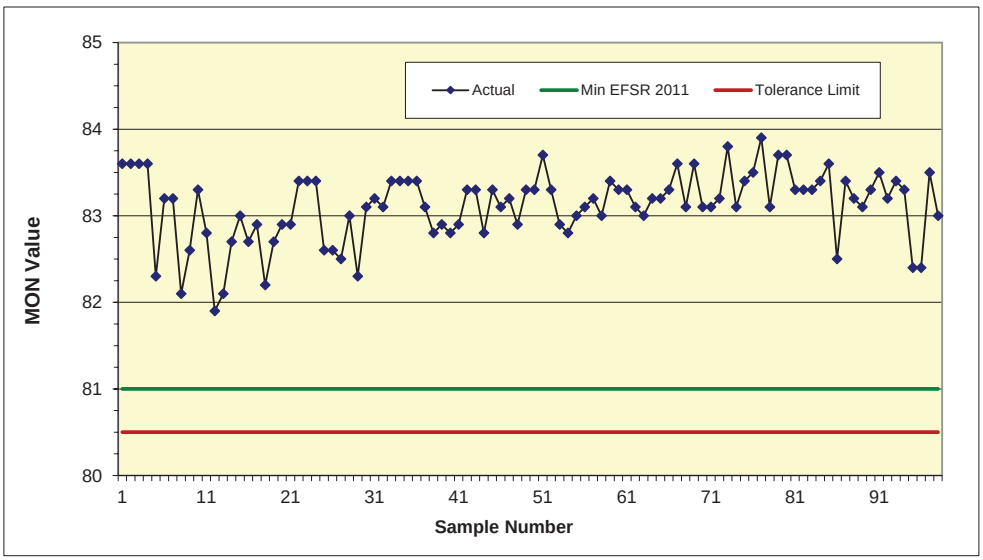
Figure 1a: Test Results for Petrol RON 91, Year 2020-21



6 ASTM D2699–19E01 *Standard Test Method for Research Octane Number of Spark-Ignition Engine Fuel. Here and further in footnotes, the test method's version is shown that was current in the period of testing.*
7 ASTM D2700-19 *Standard Test Method for Motor Octane Number of Spark-Ignition Engine Fuel.*

All samples of regular petrol were tested for MON, and the results were above the minimum specification limits of 81.0 for MON. Fig. 1b below shows the testing results for MON.

Figure 1b: Test Results for Regular Petrol MON, Year 2020-21



RON 95

In total, 76 samples of premium grade petrol were tested for RON 95.

All samples met the minimum specification limit of 95.0 for RON. Five samples were found to be on the specification limit.

The same number of samples of petrol with RON 95 were tested for MON. All samples were found to have MON on or above the minimum specification limit of 85.0 for premium petrol.

Fig. 2a and Fig. 2b below show the testing results for RON and MON respectively.

Figure 2a: Test Results for Petrol RON 95, Year 2020-21

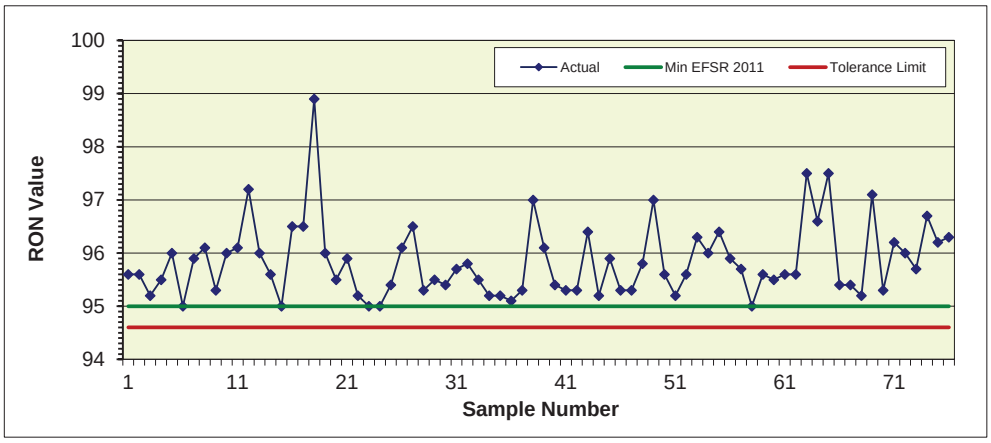
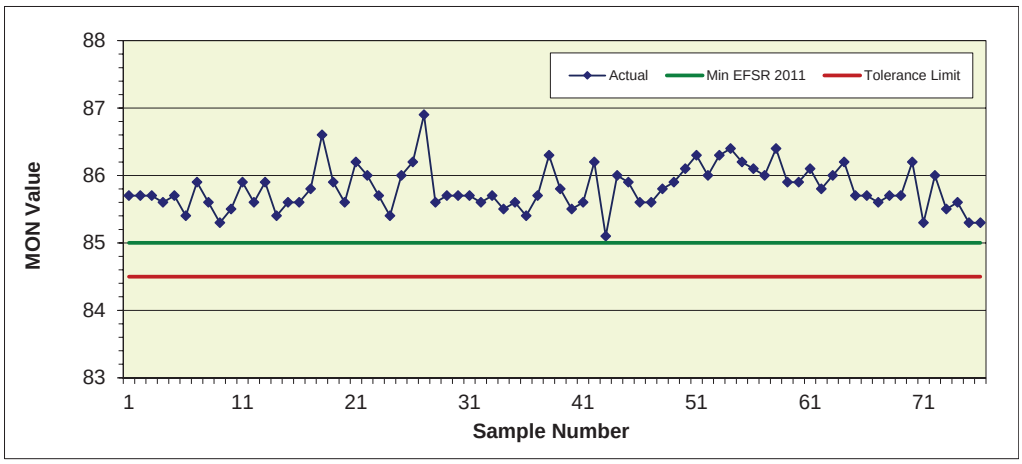


Figure 2b: Test Results for MON, Premium Petrol RON 95, Year 2020-21



RON 98 & ABOVE

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 with regard 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, 28 samples of petrol with advertised RON 98 and above were collected and tested. Fig. 3a below shows the testing results for RON.

All samples with the advertised RON of 98.0 and above were found to be above or on the advertised minimum limit. 1 (one) sample was found to be on the specification 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. Fig. 3b below shows the testing results for MON.

Figure 3a: Test Results for Petrol RON 98 & above, Year 2020-21

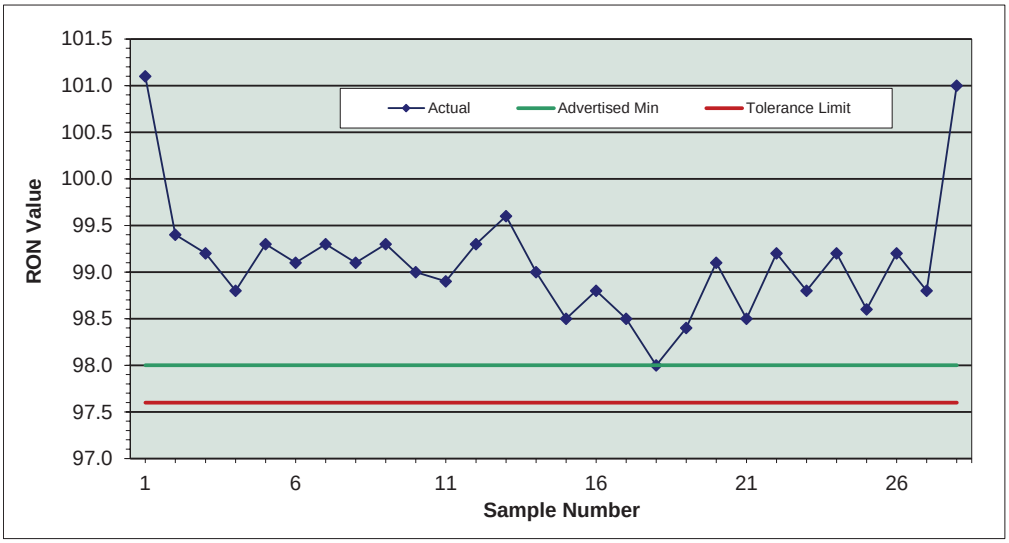
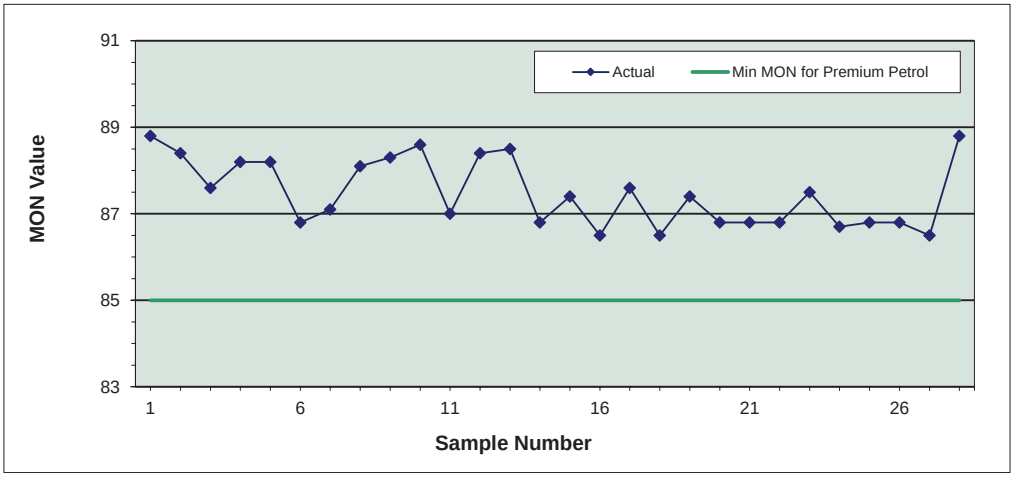


Figure 3b: Test Results for MON, Premium Petrol RON 98 & above, Year 2020-21



Evaporation Percentage

The test method ASTM D86[8] is prescribed in the Regulations for the definition of the volume percentage of evaporated petrol at the three fixed temperatures: at 70ºC, 100ºC and 150ºC. 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).

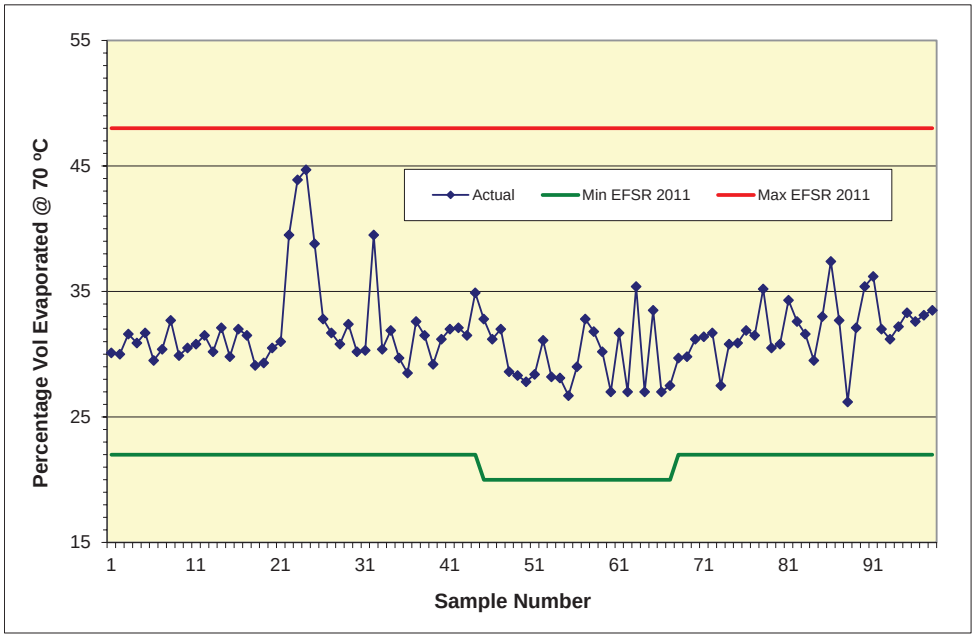
RON 91

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 98 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 2020-21



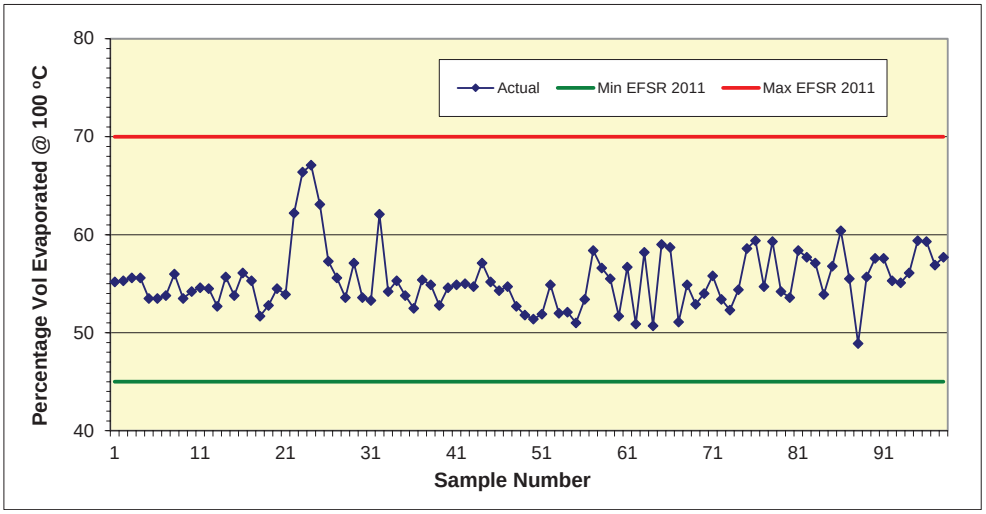
8 ASTM D86-20b *Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure.*

Percentage Volume Evaporated at 100°C

All 98 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 2020-21

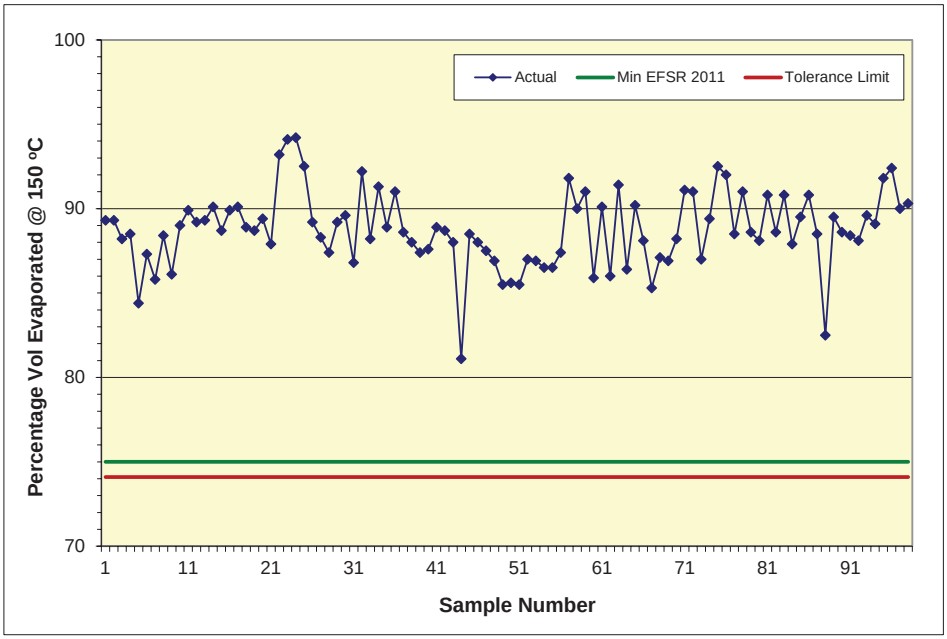


Percentage Volume Evaporated at 150°C

All 98 samples were found to be well above the minimum specification limit of 75%. The minimum tolerance limit is 74.1%.

No maximum limit is prescribed by the Regulations for this property.

Figure 4c: Test Results for E150, RON 91, Year 2020-21



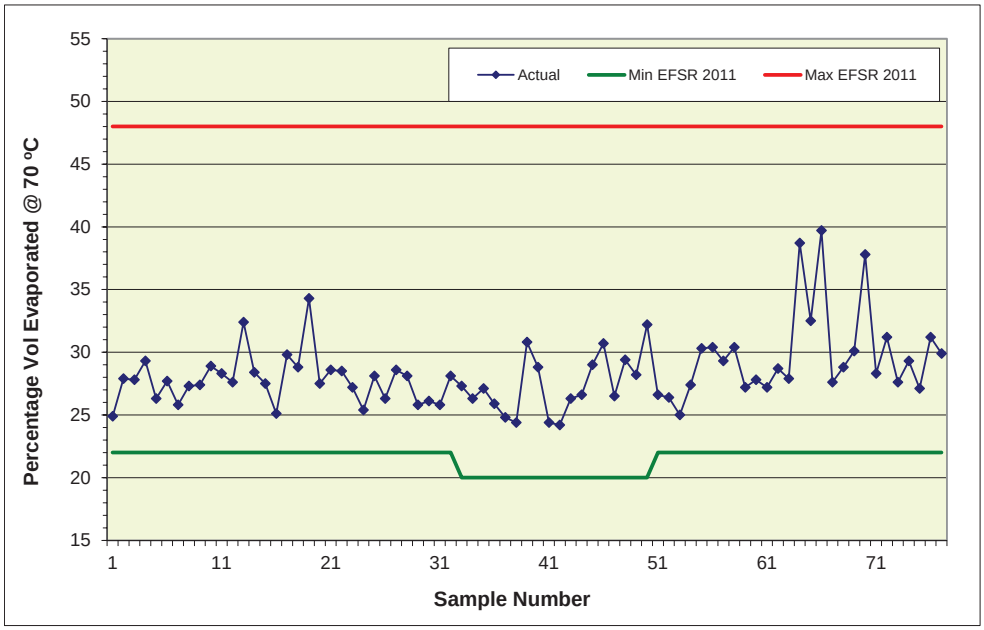
RON 95

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%.

All 76 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%.

Figure 5a: Test Results for E70, RON 95, Year 2020-21

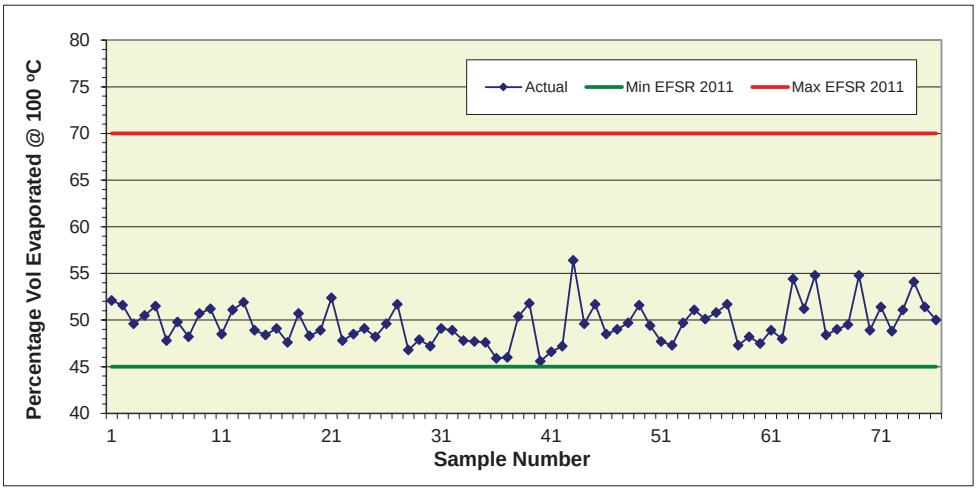


Percentage Volume Evaporated at 100°C

All samples were found to be within the specification limits from the minimum of 45% to the maximum of 70%.

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

Figure 5b: Test Results for E100, RON 95, Year 2020-21

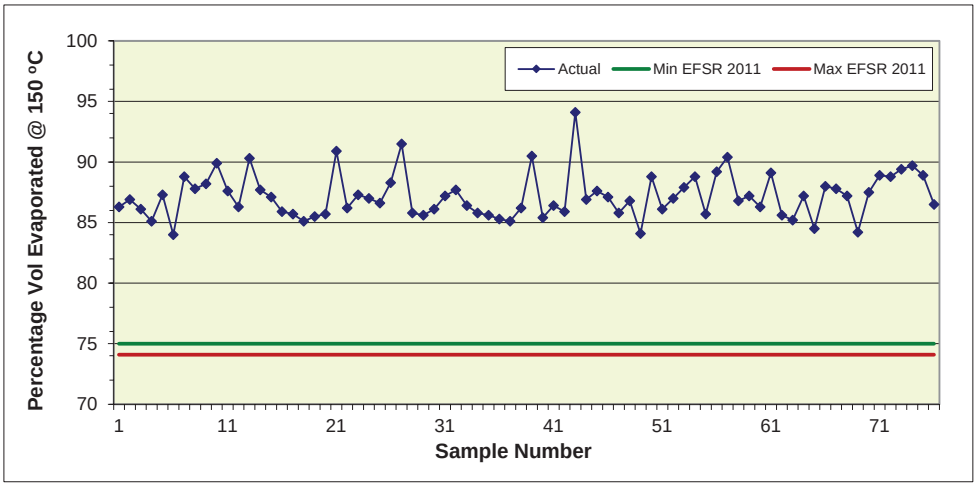


Percentage Volume Evaporated at 150°C

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 75% (Fig. 5c).

Figure 5c: Test Results for E150, RON 95, Year 2020-21



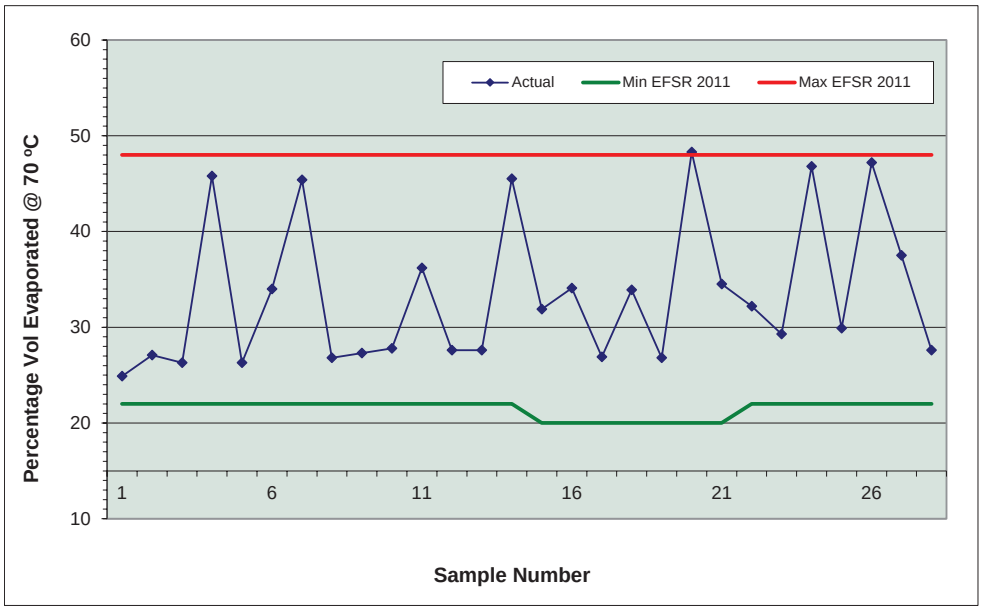
RON 98 & above

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%. All results were found within the specified maximum and minimum limits.

The majority of results were found to be within the specification limits of 22% to 48% with the exception of one ethanol blended sample. According to the Regulations (Footnote 2 in Schedule 1), the maximum allowed percentage of volume evaporation at 70ºC (E70) is increased by 1% per each 1% volume of ethanol in the blend. One result was found to be 48.3% which was ethanol blended petrol with 9.14% ethanol content.

Figure 6a: Test Results for E70, RON 98 & above, Year 2020-21

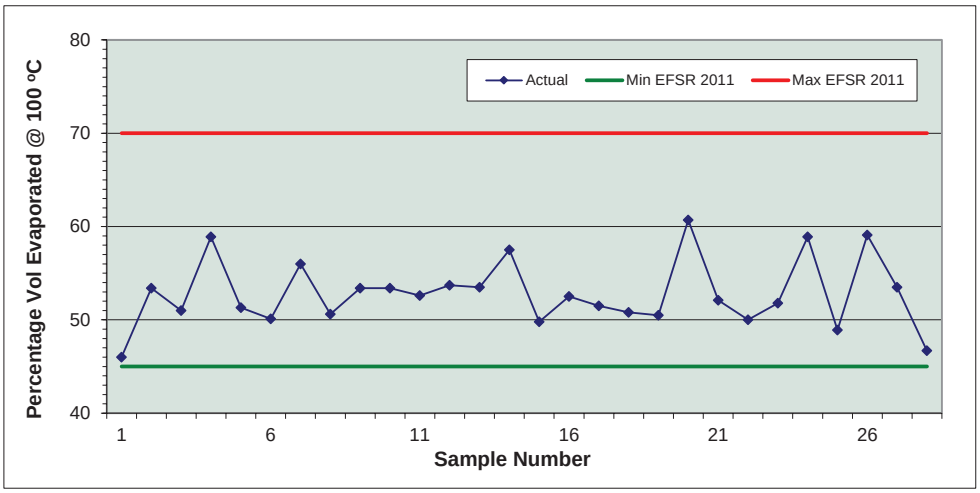


Percentage Volume Evaporated at 100°C

All samples were found to be within the specification limits from the minimum of 45% to the maximum of 70%.

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

Figure 6b: Test Results for E100, RON 98 & above, Year 2020-21

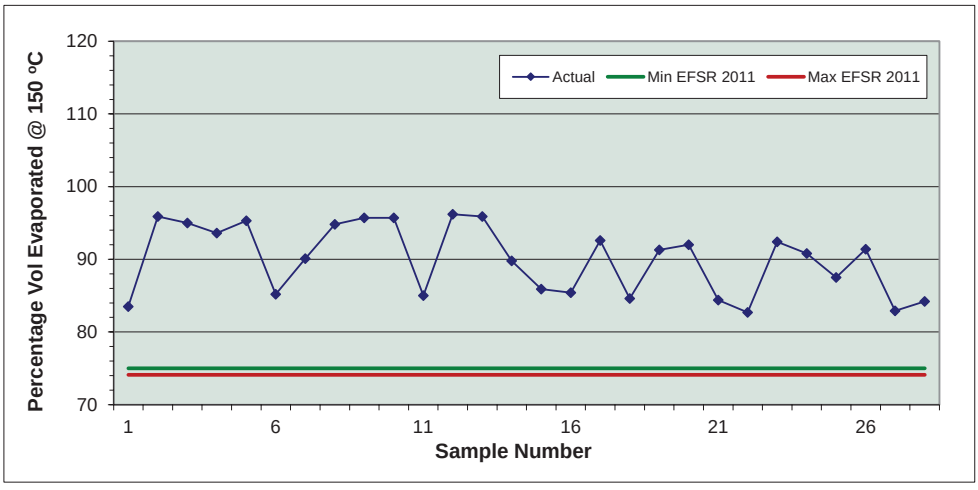


Percentage Volume Evaporated at 150°C

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. (Fig. 6c).

Figure 6c: Test Results for E150, RON 98 & above, Year 2020-21



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 210ºC for both regular and premium grades (Fig.7). The tolerance limit is 214ºC.

Figure 7a: Test Results for Final Boiling Point, RON 91, Year 2020-21

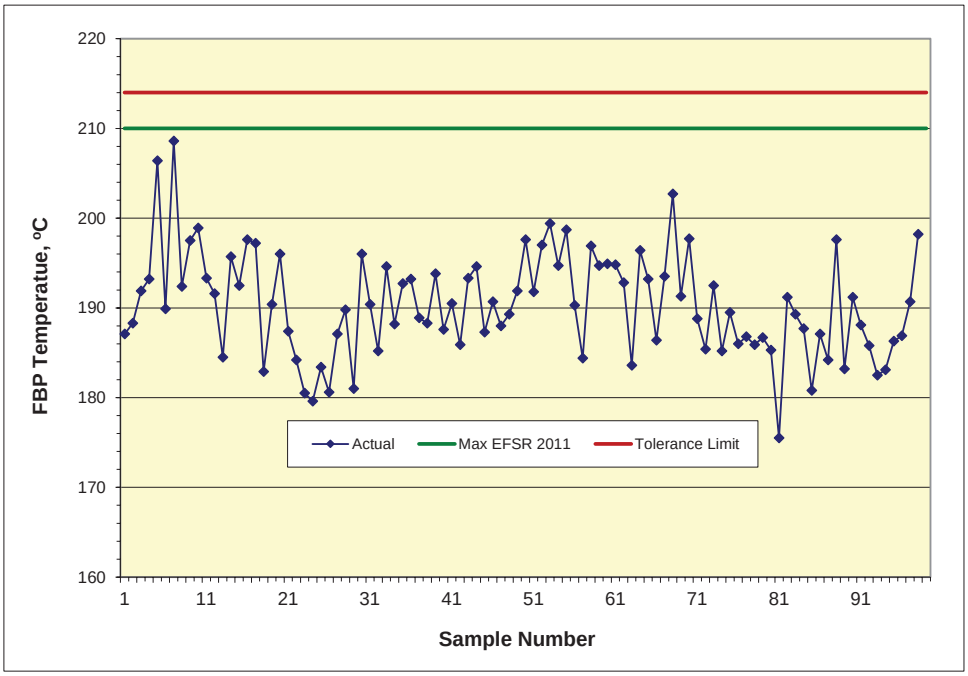
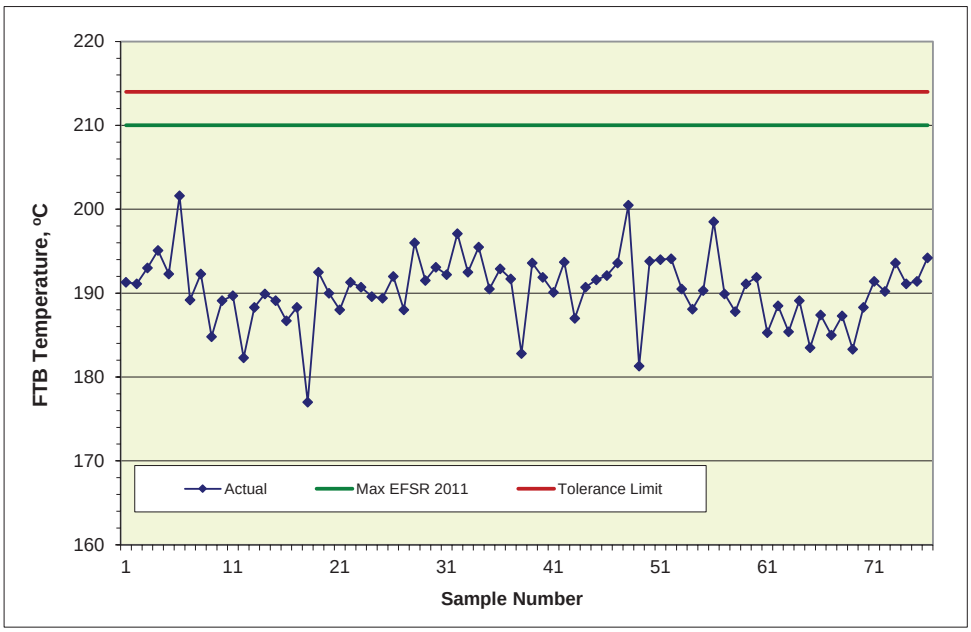
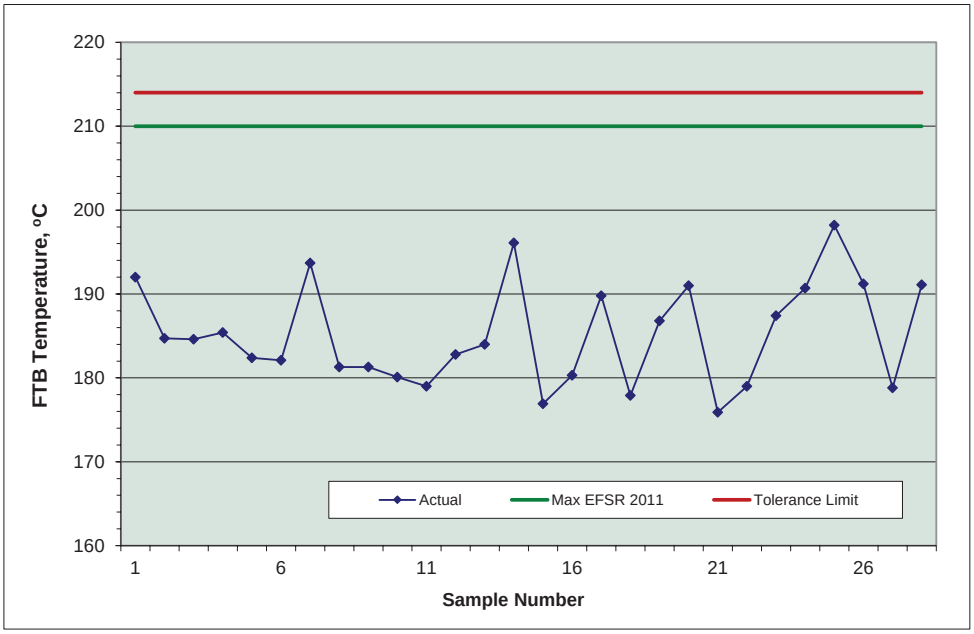


Figure 7b: Test Results for Final Boiling Point, RON 95, Year 2020-21



9 ASTM D86-20b *Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure*.

Figure 7c: Test Results for Final Boiling Point, RON 98 & above, Year 2020-21



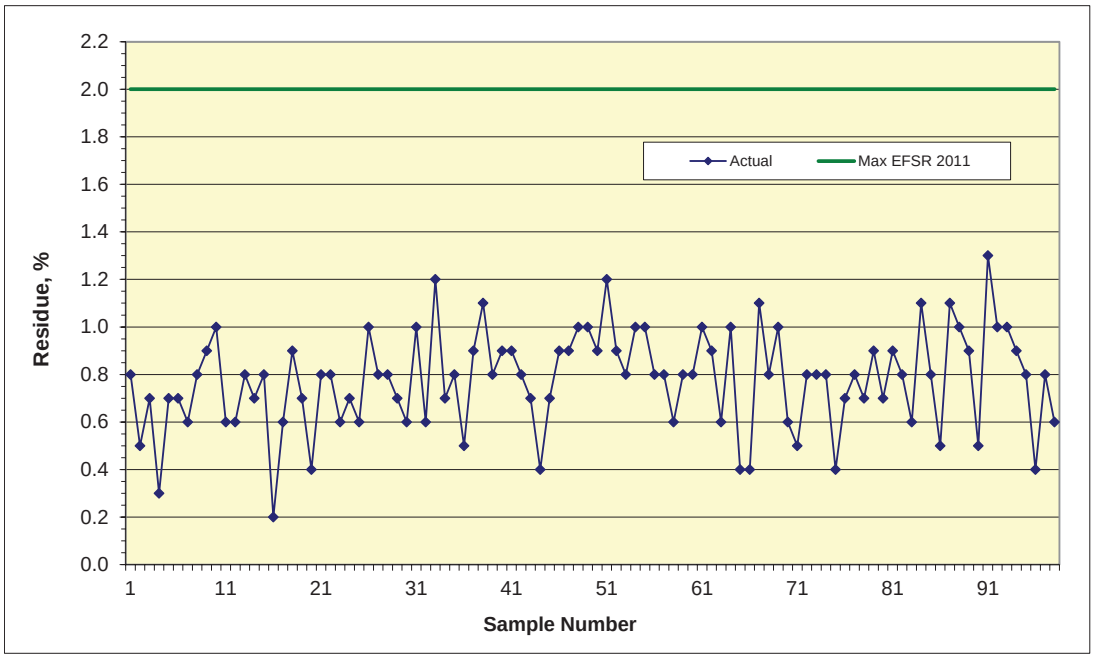
Residue

All samples were found to be well within the limits for both regular and premium grades (Fig. 8).

Distillation residue, according to the standard ASTM D86[10] is usually expected to be within a certain range and serves primarily for indication of the correct running of the distillation process. This is one of the process control parameters and as such residue, is not something that can be measured for repeatability and reproducibility that could be listed in the Standard. Therefore, no tolerance limit for residue could be defined in ASTM D86. Fortunately, residue content was found to be well below the specified maximum limit of 2% volume.

All results for regular petrol were found to be not higher than 1.3%.

Figure 8a: Test Results for Residue, RON 91, Year 2020-21



10 ASTM D86-20b *Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure*.

All results for premium petrol were found to be not higher than 1.3%. The minimum result for regular petrol was reported as 0.2%.

Figure 8b: Test Results for Residue, RON 95, Year 2020-21

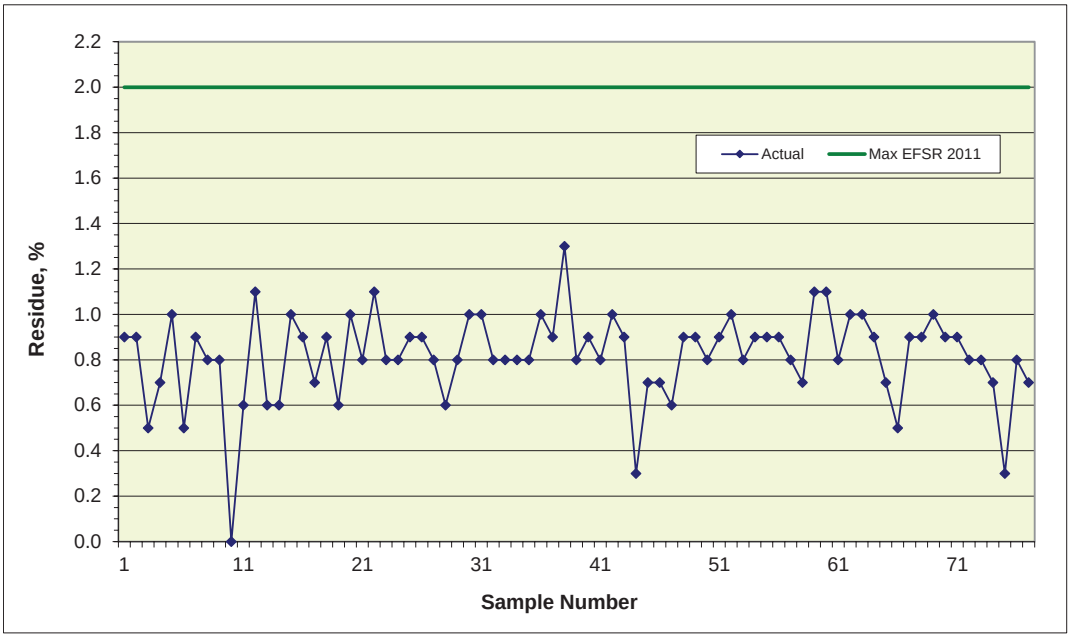
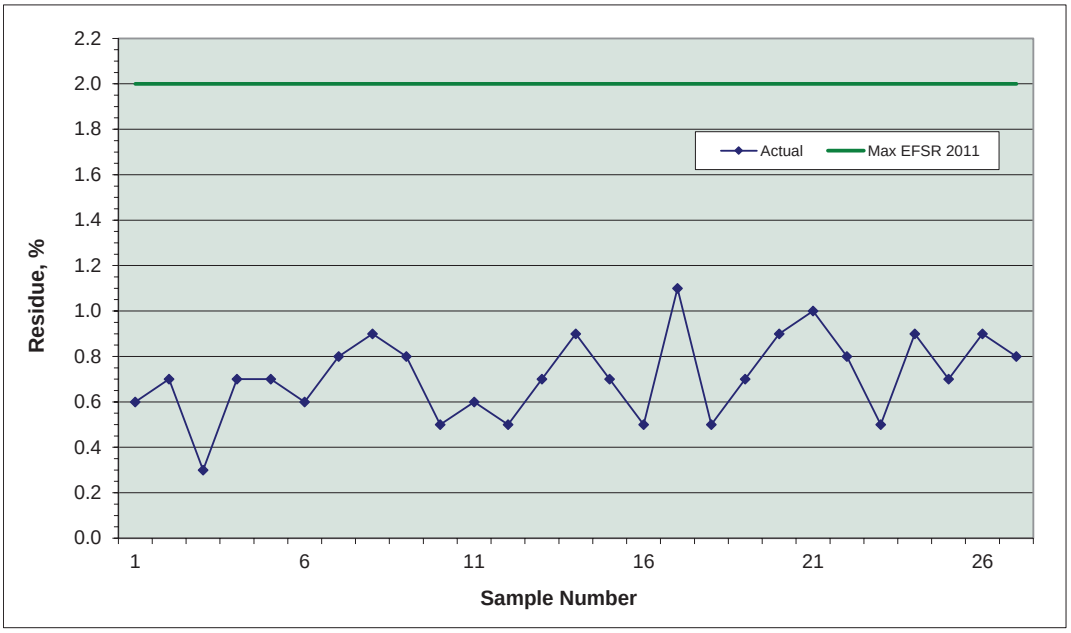


Figure 8c: Test Results for Residue, RON 98 & above, Year 2020-21



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 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.

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 these are 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. 9 by a minimum dip.

The lines before and after the dip, are the next lowest maximum, 80 kPa, which is prescribed for the North Island, for the autumn and spring seasons, respectively, from 1 April to 31 May inclusive and from 1 September to 30 November inclusive.

The maximum limits prescribed for winter in the North Island from 1 June to 31 August inclusive, are equal to the 90 kPa level which is shown in the graph by two top lines. The maximum limit for winter in the South Island is 95 kPa (not shown).

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

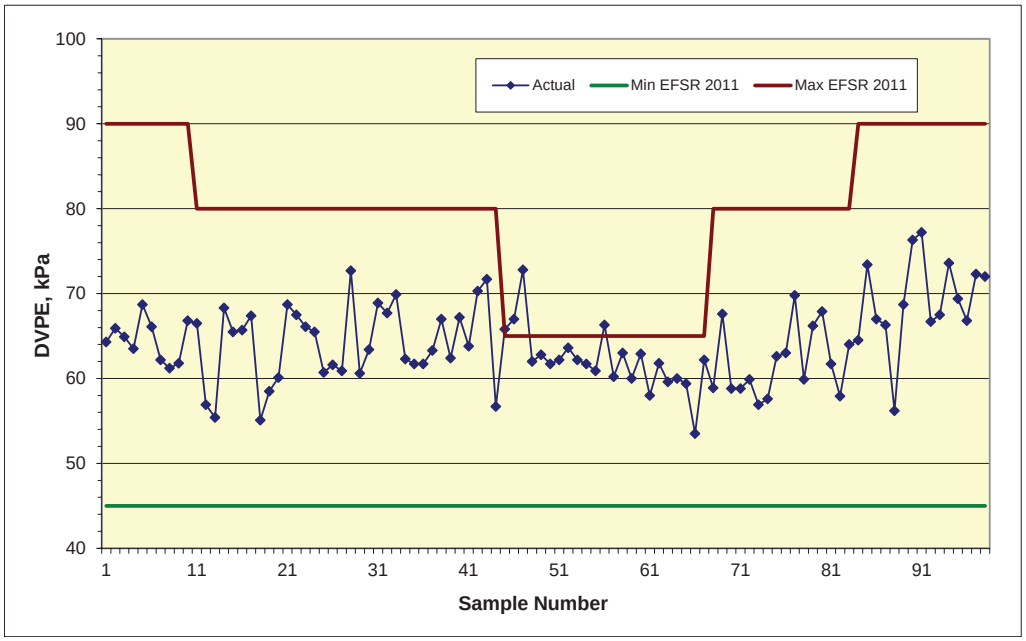
Tolerance limits related to the maximum specification limits are not shown since they are only approx. 3% above each relevant limit.

RON 91

In some periods, a number of samples were initially found to be above the lowest maximum at the time. However, all these were subsequently found to be within the specification limits for their region and season.

The samples which had results above the limit (65.8 kPa, 67.0 kPa, 72.8 kPa and 66.3 kPa) in the figure 9a were found to be within the maximum limit of 75 kPa for summer in South Island.

Figure 9a: Test Results for DVPE, RON 91, Year 2020-21



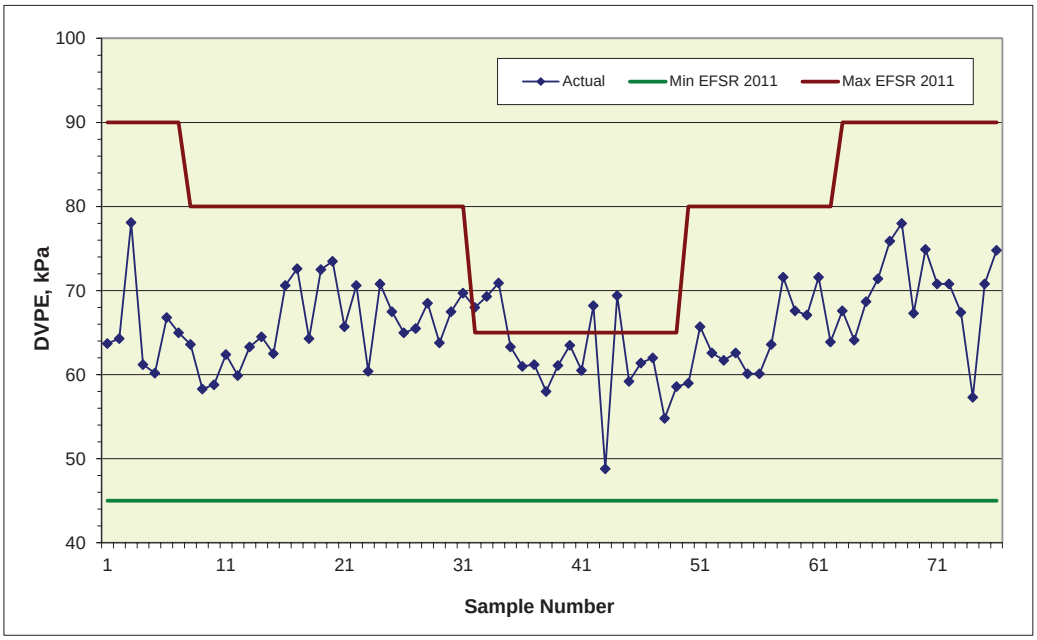
11 ASTM D5191-20 *Standard Test Method for Vapor Pressure of Petroleum Products (Mini Method).*

RON 95

All samples were found to be within the specification limits for premium petrol (Fig. 9b). However, as in case with regular petrol, in various periods, some samples (five in total) were initially found to be above the lowest maximum at the time, *i.e.* they were found to be compliant due to their regional maxima.

The five samples were found to be above the lowest maximum in the summer period which were found to be in the range from 68.0 kPa to 70.9 kPa, were well within the maximum limit of 75 kPa for summer in South Island.

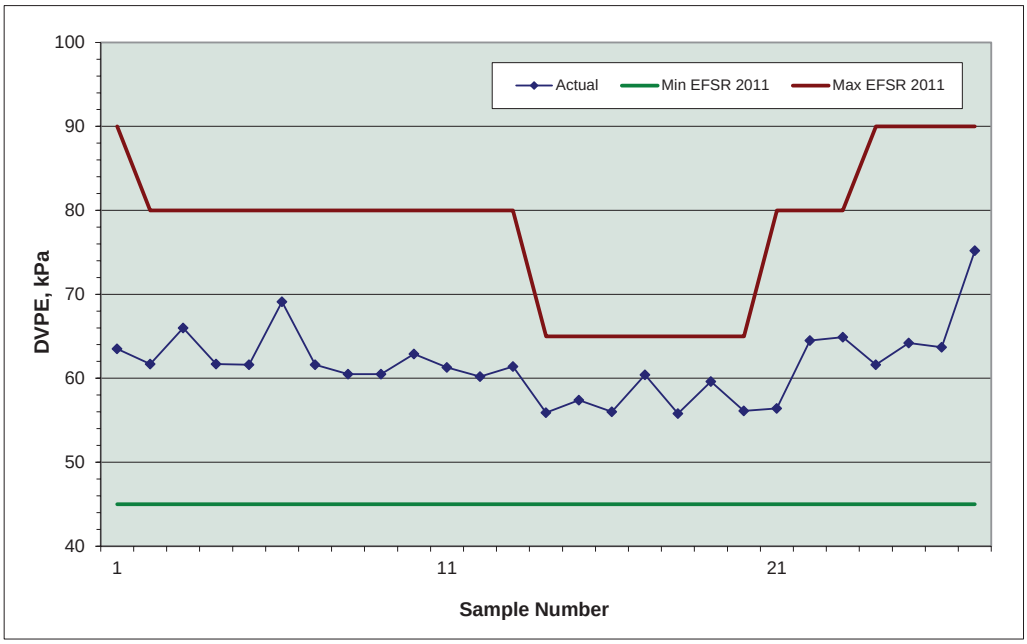
Figure 9b: Test Results for DVPE, RON 95, Year 2020-21



RON 98 & ABOVE

All 28 samples were found to be within the specification limits for premium petrol RON 98 and above (Fig. 9c).

Figure 9c: Test Results for DVPE, RON 98 & above, Year 2020-21



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

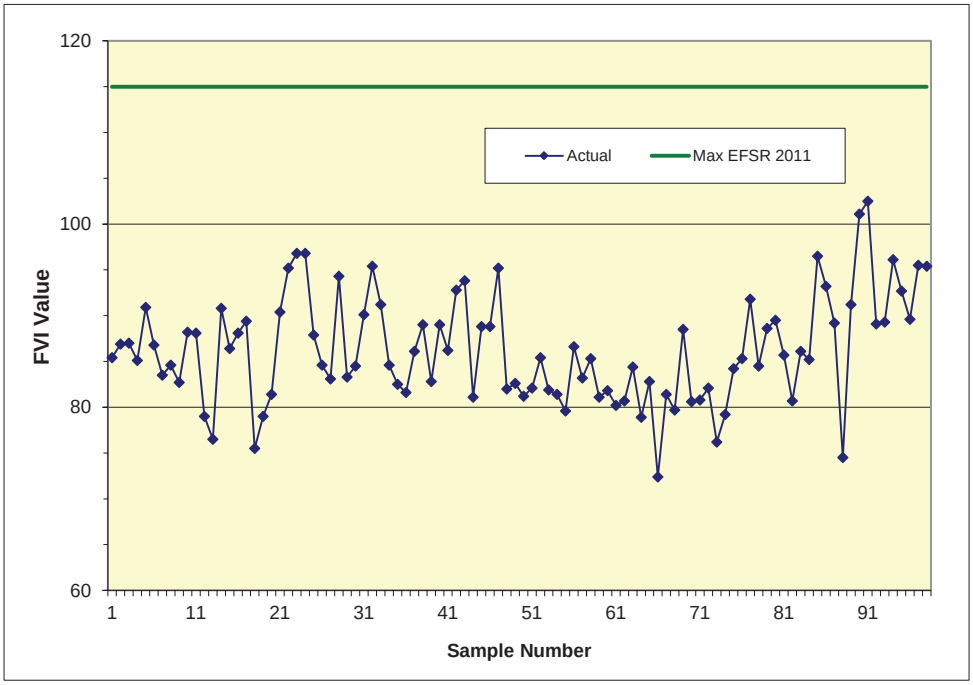
FVI = DVPE + (0.7 x E70)

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[12]) 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 of regular petrol were found to be well within the specification maximum limit of 115.0, with the maximum value of 102.5.

Figure 9d: Results for Flex. Vol. Index, RON 91, Year 2020-21

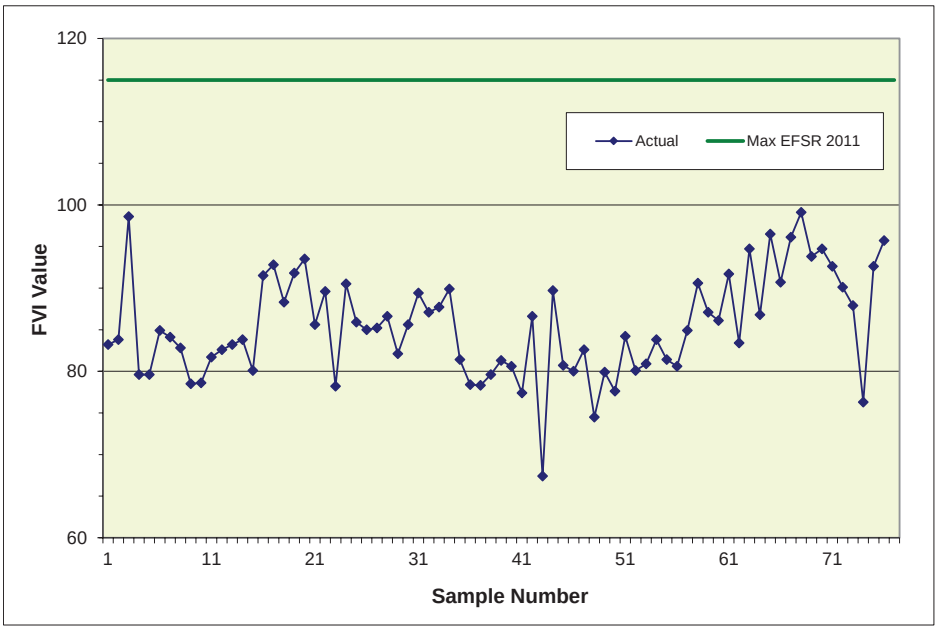


12 ASTM D5191 - 20 *Standard Test Method Method for Vapor Pressure of Petroleum Products (Mini Method).*

RON 95

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

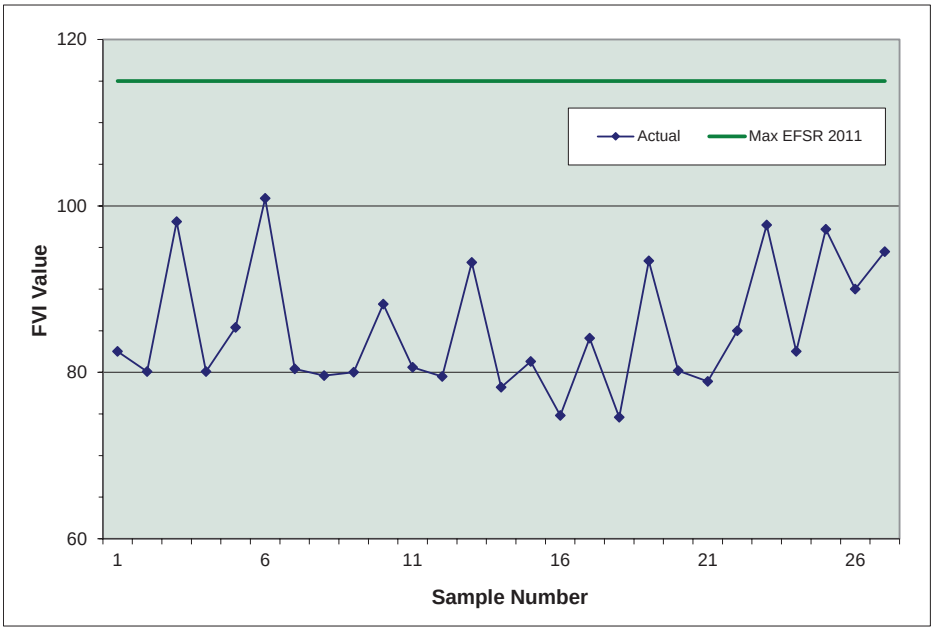
Figure 9e: Results for Flex. Vol. Index, RON 95, Year 2020-21



RON 98 & ABOVE

All samples of premium petrol were found to be within the specification maximum limit of 115.0, with the maximum value of 100.9.

Figure 9f: Results for Flex. Vol. Index, RON 98 & above, Year 2020-21



Sulphur

Sulphur has a significant impact on vehicle emissions by reducing the efficiency of catalysts. Sulphur also adversely affects heated exhaust gas oxygen sensors. Reductions in sulphur will provide immediate reductions of emissions from all catalyst-equipped vehicles on the road.[13]

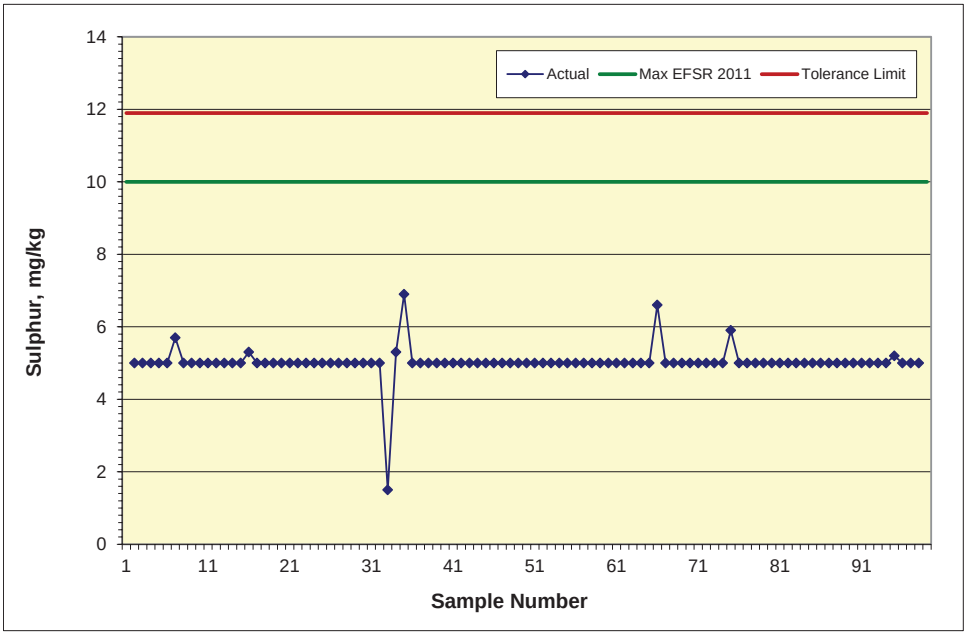
The scope of the test method IP 497[14] prescribed in the Regulations is from 5 to 60 mg/kg. Accordingly, the lowest testing result by this method is 5 mg/kg where the actual figures were found to be on or below this indicative level at the specified maximum limit since 1 July 2018 of 10 mg/kg with the tolerance limit of 11.8 mg/kg.

The ASTM standard D5453[15] which is also prescribed in the Regulations along the IP 497, gives results down to a fraction of 1 mg/kg with the tolerance limit of 11.9 mg/kg (shown on the Fig.9 by a red line).

RON 91

All 98 samples tested for sulphur for regular petrol were found to be within the prescribed maximum limit with the largest value of 6.9 mg/kg.

Figure 10a: Test Results for Sulphur, RON 91, Year 2020-21



13 *Worldwide Fuel Charter,* 6th Ed., 2019, p.17.

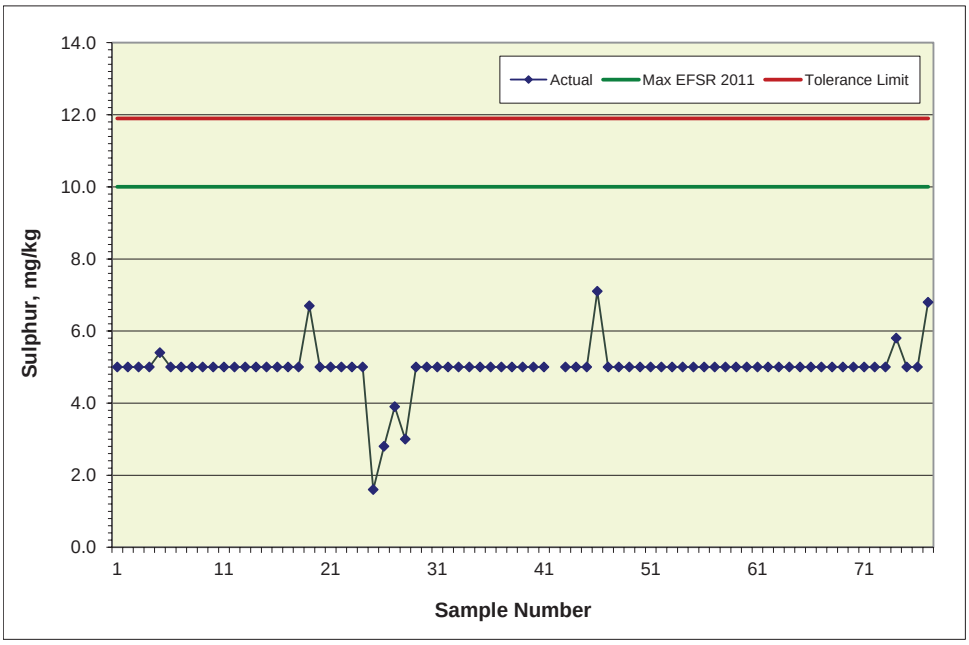
14 IP497 EN ISO 20884:2019 *Petroleum products - Determination of sulfur content of automotive fuels. Wavelength-dispersive X-ray fluorescence spectrometry* .

15 ASTM D5453–19a *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 95

All results for premium petrol were found to be within the prescribed maximum limit of 10 mg/kg with the largest value of 7.1 mg/kg.

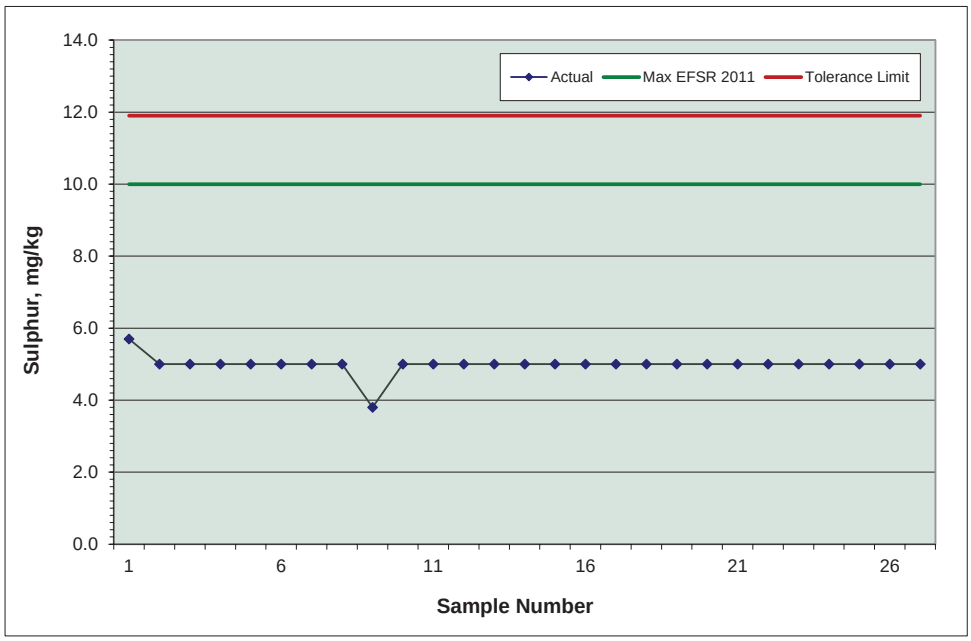
Figure 10b: Test Results for Sulphur, RON 95, Year 2020-21



RON 98 & ABOVE

All results for premium petrol 98 and above were found to be within the prescribed maximum limit not exceeding 6 mg/kg.

Figure 10c: Test Results for Sulphur, RON 98 & above, Year 2020-21



Benzene and Total Aromatics

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

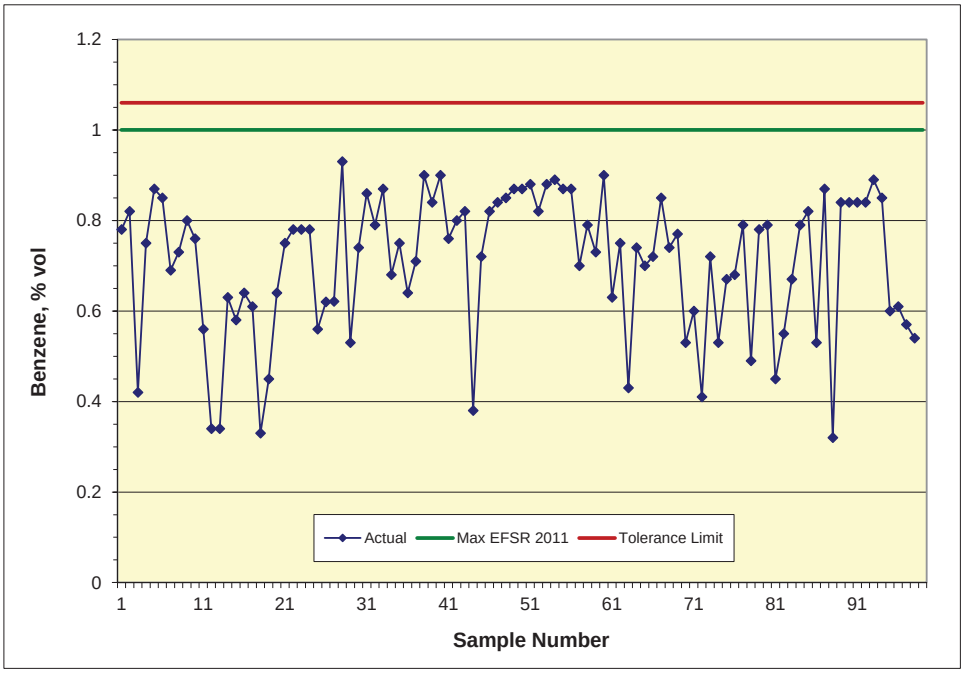
All samples were found to be within the prescribed maximum limits, for both benzene (maximum 1% vol) and total aromatic compounds (45% vol maximum cap) for regular as well as premium grade of petrol with the tolerance limits, respectively, of 1.06% for benzene and of 46.03% for the maximum cap in total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

RON 91

All 98 results tested for benzene content in regular petrol were found to be below 0.95% with the largest figure of 0.93% (Fig.11a).

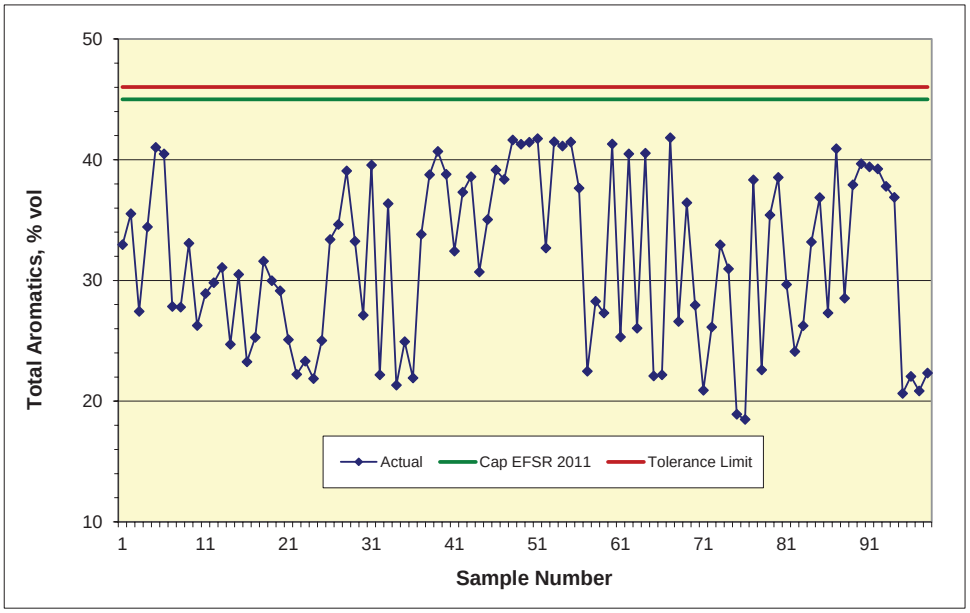
All results of total aromatics were found to be within the prescribed limit with the largest figure of 41.83% (Fig. 11b).

Figure 11a: Test Results for Benzene, RON 91, Year 2020-21



16 ASTM D5580-21 *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 11b: Test Results for Total Aromatics, RON 91, Year 2020-21



RON 95

All samples of premium petrol tested for benzene were found to be well within the prescribed maximum limit for benzene with the largest result for a sample reported as 0.87%.

For premium petrol, all 76 results on total aromatics were found to be within the maximum limit of 45% with the largest result of 43.44% (Fig. 11d).

Figure 11c: Test Results for Benzene, RON 95, Year 2020-21

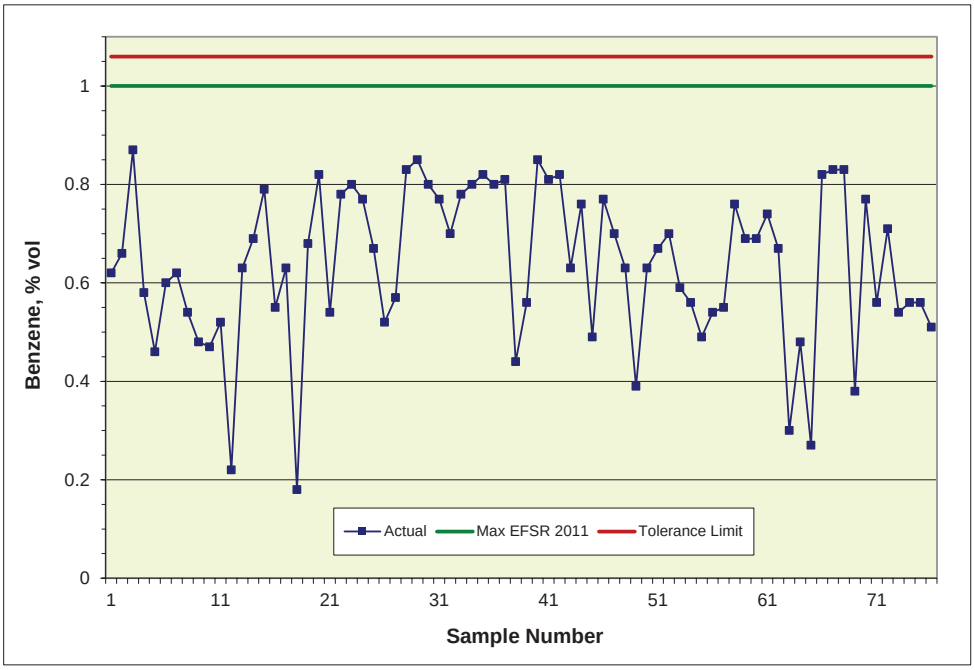
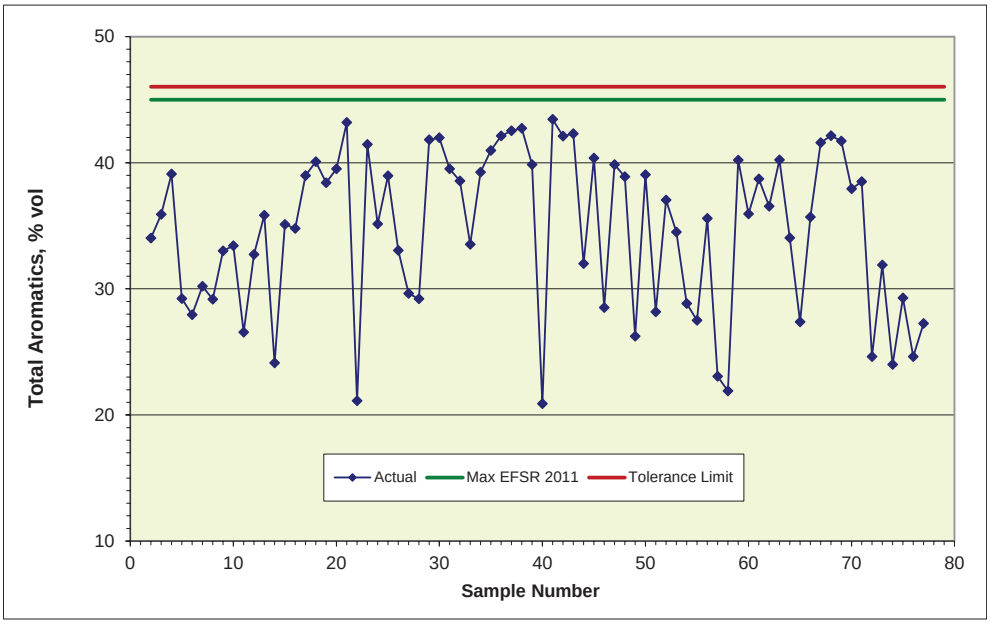


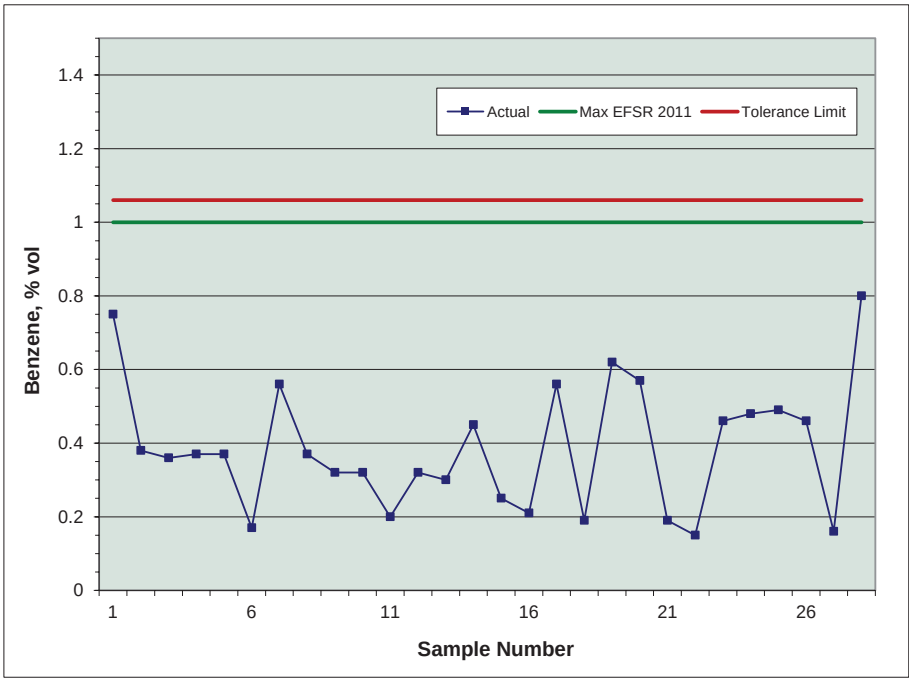
Figure 11d: Test Results for Total Aromatics, RON 95, Year 2020-21



RON 98 & ABOVE

All samples of premium petrol RON 98 and above tested for benzene were found to be well within the prescribed maximum limit for benzene with the largest result for a sample reported as 0.80%.

Figure 11e: Test Results for Benzene, RON 98 & above, Year 2020-21

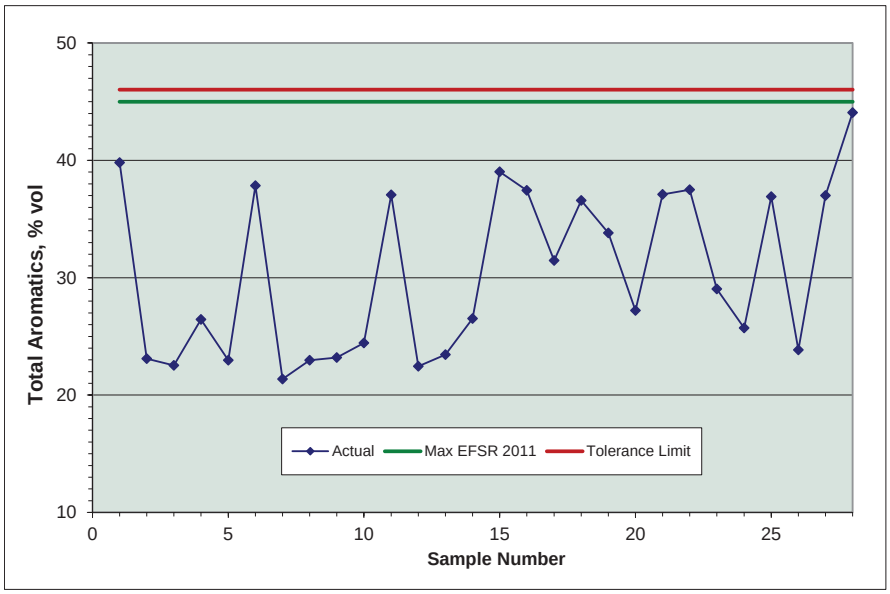


For premium petrol RON 98 and above, all 28 results on total aromatics were found to be within the maximum limit of 45% with the largest result of 44.07% (Fig. 11f).

According to Section 19 of the Regulations, actual amounts of petrol which were produced or imported, must be considered in order to calculate the 'pool average' figures for the total aromatic compounds for each calendar month. Pool average figures mean each month averages reported by producers and/or importers according to the Regulations. The pool average specification for total aromatics is 42% vol maximum.

Data on 'pool average' was collected from four fuel retail companies which import petrol and from The New Zealand Refining Company Ltd for the one year period ending on 30 June 2021. 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 11f: Test Results for Total Aromatics, RON 98 & above, Year 2020-21



Olefins

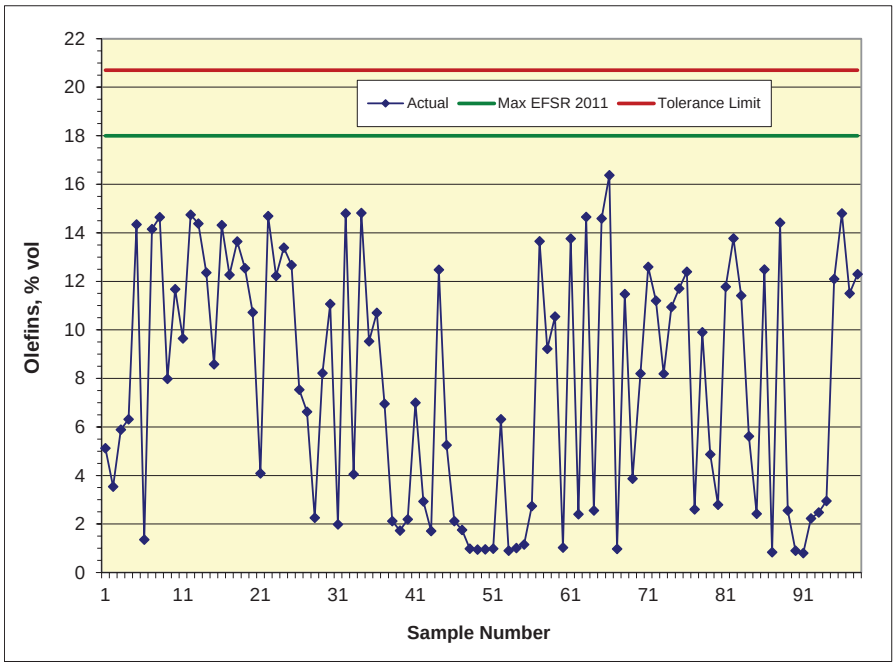
The test methods ASTM D1319[17] and ASTM D6839[18] are prescribed in the Regulations for olefins content.

Majority of samples were tested by D6839; all samples were found to be within the specification maximum limit of 18% vol with the tolerance limit of 19.6% for D6839 and 20.7% for D1319.

RON 91

For regular petrol, most of the results were found to be below 16% (Fig. 12a) except one sample with the largest result of 16.37%.

Figure 12a: Test Results for Olefins, RON 91, Year 2020-21

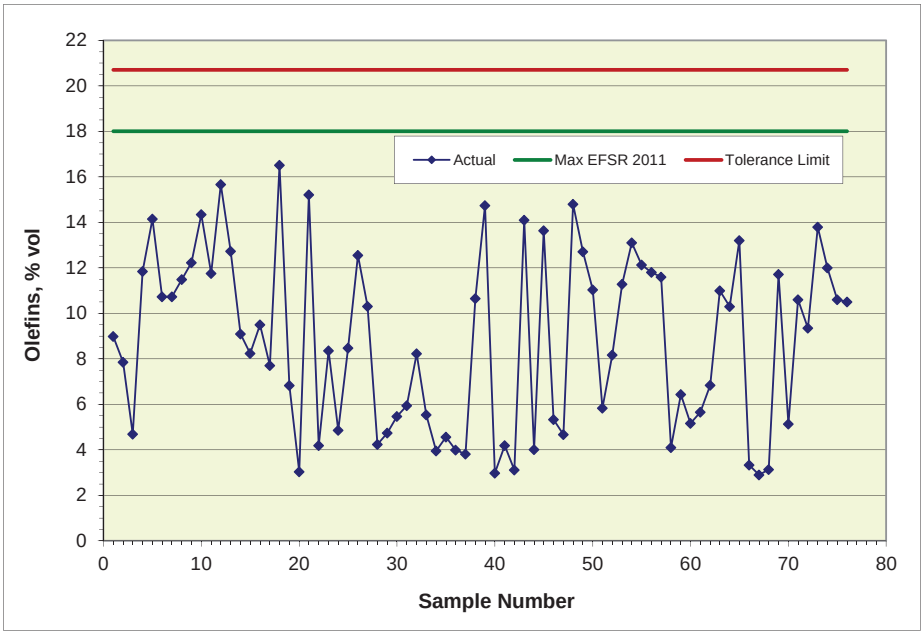


17 ASTM D1319-20a *Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption.*
18 ASTM D6839-18 *Standard Test Method for Hydrocarbon Types, Oxygenated Compounds, and Benzene in Spark Ignition Engine Fuels by Gas Chromatography.*

RON 95

For premium petrol RON 95, most of the results were found to be below 16% (Fig. 12b) except one sample with the largest result of 16.51%.

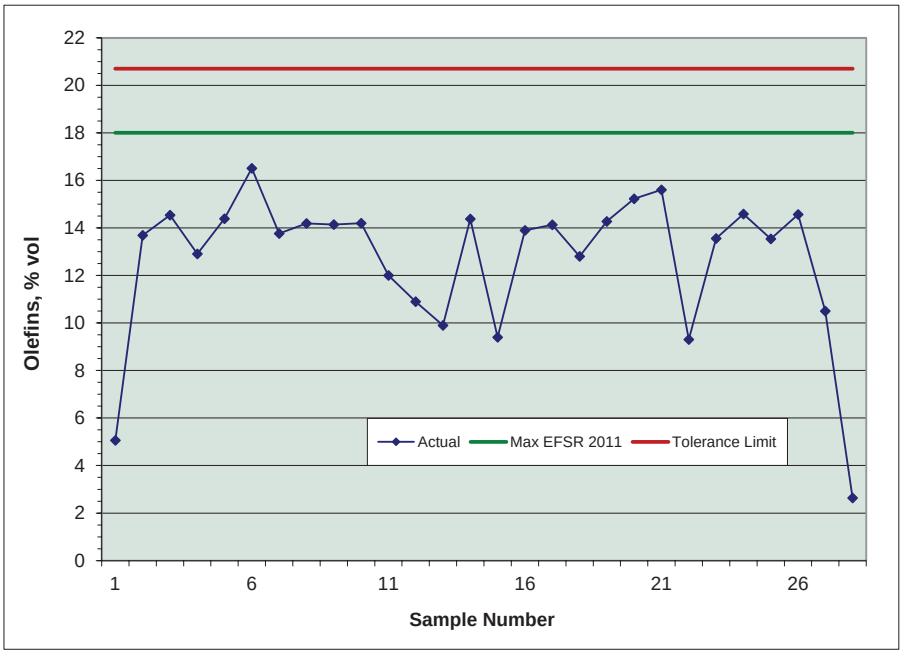
Figure 12b: Test Results for Olefins, RON 95, Year 2020-21



RON 98 & ABOVE

For premium petrol RON 98 and above, most of the results were found to be below 16% (Fig. 12c) except one sample with the largest result of 16.51%, also as for Premium 95 which is purely coincidental.

Figure 12c: Test Results for Olefins, RON 98 & above, Year 2020-21



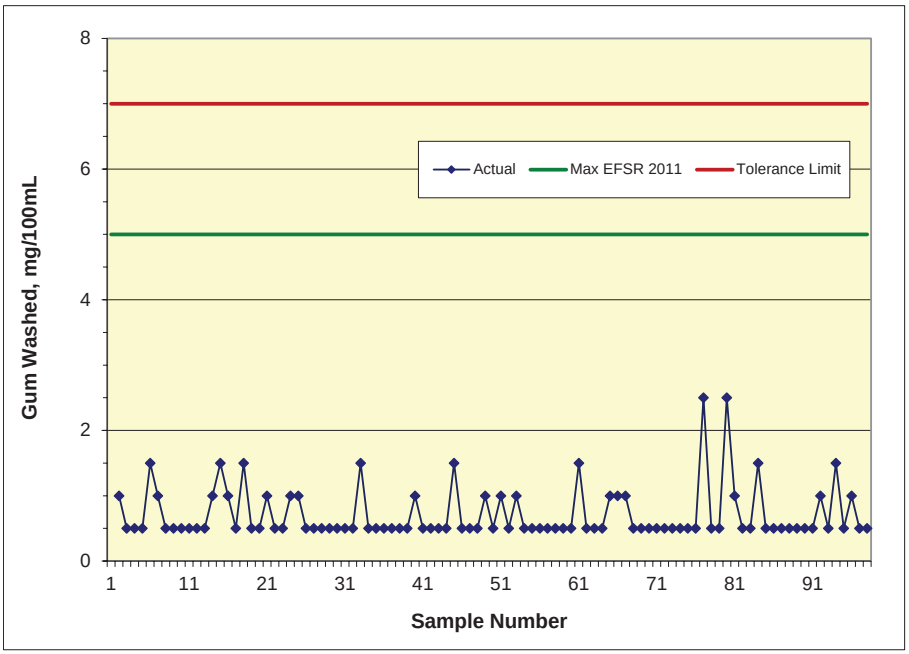
Existent Gum (solvent washed)

The threshold of the test method ASTM D381[19] 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.

RON 91

For regular petrol, all results were found to be within the maximum specification limit. (Fig. 13a).

Figure 13a: Test Results for Gum, RON 91, Year 2020-21

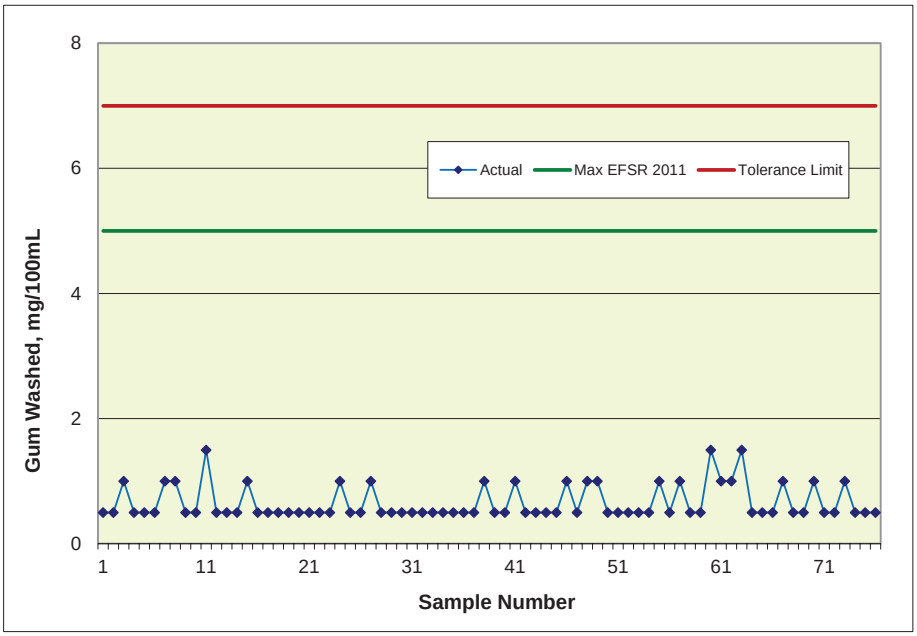


RON 95

For premium petrol RON 95, all results were found to be not higher than 2.0 mg/100mL (Fig. 13b).

19 ASTM D381-19 *Standard Test Method for Gum Content in Fuels by Jet Evaporation.*

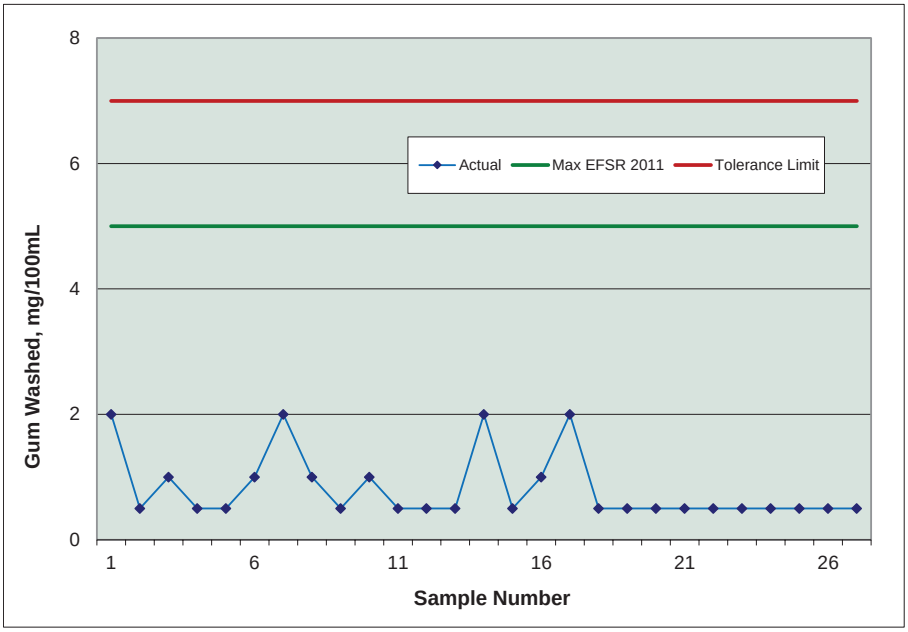
Figure 13b: Test Results for Gum, RON 95, Year 2020-21



RON 98 & ABOVE

For premium petrol RON 98 & above, all results were also found to be not higher than 2.0 mg/100mL (Fig. 13c).

Figure 13c: Test Results for Gum, RON 98 & above, Year 2020-21



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 such contaminants as lead and manganese which are not expected to be present in fuel. The screening is done by a test method conditionally agreed between the Ministry and the testing laboratory[20]. For phosphorus, this is done by means of an initial identification of its presence on the threshold of resolution by the specified method[21]. 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 specified limit. All results for samples with ethanol content up to 10%[22], are discussed below in the Biofuel section.

Further, 20 samples of regular petrol and 21 samples of premium petrol were tested for copper strip corrosion[23] and a small number of samples for oxidation stability[24]; all of them were found to be compliant.

Finally, a number of samples of petrol with an advertised RON 100+ were tested this year. All results were found to be within the specifications of Schedule 1 in the Regulations.

Summary for Petrol Test Results

There were no instances when a petrol sample would have been identified as non-compliant according to the requirements of the Regulations.

Still, there were five test results for RON of premium petrol that were found to be on the minimum specified limit according to the Regulations. The samples were accepted as compliant without repeated testing. The relevant figures for MON were above the minimum limit.

Further, 27 samples of regular petrol and 25 samples of premium petrol were tested for silver strip corrosion[25] which is not yet listed in the Regulations but has become important since the sulphur contamination incident in 2017-18 (see Report for yr. 2018-19). All tested samples returned results that were recognised as compliant.

The Ministry is now considering to propose the inclusion of a silver strip corrosion test for detecting, in particular, active sulphur presence, into the Regulations.

20 ASTM D5185–18 *Standard Test Method for Multielement Determination of Used and Unused Lubricating Oils and Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES).*
21 ASTM D3231–18 *Standard Test Method for Phosphorus in Gasoline.*
22 ASTM D4815-15b (2019) *Standard Test Method for Determination of MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C1 to C4 Alcohols in Gasoline by Gas Chromatography.*
23 ASTM D130-19 *Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test.*
24 ASTM D525-12a (2019) *Standard Test Method for Oxidation Stability of Gasoline (Induction Period Method).*
25 ASTM D525-12a (2019) *Standard Test Method for Oxidation Stability of Gasoline (Induction Period Method).*

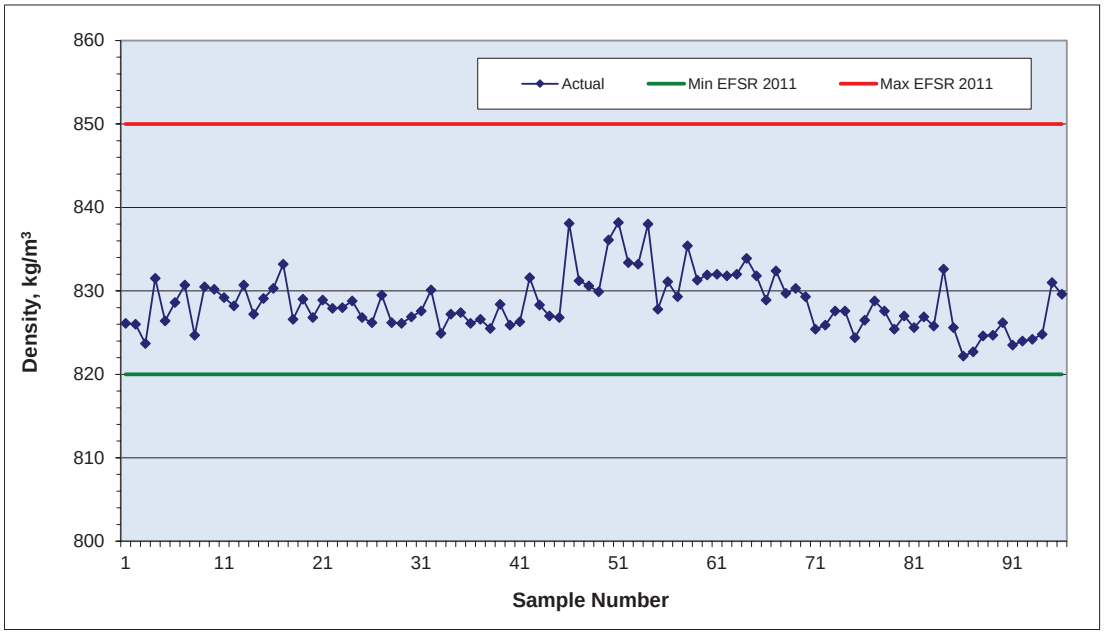
Diesel

Density

Density of diesel at 15ºC can be tested according to ASTM D1298[26] or ASTM D4052[27] 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 96 samples were found to be well within the specification limits, whereas the lowest and highest figures were respectively 822.0 kg/m^3 and 838.2 kg/m^3.

Figure 14: Test Results for Density, Diesel, Year 2020-21



26 ASTM D1298-17 *Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.*
27 ASTM D4052-18a *Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter.*

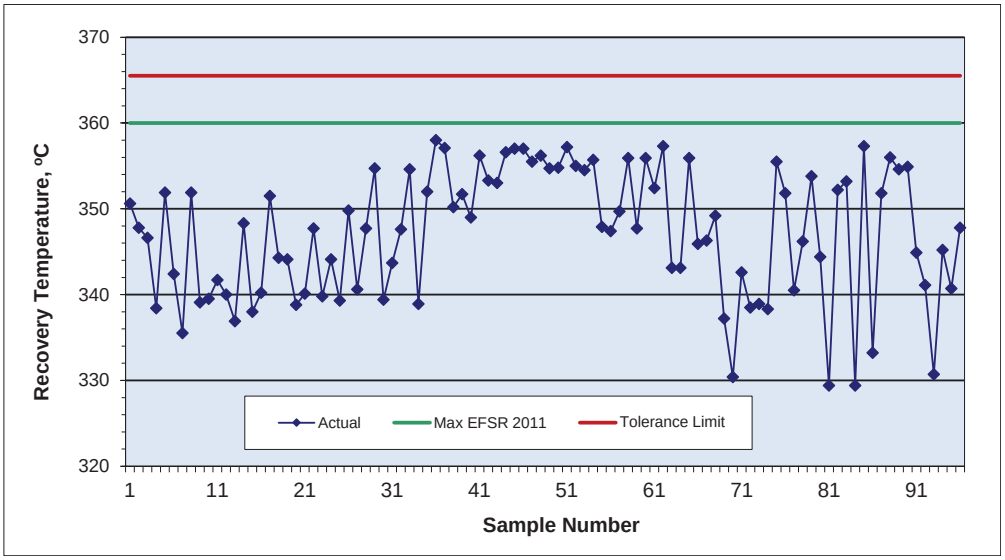
Distillation

The Distillation test means definition of temperature (ºC) at which 95% volume recovered. The temperature should be tested by ASTM D86[28] prescribed in the Regulations.

All 96 samples were found to be below the specification maximum limit of 360ºC for distillation at 95% volume recovered (T95) at the tolerance limit of 365.5ºC.

The highest actual figure was 358ºC and the lowest actual figure was 313.9°C although there is no prescribed minimum limit for this property.

Figure 15: Test Results for Distillation 95% Vol Recovered, Diesel, Year 2020-21



28 ASTM D86-20b *Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure.*

Cetane Index

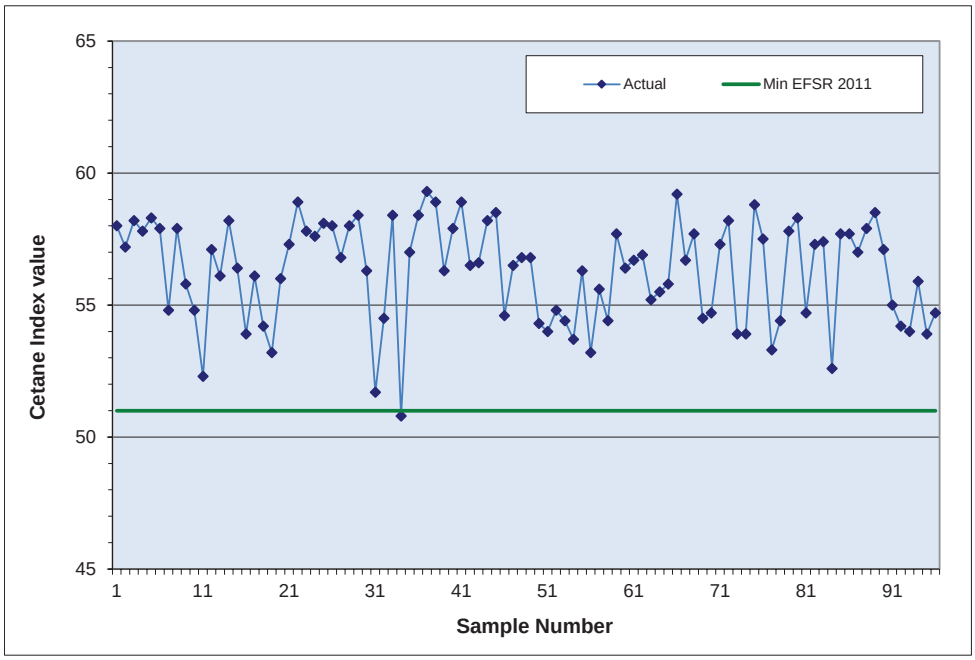
Cetane is a measure of the compression ignition behaviour of a diesel fuel; higher cetane levels enable quicker ignition. Cetane influences cold startability, exhaust emissions and combustion noise. In general, higher cetane enables improved control of ignition delay and combustion stability, especially with modern diesels which use high amounts of exhaust gas recirculation.[29]

The cetane index, according to ASTM D4737[30] 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.

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.

All 95 samples out of 96 tested were found to be above the minimum limit of 51 (Fig.16) except one sample which had result of 50.80 which is well within the estimated tolerance limit.

Figure 16: Test Results for Cetane Index, Diesel, Year 2020-21



29 *Worldwide Fuel Charter.* 6th Ed., 2019, p.64.
30 ASTM D4737-16 *Standard Method for Calculated Index by Four Variable Equation.*

Water

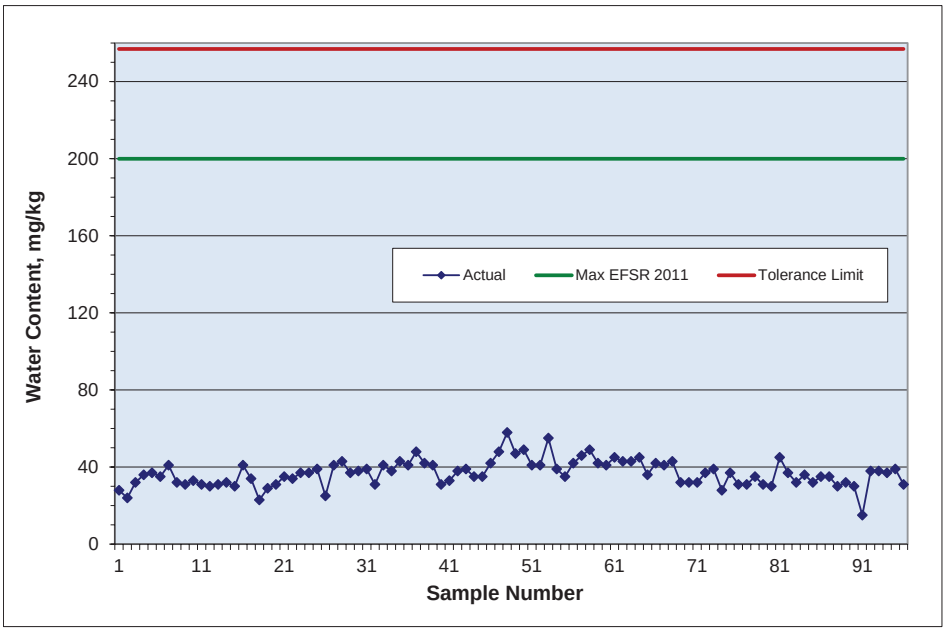
The test for water content is done according to IP438[31] which determines the total water present in diesel sample held either in solution or in solution and free water.

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 were found to be well within the specification limit of 200 mg/kg at the tolerance limit of 257 mg/kg with actual testing results not exceeding 50 mg/kg.

Figure 17: Test Results for Water in Diesel, Year 2020–21

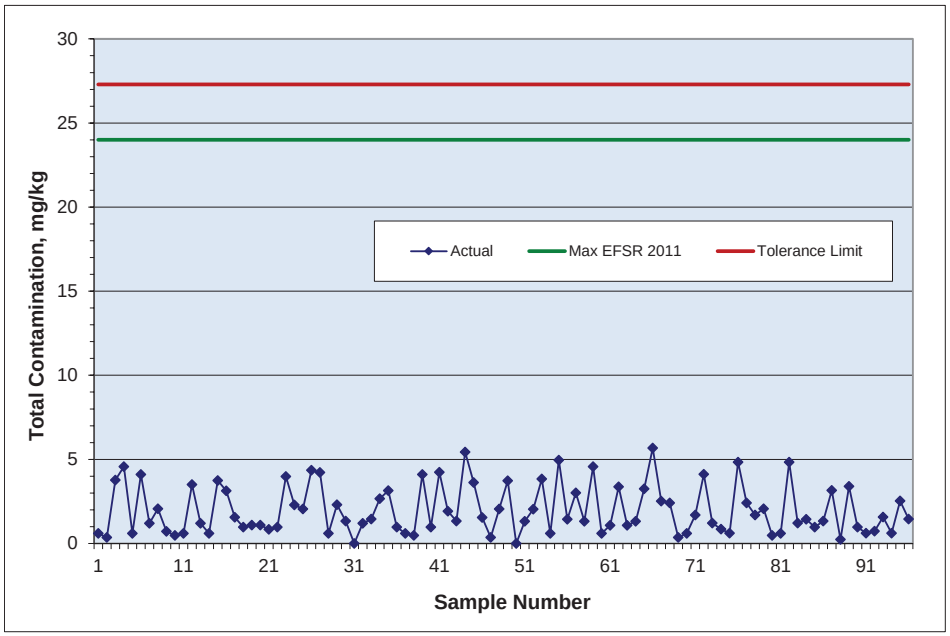


31 BS EN ISO 12937:2001, BS 2000-438:2001. *Petroleum products. Determination of content. Coulometric Karl Fischer titration method*.

Total Contamination

All 96 samples were found to be well below the maximum limit of 24 mg/kg specified in the Regulations (Fig. 18) with actual figures below 6 mg/kg. The tolerance limit for D6217[32] is 27.3 mg/kg.

Figure 18: Test Results for Total Contamination, Diesel, Year 2020-21



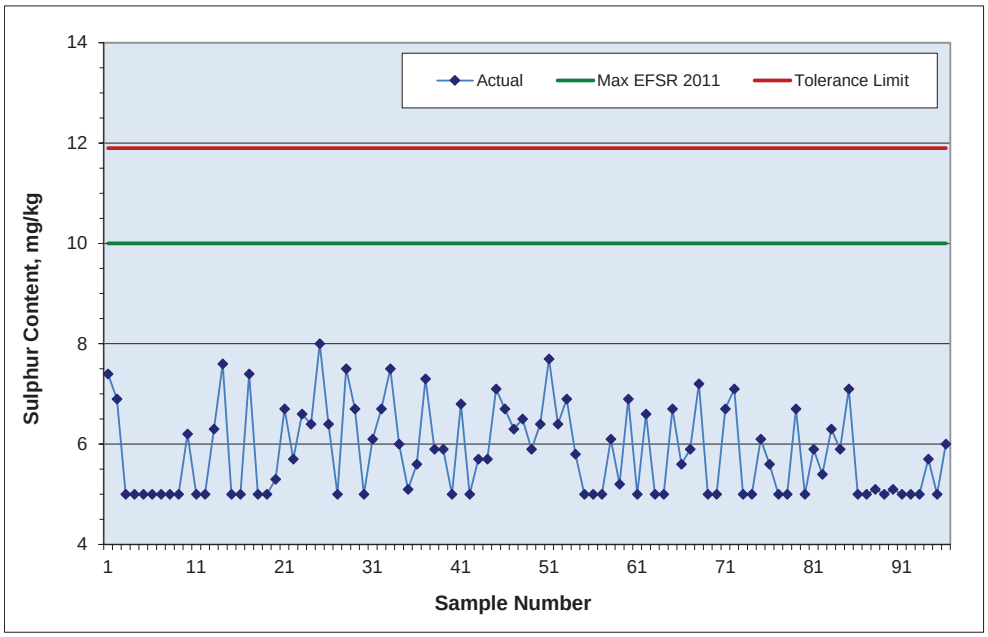
32 ASTM D6217-18 *Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration.*

Sulphur

Sulphur content can be tested according to IP 497[33] or ASTM D5453[34] prescribed in the Regulations. Respectively, there are two slightly different tolerance limits identified for the two methods: 11.8 mg/kg for IP497:2019 and 11.9 mg/kg for D5453-19a (the latter is shown on Fig.19).

All 96 tested samples were found to be below the maximum limit of 10 mg/kg specified in the Regulations (Fig. 19).

Figure 19: Test Results for Sulphur, Diesel, Year 2020-21



33 IP 497 ISO 20884:2019 *Petroleum products — Determination of sulfur content of automotive fuels — Wavelength-dispersive X-ray fluorescence spectrometry*.

34 ASTM D5453-19a *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 (CP) of diesel is the temperature at which the heaviest paraffins start to precipitate and form wax crystals; the fuel becomes 'cloudy'.[35] CP is tested according to ASTM D5773[36] prescribed in the Regulations.

The cumulative results for CP are presented below by combining the lowest prescribed maximum limits for each season in one graph (Fig.20). Generally, if results were below the lowest maximum limit established for an area they definitely complied with the Regulations in all other areas.

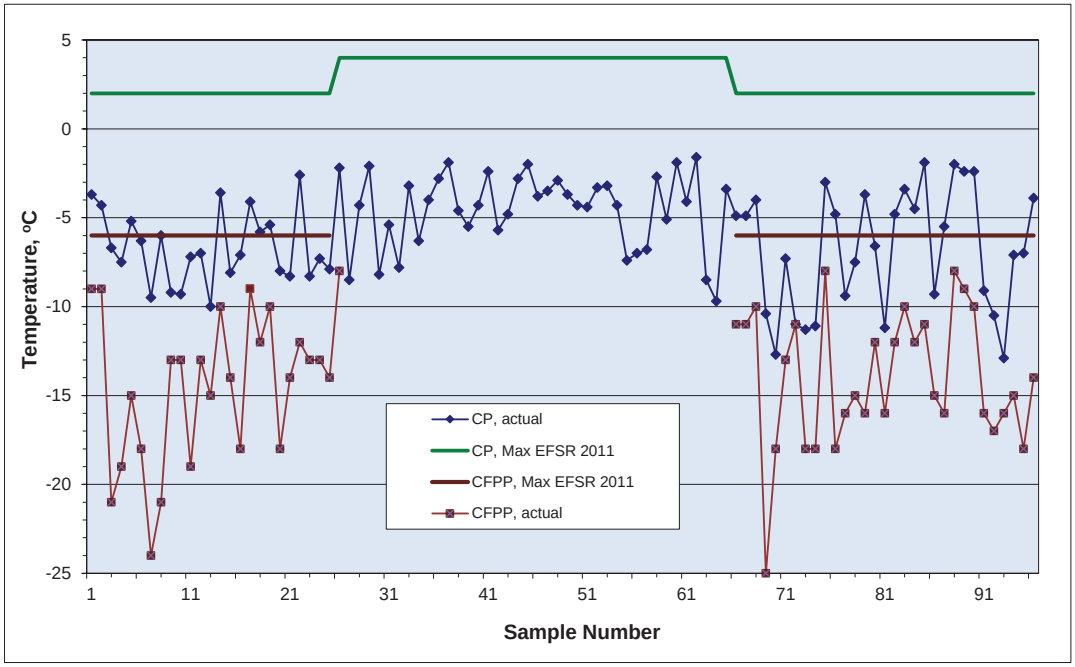
For the period of summer in Schedule 2 (season definitions in Section 5, the Regulations) from 15 October to 14 April inclusive, the lowest maximum limit of CP +4°C is prescribed for all New Zealand excluding Auckland and Northland.

The bottom line before the 'pedestal' on the graph in Fig.20, 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. The tolerance limits are 3.4°C and 5.4°C, respectively, for the specified limits of +2°C and +4°C.

All 96 samples appeared to be below the lowest maximum limit within the relevant seasons.

Figure 20: Test Results for Cloud Point and Cold Filter Plugging Point, Diesel, Year 2020-21



35 *Worldwide Fuel Charter,* 6th Ed., 2019, p.81.
36 ASTM D5773-20 *Standard Test Method for Cloud Point of Petroleum Products (Constant Cooling Rate Method)*.

Cold Filter Plugging Point

Cold Filter Plugging Point (CFPP) of diesel is the lowest temperature at which the fuel can pass through the filter in a standardised filtration test.

The CFPP test was developed from vehicle operability data and demonstrates an acceptable correlation for fuels and vehicles in the market as long as the delta between CFPP and CP is below 10°C.[37] should be tested according to IP 309[38] prescribed in the Regulations. CFPP is defined only for the winter season, from 15 April to 14 October inclusive, with the maximum limit of −6°C and the tolerance limit of −5°C.

The test results for CFPP are set out on the same graph as that for CP (Fig.20). This gives an advantage to see the data 'at glance' and compare the two sets where necessary.

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

It is worthwhile to note that a criterion suggested by vehicle and engine manufacturers for the delta between CFPP and CP to be below 10°C[37], has not been met in 14 instances out of 58 pairs of tests with the maximum delta of 15.0°C for Sample 8. However, this is just an empirical rule which is not reflected in the Regulations.

The CFPP test was developed for passenger cars from vehicle operability data and demonstrates an acceptable correlation for fuels and vehicles in the market (including heavy-duty trucks) as long as the delta between CFPP and CP is below 10°C max.

37 *Worldwide Fuel Charter,* 6th Ed., 2019, p.81.
38 BS EN 116:2015, BS 2000-309:2015 *Diesel and domestic heating fuels. Determination of cold filter plugging point. Stepwise cooling bath method.*

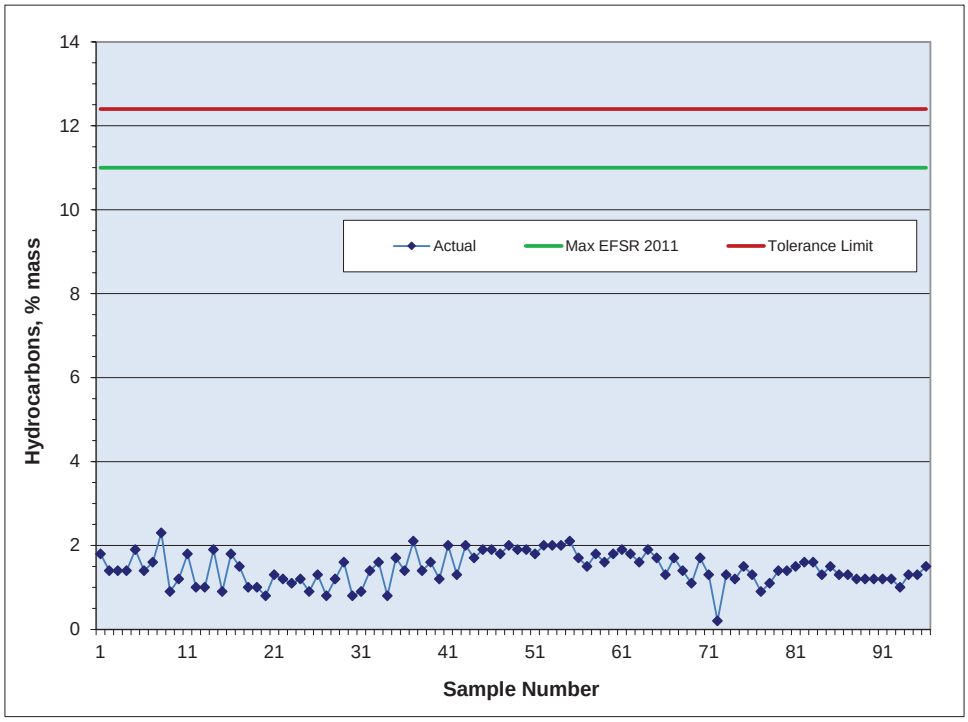
Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons should be tested by IP 391[39] prescribed in the Regulations.

All 96 tested samples were found to be well below the maximum limit of 11% specified in the Regulations at the tolerance limit of 12.4%.

All testing results were found to be below 3%.

Figure 21: Test Results for Polycyclic Aromatic Hydrocarbons, Diesel, Year 2020-21



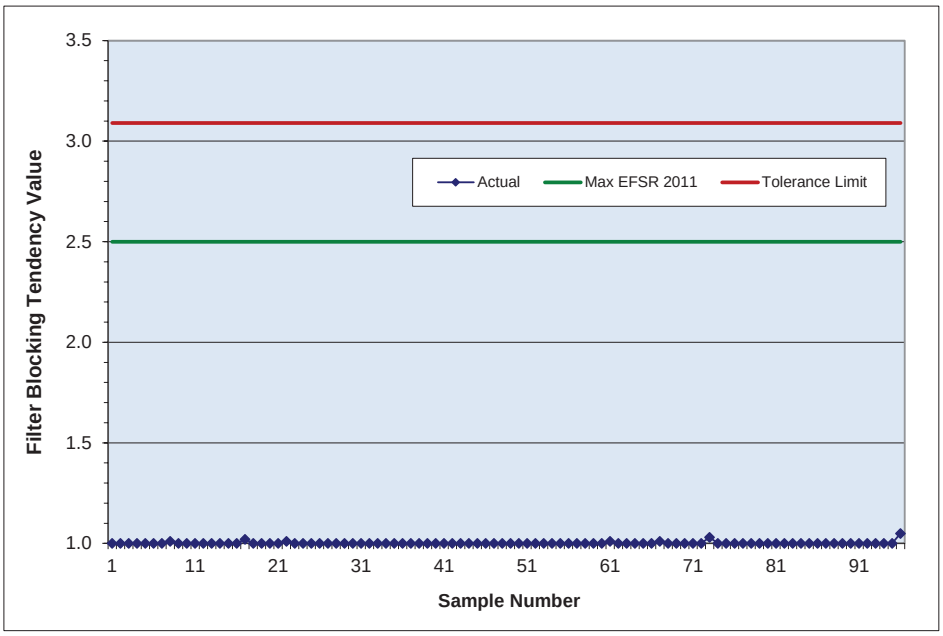
39 BS EN 12916:2019 *Petroleum products. Determination of aromatic hydrocarbon types in middle distillates. High performance liquid chromatography method with refractive index detection.*

Filter Blocking Tendency

Filter blocking tendency can be tested by IP 387[40] or ASTM D2068[41] prescribed in the Regulations.

All 96 samples were found to be well within the specified maximum limit of 2.5 for filter blocking tendency at the tolerance limit of 3.09.

Figure 22: Filter Blocking Tendency, Diesel, Year 2020-21



40 IP 387:2017 *Determination of filter blocking tendency*.
41 ASTM D2068-20 *Standard Test Method for Determining Filter Blocking Tendency*.

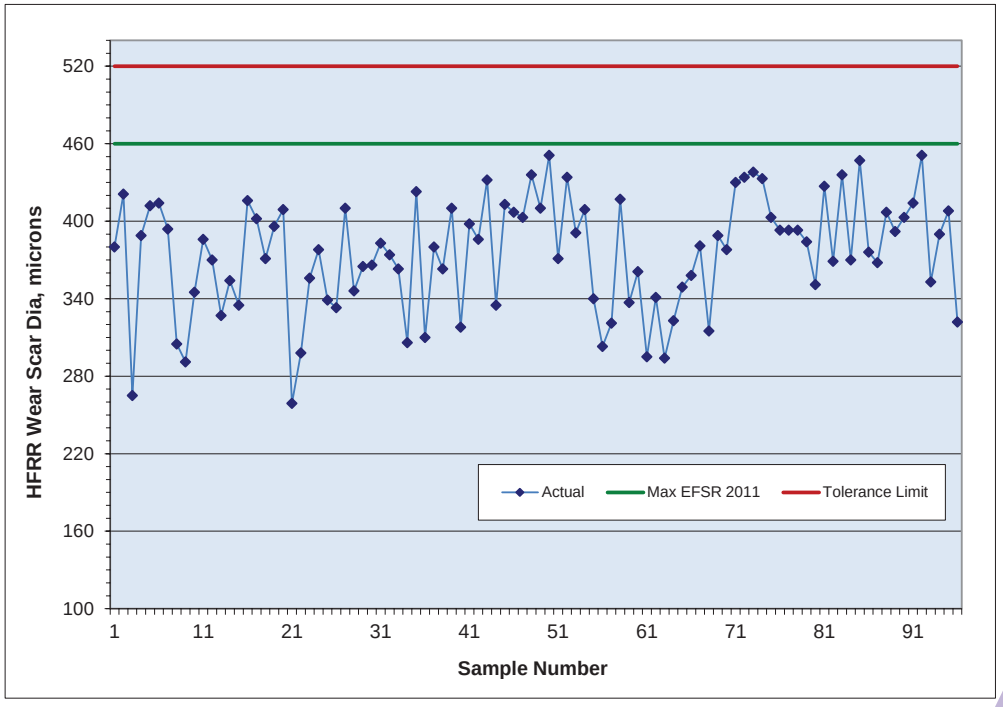
Lubricity

Lubricity is identified as a diameter of the wear scar produced on an oscillating ball from contact with a stationary plate immersed in the fluid and should be tested by IP 450[42] prescribed in the Regulations.

The diameter is usually measured in microns: the specification maximum limit is 460 µm. The tolerance limit is 520 µm.

All 96 samples were found to be below the specification maximum limit for the lubricity. Two samples were found to be the closest to the specification limit with the actual figure of 451 µm.

Figure 23: Test Results for Lubricity, Diesel, Year 2020-21



42 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.*

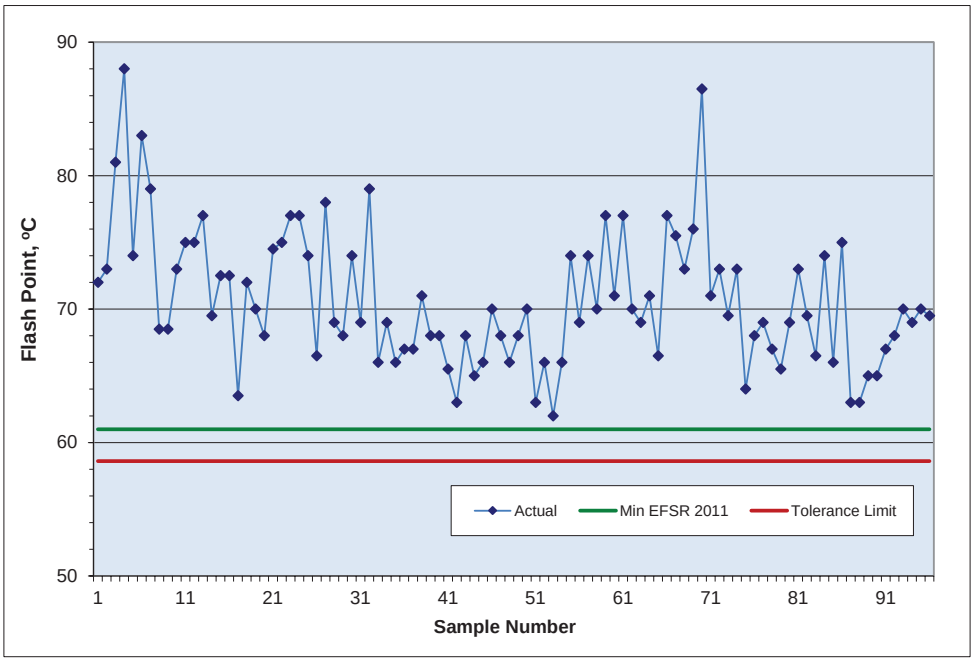
Flash Point

Flash point is tested by ASTM D93[43] prescribed in the Regulations.

All 96 samples were found to be above the specified minimum limit of 61ºC for flash point of diesel.

The tolerance limit is 58.6ºC. The closest result to the minimum limit was 62.0ºC.

Figure 24: Test Results for Flash Point, Diesel, Year 2020-21



43 ASTM D93-20 *Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester.*

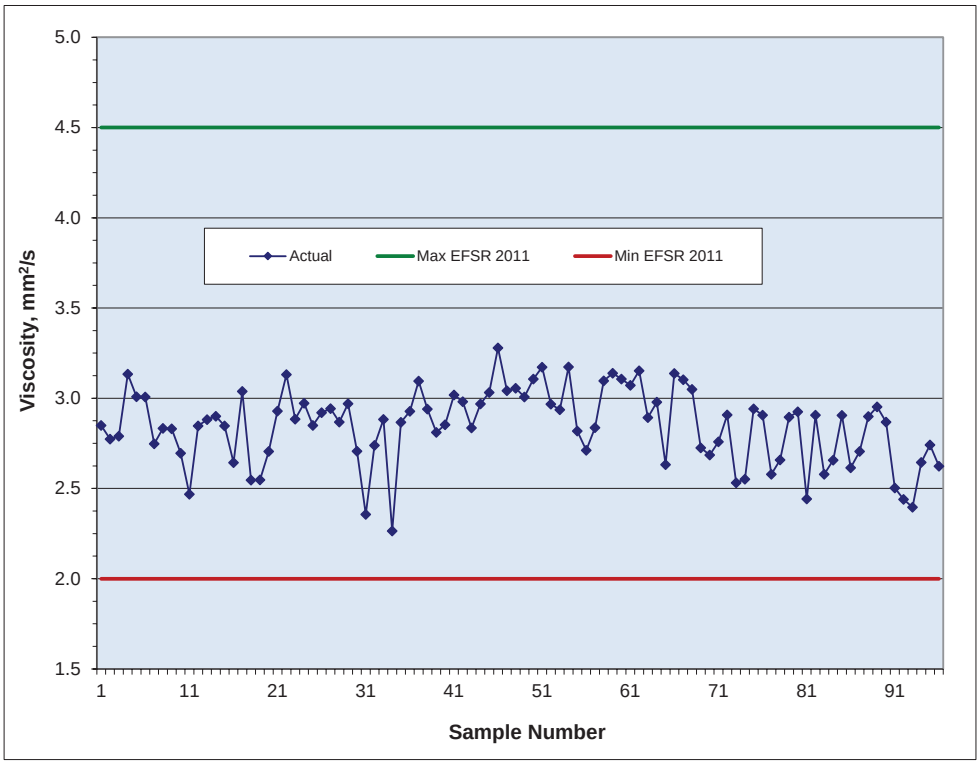
Viscosity

The viscosity is tested at 40ºC by ASTM D445[44] prescribed in the Regulations.

All 96 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.

All test results were in the range between 2.5 and 4.0 mm^2 per second with the minimum result of 2.265 mm^2 per second for Sample 34 and the maximum result of 3.279 mm^2 per second for Samples 46. 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 25: Test Results for Viscosity, Diesel, Year 2020-21



44 ASTM D445-19a *Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity).*

Summary for Diesel Test Results

There was one instance when a diesel sample was identified as suspect non-compliant according to the requirements of the Regulations. One result for cetane index was found to be 50.8 *i.e.* below the specification limit of 51. Still, the sample after repeated testing was recognised to be compliant since the estimated tolerance limit is 49.8.

Further, 30 out of 96 samples were tested for copper strip corrosion[45] and all of them were found to be compliant. A number of samples were tested for oxidation stability[46] and also were found to be compliant.

Testing of diesel for appearance according to the ASTM standard D4176[47] 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.

45 ASTM D130-19 *Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test*.
46 ASTM D2274-2014(2019) *Standard Test Method for Oxidation Stability of Distillate Fuel Oil (Accelerated Method)*.
47 ASTM D4176-04(2019) *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 that this report covers. As in previous annual reports, the actual results are not always shown due to the commercial sensitivity of the data.

Retail Fuel Sampling and Testing

BIODIESEL B5

The product falls into the category of diesel by definition in the Regulations, with FAME (Fatty Acid Methyl Esters), *i.e.* the main component of biodiesel according to Schedule 3, content up to 5%. There was one sample collected which was found to be fully compliant as diesel, with a low content of FAME of approx. 1%. This product wasn't available in the market since late 2020 until the end of the period covered in this report.

Diesel with FAME content up to 7% was permitted in New Zealand but wasn't supplied.

ETHANOL BLENDED PETROL E10

This year, nine samples of premium petrol blended with ethanol and labelled as E10, were sampled from the retail sites tested for oxygenates and oxygen content. All samples were found to be compliant, in particular, ethanol and oxygen content as well as dry vapour pressure, were found within the prescribed specifications, for all the samples.

ETHANOL BLENDED PETROL E85

This product is specified in the Schedule 1A of the Regulations since there are flexible-fuel vehicles on roads in New Zealand which are able to use E85. However, no E85 dispensers have been accessible to the public throughout the period covered by this report.

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, three sets of biodiesel, B100 (pure biodiesel) and relevant B10 (10% blend with mineral diesel), were sampled and tested. Biodiesel B100 was tested according to the requirements of Schedules 3 in the Regulations while B10 blend was tested according to the Regulation 17.

BIODIESEL B100

Three samples were taken with an interval of a few months from a producer. Total contamination appeared to be the major problem in all three where a filtering process according to EN BS 12662:98 was found to be incomplete in the first sample with approx. a 40% product not filtered within the required period. Samples were found to be non-compliant; relevant non-conformance certificates were issued. After notification, the company undertook remedial actions. The third series of tests revealed ongoing problems with the filtering properties; total contamination appeared to be not less than 32 mg/kg which is beyond the tolerance limit of 28.2 mg/kg, with some product remaining unfiltered. A biodiesel blend B10 based on this product was also tested (see below).

One sample failed an oxidation stability test, but remedial actions were implemented, and the product properties returned to normal.

Further, problems with accurately measuring FAME content remained the focus of the testing programme. Some test results were found to be slightly below the specified minimum limit of 96.5%. Still, all average results were found to be above the tolerance limit of 94.1%, for example, two determinations of 94.5% and 95.6% under the condition of reproducibility. This was seen as a reflection of the variability and tolerances around the test method as opposed to sub-standard products.

BIODIESEL B10

This blend is considered to be a final product supplied to commercial 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 were also collected at the plant dispenser when biodiesel B100 was collected. The samples of biodiesel B10 including the one blended with biodiesel B100 which was later found to be non-compliant were found to be fully compliant except for the FAME content in the first sample which was found to be 18.8% at the advertised volume of 10%. Advertised limits are enforceable under the provisions of the Fair Trading Act 1986 in relation to possible misdescription.

ETHANOL COMPONENT E100

Denatured ethanol E100 for blending with petrol, was tested three times from a storage terminal throughout the period covered in this report. Properties of duplicate samples taken from top and bottom of the storage tank were found to be fully within the specified limits.

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

Appendix

A Brief Glossary and Abbreviations

ASTM	American Society for Testing and Materials
BS EN	British Standard European Norm
CEN	Comité Européen de Normalisation (*French for:* European Committee for Standardization)
ISO	International Organization for Standardization (a common short name not an acronym)
IP	Institute of Petroleum, UK
IPL	Independent Petroleum Laboratory
FAME	fatty acid methyl esters, *i.e.* the main component of biodiesel according to Schedule 3 of the Regulations
CP	cloud point of diesel *i.e.* the temperature at which the heaviest paraffins start to precipitate and form wax crystals; the fuel becomes 'cloudy'
CFPP	cold filter plugging point of diesel *i.e.* the lowest temperature at which the fuel can pass through the filter in a standardised filtration test
B100	biodiesel according to Schedule 3 of the Regulations
E85	fuel ethanol *i.e.* a blend of petrol and ethanol, containing not less than 70% and not more than 85% ethanol by volume
Cetane	a measure of the compression ignition behaviour of a diesel fuel; higher cetane levels enable quicker ignition
Octane	usually in RON (Research Octane Number) or MON (Motor Octane Number), petrol's ability to resist auto-ignition; auto-ignition can cause engine knock, which can severely damage engines; the higher the octane number the greater the fuels resistance to knock. RON is an indicator of the fuel's anti-knock performance at lower engine speed and typical acceleration conditions. MON is an indicator of the anti-knock performance under higher engine speed and higher load conditions.