CONCAWE issues guidelines on gasoline volatility aspects for year 2000 EN 228 standard

CONCAWE studied the impact of environmental gasoline specifications and car parc change on hot weather driveability performance.

Gasoline volatility specifications are defined in volatility classes in the European Standard EN 228. CEN member countries have selected up to three volatility classes to satisfy the driveability requirements for their market based on regional climatic variations over the year.

The new EU Fuels Directive 98/70/EC defines the environmentally relevant specifications and thus affects fuel composition. Consequently, other specifications, especially volatility classes, have also to be reviewed. To accommodate new legal specifications and other technical aspects, CEN is revising the year 2000 EN 228 specifications accordingly, which were established for the first time as a European gasoline standard in 1993.

CONCAWE has reviewed the volatility specifications related to hot weather driveability (or HFH[1]), i.e. RVP[2], E70[3] and VLI[4]. As a result CONCAWE has proposed revisions to the volatility specifications based on extensive knowledge of hot weather driveability performance and its assessment, accumulated by member companies over many years. A document providing details of the calculations and technical background was made available to the technical experts' working group in CEN/TC19 (WG21) and will be published soon as a CONCAWE report (99/51).

VOLATILITY SPECIFICATIONS ENSURE SATISFACTORY HOT WEATHER DRIVEABILITY

If there is a mis-match between the maximum ambient temperature in which a vehicle is expected to operate and the volatility of the fuel it uses, then hot weather driveability (or hot fuel handling) malfunctions can be experienced. These problems are caused by overheating in the vehicle fuel system leading to the formation of vapour bubbles in the fuel line system, interrupting the flow of liquid fuel or causing foaming of gasoline in the carburettor bowl. This can cause problems in fuel pumps and metering systems (injectors or carburettors) which are designed to handle liquid fuel and cannot cope with vapour. The problems which affect fuel systems can result from an over-rich mixture in carburetted engines or over-lean mixtures in fuel pumps/injection equipped engines, making it hard or impossible to restart the engine.

Modern electronic fuel injection (EFI) engines are much less prone to hot fuel handling problems than carburetted engines. Therefore, modern vehicles are far more tolerant of hot conditions and high volatility fuels, and very few HFH problems occur in the market.

[1] *HFH = Hot Fuel Handling*
[2] *RVP = Reid Vapour Pressure*
[3] *E70 = % of gasoline evaporated at a temperature of 70 °C*
[4] *VLI (Vapour Lock Index) = 10 x RVP (kPa) + 7 x E70 (% v/v)*

Adequate volatility specifications including RVP, E70 and VLI will avoid the problems described and ensure satisfactory hot weather driveability performance.

NEW EU FUEL DIRECTIVE AFFECTS OTHER SPECIFICATIONS SUCH AS VOLATILITY

Gasoline volatility characteristics will change after year 2000 due to the impact of the new EU Fuels Directive. In particular, restrictions on maximum content of olefins (18% v/v), aromatics (42% v/v) and benzene (1% v/v) will require changes in refinery processing. There will be a need for increased use of lower boiling blending components, such as isomerate and MTBE. CONCAWE studies show that, because of these changes to gasoline production, the current limit on maximum E70 (45–47% v/v) will be constraining after year 2000.

Therefore, the needs of the car populations in the different European countries have been analysed for year 2000. These car parc responses to fuel volatility have shown that current E70 and VLI limits can be modified whilst maintaining problem-free hot fuel handling performance and still retaining refinery blending flexibility. CONCAWE's proposal for volatility classes showing the key properties is given in the table. The requirements for a VLI are discussed below.

Proposed gasoline volatility classes for summer and other seasons (key properties)

	Summer		*Other seasons*			
Class	*A*	*B*	*C*	*D*	*E*	*F*
RVP kPa	45–60	45–70	50–80	60–90	65–95	70–100
E70 % v/v	20–48	20–48	22–50	22–50	22–50	22–50
E100 % v/v	46–71	46–71	46–71	46–71	46–71	46–71
E150 % v/v min.	75	75	75	75	75	75
VLI	no	no	*	*	*	*

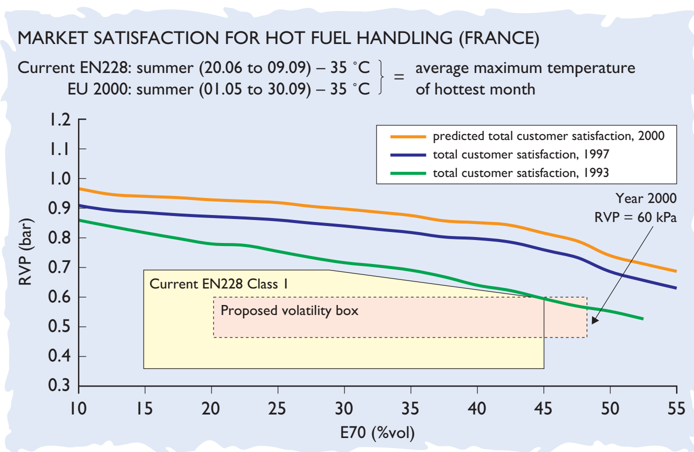
** VLI only for some critical markets during transition between summer and winter periods*

PREDICTIONS OF CUSTOMER SATISFACTION ON HOT WEATHER DRIVEABILITY PERFORMANCE BASED ON EXTENSIVE DATABASE AND EXPERIENCE

Predictions of customer satisfaction for hot weather driveability are based on a database containing information on many hundreds of vehicles tested over many years. These tests are conducted on a selection of vehicle technologies representative of the European market at different ambient temperatures, and the vehicles are assessed for their sensitivity to a wide range of fuels of different volatility. These performance data, when linked on a market weighted basis with the vehicle population data and an accurate ambient temperature profile of a region, allows hot weather driveability technical satisfaction levels to be generated for any combination of ambient temperature and volatility. The average monthly maximum temperatures (recorded over many years in the hottest city of the market) are used to define either the hottest month in the season under review or any individual month. These technical satisfaction levels are then used to calculate lines of total customer satisfaction for individual European markets based on customer reaction test data.

The predictive potential of the CONCAWE approach is demonstrated for France in Figure 1. It shows that the calculated satisfaction curve for the 1993 vehicle population matches well with the CEN

Figure 1
Summer market satisfaction for hot fuel handling (France). Due to a change in the car parc over the years, total customer satisfaction curves have moved away from the volatility box.

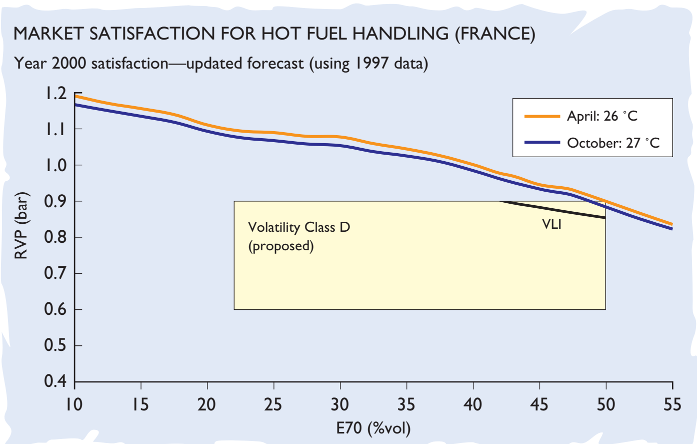


volatility class chosen for the summer period in 1993 when EN 228 was first introduced. The Figure also shows that the satisfaction curve moves away from the volatility box for the 1997 car parc and even further for the predicted 2000 car parc when older, more sensitive vehicles have been scrapped. It can be seen clearly that there is no further need for a summer VLI, as the satisfaction line is well above the proposed new rectangular volatility box which is based on the legally defined summer RVP of maximum 60 kPa for 2000. This conclusion is valid for all European countries investigated.

CONCAWE PROPOSAL TO SERVE AS A GUIDELINE; LIMITED NEED FOR A VLI DURING TRANSITION PERIODS

Investigations have shown that, for volatility classes for seasons other than summer, the VLI specification would also generally be no longer necessary. This conclusion can be drawn from customer satisfaction curves developed for average monthly maximum temperatures in individual months, covering the critical transition months between winter and summer for individual markets (14 EU markets). These diagrams serve as guidelines to define adequate non-summer volatility classes for individual markets and to decide whether extra control of volatility is needed during the critical transition periods between summer and winter. Only four markets were identified as critical—Finland, France, Greece and Portugal. Figure 2 shows the monthly satisfaction curves for France during transition, and Volatility Class D for the winter season. To avoid driveability problems, a satisfaction curve should never intersect a volatility box; hence some further control is needed during the transition months of April and October, which could include a VLI specification.

Figure 2
Other seasons (not summer) market satisfaction for hot fuel handling (France)



FURTHER WORK REQUIRED FOR 2005—JOINT INDUSTRY PROGRAMME?

All hot weather driveability assessments are based on existing, European-wide approved CEC (Coordinating European Council) test procedures and well established relationships between test-procedure derived data, road driving behaviour and customer satisfaction curves. CONCAWE's guidelines are currently based on ca. 15 000 individual tests carried out over many years using 655 vehicles covering a wide range of vehicle technologies. CONCAWE considers that the guidelines have been a valuable contribution in the debate for the revision of the year 2000 volatility specifications.

A new hot weather driveability test method has been published recently by the driveability group within GFC, the French national CEC body. GFC consider this method to be a more appropriate and critical assessment of the driveability performance of new vehicle technology. Basic performance data obtained with the new method have not yet been published. Neither—as far as CONCAWE is aware—have comparisons been carried out with the current CEC test method, nor have relationships been established to road driving and customer satisfaction. The generation of an additional database for newly registered vehicles with the new test method could be a challenge for the next revision of EN 228, currently scheduled for 2005. This new database should be developed jointly by the automotive and oil industries.