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COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

on a future strategy for the control of atmospheric emissions from road transport taking into account the results from the Auto/Oil Programme

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Proposal for a
EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE

relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC

Proposal for a
EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE

relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directives 70/156/EEC and 70/220/EEC

(presented by the Commission)

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

on a future strategy for the control of atmospheric emissions from road transport taking into account the results from the Auto/Oil Programme

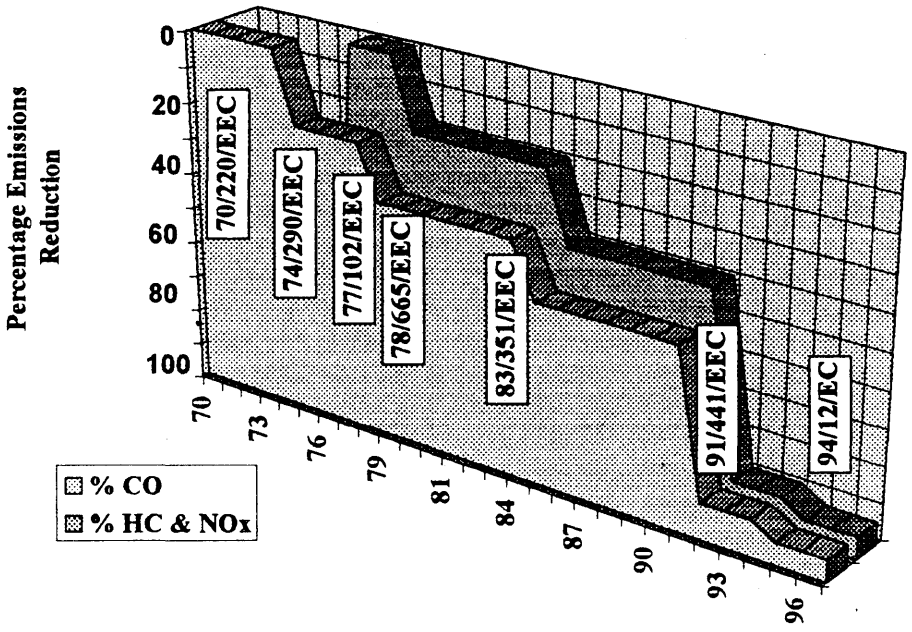
1. BACKGROUND

EU Legislation on vehicle emission standards

Directive 70/220/EEC[1] was the first directive to lay down emission limits for passenger cars. Over the past two decades subsequent amendments to Directive 70/220/EEC and the adoption of legislation on emission standards for light commercial[2] and heavy duty vehicles[3] have strengthened and extended Community policy in this area. When the emission standards for passenger cars laid down in Directive 94/12/EC[4] (the latest amendment of the 1970 base directive) comes into effect in 1996/97, emissions of regulated pollutants from new passenger cars will be reduced by over 90% as compared to the standards which prevailed in the early 1970s. These improvements in standards are illustrated below in Figure 1.

Figure 1

Evolution of Community Passenger Car Emission Standards



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(1) Directive 70/220/EEC; OJ No L 76, 6.4.1970, p. 1.

(2) Directive 93/59/EEC; OJ No L 186, 28.7.1993, p. 21.

(3) Directive 91/542/EEC; OJ No L 295, 25.10.1991, p. 1.

(4) Directive 94/12/EC; OJ No L 100, 19.4.1994, p. 42.

However, despite these considerable achievements with regard to the emission reduction of individual vehicles, increased traffic activity (increased numbers of vehicles, increased kilometres travelled) are likely to counteract these improvements and to militate against overall emissions being reduced to a level consistent with the attainment of future air quality objectives.

Given the reductions already achieved, further action to reduce vehicle emissions necessitated a reassessment of the existing policy approach since the emission reduction potential offered by further improvements in vehicle technology, was limited and possibly very costly in comparison to other potential solutions. The Commission, in October 1992 therefore organized a conference with all relevant interest groups to discuss the issue of vehicle emission standards for the year 2000 and beyond. The major conclusion from this conference was that future emission standards should be based on an integrated approach and should have as their objective the achievement of air quality targets. In this context it was recognized that further steps would be needed not least because of increased traffic activity (increased numbers of vehicles and increased kilometres travelled).

This new approach was outlined in the legislative proposals the Commission submitted to Council and Parliament in 1992. It is reflected in Article 4 of Directive 94/12/EC which was adopted by Council and Parliament in 1994 under the co-decision procedure. The main elements of Article 4 are outlined below:

"In these proposals [future proposals for emission standards to apply from 2000] the Commission shall take the following approach:

- the measures shall be designed to produce effects to meet the requirements of the Community's air quality criteria and related objectives,

- an assessment of the cost effectiveness of taking each measure shall be undertaken; in this global assessment full account shall be taken, *inter alia*, of the contributions that:

    - traffic management, for example by spreading the environmental costs appropriately,

    - enhanced urban public transport,

    - new propulsion technologies (e.g. electric propulsion),

    - the use of alternative fuels (e.g. biofuels), could make to improving air quality,

- the measures shall be proportional and reasonable in the light of the intended objectives.

The proposals, taking account of the methodology outlined above and aimed at a substantial reduction of pollutant emissions as regards the vehicles covered by this Directive, shall comprise in particular the following elements:

1. Further improvements in the requirements of this Directive:
   based on the assessment of

    - the potential of the traditional engine and post-combustion technology,

    - possible improvements in the test procedure, e.g. cold-start, starting in low or wintry temperatures, durability (e.g. in the conformity tests), evaporative emissions,

    - measures at the level of type-approval supporting strengthened inspection and maintenance requirements, including, for example, on-board diagnostic systems,

- the possibility of checking the conformity of vehicles in circulation,

- the proportional need for:

  (i) specific limits for HC and NOx in addition to a cumulative limit value, and

  (ii) measures to cover pollutants not yet regulated.

2. Complementary technical measures in the framework of specific Directives, including:

- improvements in fuel quality as far as vehicle emissions of dangerous substances (in particular benzene) are concerned,

- strengthening of the requirements of the inspection and maintenance programme.

The reduced limit values which will be the subject of the new Directive shall not apply before 1 January 2000 for new type-approvals. The Council shall decide on the conditions for granting tax incentives on the basis of these limit values."

While Directive 94/12/EC was only adopted in 1994, Article 4 of that Directive is the formal expression of the framework within which the Commission carried out its preparatory work for the development of future legislative proposals directed at the reduction of emissions from road transport to be effective from the year 2000.

2. THE AUTO/OIL PROGRAMME

In recognition of the fact that the future Community policy on the control of vehicle emissions should be based on an integrated and comprehensive approach and taking into account the potential of a wide variety of different measures for bringing about cost-effective solutions, the Commission, in 1992, invited the European oil and automobile industries to participate in a collaborative programme with the intention of developing a solid technical foundation upon which the Commission could build its future strategy: this programme subsequently became known as the Auto/Oil Programme. (A short summary of the technical analysis carried out in the Auto/Oil Programme is included as Annex 1 to this Communication. A more detailed explanation of the programme can be found in a consolidated technical report).

The Auto/Oil Programme was a ground-breaking initiative in which the resources and expertise of two major industries were combined in collaboration with the services of the Commission and focused on the challenge of developing a rationale basis for future legislative action. The programme is an example of the principle of partnership identified in the fifth Environmental Action Programme. The Commission would like to record its thanks and appreciation to both industries in demonstrating their commitment to the goal of sustainable development in such a tangible manner. In particular the extensive research programme known as the European Programme on Engines Fuels and Emissions (EPEFE) has provided a unique insight into the relationship between engine technology/fuel quality and vehicle emissions.

The rationale of the Auto/Oil Programme was to quantify both the cost and the emission reduction potential of a variety of different measures which could contribute to reducing vehicle emissions and the attainment of air quality targets. The measures which were included in the analysis included not only advances in vehicle technology and fuel quality but also the benefits of improvements to the regular inspection and maintenance procedures as well the potential contribution of non-technical measures such as road pricing, improved public transport and scrappage schemes. The objective of the auto/oil analysis was to identify cost effective packages of measures sufficient to reduce vehicle emissions to the level compatible with the achievement of rigorous air quality standards throughout the Community.

3. CLEAN AIR: THE MOTIVATION FOR REDUCING VEHICLE EMISSIONS

Article 4 of Directive 94/12/EC requires that measures to reduce emissions from road traffic shall be designed to meet the requirements of the Community's air quality criteria and related objectives. The existing Community legislation on air quality objectives and dealing *inter alia* with nitrogen di-oxide, sulphur dioxide and particulate matter, lead and troposheric ozonze are currently being revised. In order to take account of the latest information emerging from that review process as well as the ongoing work to revise the existing World Health Organization air quality guidelines, the Commission and the two industry partners in the Auto/Oil Programme agreed to explore a number of air quality objectives: these objectives and the way they were used in the Auto/Oil Programme are described in summary form in the Annex to the present Communication and in greater detail in the consolidated air quality report from the Auto/Oil Programme.The critical air quality objectives which were eventually used as the basis for designing the package of measures to reduce road transport emissions are presented in Table 1.

Table 1

Air Quality Targets

Pollutant:	Urban NO_2	Urban Carbon Monoxide	Urban Benzene	Urban Particulates	Tropospheric Ozone
Air Quality Targets:	200 $\mu g/m^3$ As maximum hourly value	10 mg/m^3 As maximum hourly value.	10 $\mu g/m^3$ As an annual mean	50 $\mu g/m^3$ As a24 hour rolling average	180 $\mu g/m^3$ As a one hour 99 percentile value.

4. REDUCING EMISSIONS FROM ROAD TRANSPORT - INTEGRATED STRATEGIES: SHARED RESPONSIBILITY

The Auto/Oil Programme focused exclusively on the control of emissions from the road transport sector. While for the majority of atmospheric pollutants road transport constitutes the single most important source of emissions other sources such as power stations, Industry and individual households also make a significant contribution. The implementation of the measures arising out of the Auto/Oil Programme will ensure that emissions from road transport are reduced to a level compatible with the attainment of rigorous air quality standards. However, in order that the air quality standards are achieved it will require equally significant and parallel reductions in emissions from other man made sources. In particular the results from the Auto/Oil Programme have demonstrated that reductions of man made emissions of both Volatile Organic Compounds (VOCs) and oxides of nitrogen (NOx) of the order of 70+% as compared to today's levels will be required if air quality targets for tropospheric (low-level) ozone are to be achieved.

The attainment of satisfactory air quality throughout the Community should be based on an integrated, balanced and cost-effective approach to the reduction of emissions. Clearly, there are significant differences in the air quality to be found in the different cities and regions throughout the Community. The most cost-effective solution with regard to transport related emissions, will not be based on the assumption that Community wide technical measures should be expected, on their own, to resolve the pollution problems in the worst affected cities/regions.

Air quality standards are laid down in Community legislation and Member States are required as a minimum to ensure that these standards are respected. This basic legal obligation placed upon the Member States constitutes the ultimate legal safeguard that the emission reduction measures taken at Community, national and local level will result in the achievement of the necessary air quality standards.

In the Auto/Oil Programme and in the package of measures to be put forward by the Commission the underlying rationale was that technical measures, such as emission standards, fuel quality and improved inspection and maintenance regimes, will be applied at a certain intensity across the Community and will result in a widespread and significant reduction in emissions and consequent improvements in air quality. However, these Community-wide measures will have to be complemented and supplemented, as appropriate, by local and national measures such as road pricing, the expansion of the public transport system, emission related vehicle taxes and scrappage schemes applied to old vehicles. As a minimum, these national and local measures would need to be applied in localities/regions where, in the absence of such targeted actions, the Community-wide technical measures would not, on their own, ensure that the air quality standards required under Community legislation are achieved and respected. In addition, those Member States and localities that wish to achieve air quality standards higher than the minimum standards required under Community legislation, are of course free to introduce whatever national and local measures they see fit in order to reduce emissions from vehicles on condition that such measures are compatible with the Treaty such as the provisions on the free movement of goods and in particular the provisions of the Directives accompanying the present Communication.

While decisions with regard to the appropriate choice of geographically restricted measures aimed at reducing atmospheric pollution should be taken at the national, regional and local level, in the context of shared responsibility, there is a role for the Community to inform, promote and enable in order to ensure that Community policies have a positive influence. To this end the Commission has issued a Green Paper concerning public passenger transport and entitle "The Citizens Network" which suggests ways in which public transport can be made more attractive and usable. The Commission is also involved in a number of other initiatives and collaborative projects including inter alia the Car Free Cities Network which now has over 50 participating cities ,the networks addressing transport, energy efficiency and air quality involved in JOULE-THERMIE projects (the POLIS network on transport telematics applications, the EUROCITIES, TELECITIES and POLIS networks on the European Digital Cities project, city networks in environment telematics projects and the CITELEC).

The interdependence of the various elements in the Commission's strategy applies not only to the relationship between actions taken at the Community/national/regional and local levels but also to the various technical measures. The increased severity of the vehicle emission standards applies at the time when a vehicle is type approved for marketing in the Community; manufacturers are then required to ensure that all examples of that model which are produced conform to these standards and to ensure that the emission performance will not deteriorate significantly during the life of the vehicle; once the vehicle is on the road its emission performance will be influenced by the quality of the fuel and the behaviour of the driver; electronic sensors which monitor the emissions of the vehicle will also inform the driver of any defects and signal the need for repair; finally regular inspection and maintenance tests combined with road side checks and re-call schemes will also ensure that vehicles maintain a high level of emission performance throughout their life.

The message which has to be underlined in relation to the control of vehicle emissions is the interdependence of all the elements in the systems. The technical components need to be compatible and the administrative systems need to inter-lock and be mutually supportive. In addition vehicle manufacturers and oil companies need to comply with their obligations. Finally and very importantly , individual vehicle owners have a major role to play in reducing vehicle emissions: responsible driving behaviour has a significant effect on fuel consumption and emissions; poorly maintained vehicles contribute a disproportionate amount to the total pollution load from the vehicle fleet.

The Auto/Oil Programme and the Commission's future strategy on the control of vehicle emissions is based on the concept of shared responsibility and burden sharing between the Community, national and local governments, Industry and the individual citizen: such an approach is entirely consistent with the principle of sustainable development which requires that all stake-holders have a role to play in the protection of the environment.

5. FROM AUTO/OIL PROGRAMME TO LEGISLATIVE PROPOSALS

The Auto/Oil Programme provides the technical foundation upon which the Commission will build its strategy with regard to the control of vehicle emissions. In developing its proposals for the legislative actions which form a central part of that strategy the Commission took account of a number of considerations over and above the exclusively technical input provided by the programme:

Uncertainty

In recognition of the uncertainty inherent in any scientific investigation , particularly one a complex as the Auto/Oil Programme, the Commission's proposals are based on a precautionary approach. This means that the severity of the legislative proposals is such that even making conservative assumptions regarding the efficiency of non-technical measures it is confidently to be expected that the necessary air quality objectives will be respected throughout the Community.

An integrated package

As explained in section 3 the Commission's strategy is based on an integrated approach relying on action at a number of levels and the shared responsibility of all stakeholders. The Commission's legislative proposals must therefore be seen as a package - all the elements in the package are required to be adopted for the strategy to be effective. In addition and in accordance with the underlying premises of the Auto/Oil Programme, the different elements must be implemented concurrently to ensure maximum effectiveness.

Feasibility

The Commission's proposals also take account of the technological feasibility of introducing the measures according to the specified deadlines. For example in the case of the emission standards for diesel vehicles the proposals are based on the assumption that the de-NOx catalyst will not be in commercial production by the year 2000. The Commission's proposal does, however, take account of the need to provide an incentive for the continued development of this important technology as well as a commitment to guarantee that when vehicles equipped with these technologies arrive on the market, fuels of the a quality sufficent to ensure the effective performance of the new technologies are also available. .

The integrity of the internal market

The economic benefits deriving from the creation of an internal market of over 350 million inhabitants were extremely important considerations for the Commission in developing its legislative proposals. The Commission has endeavoured to achieve an effective balance between one the one hand the need for flexibility in order to respond to the different air quality situations in the Community and on the other hand, the desire to ensure the integrity of the internal market.

Coherence in legislative policy

The Commission's proposals also took into account the history and the balance in the existing legislative regime. For example, in relation to the emission standards applied to different classes of vehicles the Auto/Oil Programme indicated that severe emission limits should be applied to light commercial vehicles and only light to moderate limits on passenger cars. In recognition of the fact that the same engines are often used in both categories of vehicle the Commission will propose that similar and co-ordinated emission limits are applied to each.

Expectations of the Member States and the Parliament

On the basis of frequent meetings with technical experts and written statements, the Commission has been kept informed of the position of the Member States with regard both to the Auto/Oil Programme and the legislative proposals arising from it. In addition the Parliament has on several occasions expressed itself in favour of environmentally ambitious measures to reduce emissions from road transport. The views of the Member States and the Parliament have been taken into account by the Commission in preparing its legislative proposals.

6. THE LEGISLATIVE PACKAGE ARISING FROM THE AUTO/OIL PROGRAMME

In order to facilitate a clearer understanding as to how the Commission's proposals correspond to the framework established under Article 4 of Directive 94/12/EC, a short description of these proposals is given below:

6.1 Vehicle-related measures

6.1(a) Passenger Cars

The emission standards for passenger cars will be tightened by means of a proposed modification to Directive 70/220/EEC (this proposal is attached to the present Communication). A summary of the new **emission standards** to come into force in 2000 and an indication of the percentage improvement as compared to current standards is given in Table 2 (designated as proposal A in the Table) Also shown in Table 2 are the indicative values which the Commission proposes should come into force in 2005 (designated as proposal B in the Table). These very stringent standards are referred to as the "second step" standards and will be subject to review and confirmation by the Council and Parliament in 1998. The rationale behind the establishment of a second step is provided in section 7 (Table 2 also shows for comparison the LEV and ULEV standards from the U.S.A.)

The Commission's proposal also contain provisions to ensure that the emission control systems in the car work effectively throughout the life of the vehicle. In particular there is now a requirement for passenger cars to be equipped with technology to monitor the emission performance and to indicate malfunctions to the driver: this technology is known as **on board diagnostics (OBD).** In addition, the Directive on passenger cars will also introduce arrangements for the in-use testing and eventual **re-call** of vehicle models after they have been placed on the market. Together with the strengthening of the periodic technical inspections (see below), OBD and re-call provisions should ensure that the emission performance should not deteriorate significantly during the life of the vehicle.

As a means to reduce the amount of volatile organic compounds (essentially petrol fumes) which are lost to the atmosphere due to evaporation, a more rigorous **test proeedure for evaporative losses** will be incorporated into the requirements for the type approval of gasoline passenger cars.

One of the conclusions from the Auto-oil study was that already existing measures will result in significant reductions in vehicle related emissions of carbon-monoxide (CO) such that CO air quality standards will be respected. It was therefore concluded that the introduction of **a cold start test procedure** as part of the type approval requirements was not in fact necessary. Finally, in relation to passenger cars, the Commission's proposals (see Table 2) also include **separate emission limits for NOx and hydrocarbons** as was requested in Article 4 of Directive 94/12/EC.

Table 2

Comparison of Passenger Car Limit Values

	Limit Values								
	Mass of Carbon Monoxide (CO)		Mass of Hydrocarbons (HC)		Mass of Oxides of Nitrogen (NOx)		Combined mass of hydrocarbons and oxides of nitrogen (HC+NOx)		Mass of particulates (PM)
	L_1 (g/km)		L_2 (g/km)		L_3 (g/km)		$L_2 + L_3$ (g/km)		L_4 (g/km)
	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Diesel
Proposal A (2000)	2.3	0.64	0.20	-	0.15	0.50	-	0.56	0.05
Proposal B* (2005)	1.00	0.50	0.10	-	0.08	0.25	-	0.30	0.025
Current U.S. Federal Standards	2.1	2.1	0.25	0.25	0.25	0.25	-	-	0.05
C.A.R.B. TLEV**	2.1	2.1	0.08	0.08	0.25	0.25	-	-	-
C.A.R.B. LEV***	2.1	2.1	0.05	0.05	0.12	0.12	-	-	-
C.A.R.B. ULEV ****	1.7	1.7	0.02	0.02	0.12	0.12	-	-	-

* Indicative limit values

C.A.R.B. (Californian Air Resources Board)standards will be progressively introduced in a number of U.S. States in addition to California over the next ten years. C.A.R.B. Standards are:

** Transient Low Emission Vehicle Standard

*** Low Emission Vehicle Standard

**** Ultra Low Emission Vehicle Standard

- These standards specify emissions for Non Metane Organic Gases (NMOG) rather than Hydrocarbons (NMOG being a major fraction of HC).
- The test cycle used in the USA differs to that used in the EU, and so limit values are not directly comparable.

6.1(b) Light commercial vehicles

By the end of 1996, the Commission will come forward with a proposal for a further modification to Directive 70/220/EEC this time in relation to light commercial vehicles. Indicative emission reductions for pollutant emissions to be incorporated into the type approval procedures for this category of vehicle as from the year 2000 are shown in Table 3: at present the exact values of the emission standards are still to be finalized and the values in Table 3 are therefore expressed as percentage reductions as compared to current standards.

In addition to the revised emission standards, the Commissions proposal for an amendment to Directive 70/220/EEC with regard to light commercial vehicles will also include many of the additional provisions which are foreseen for passenger cars e.g. OBD, re-call, an improved test procedure for evaporative emissions of volatile hydrocarbons and separate emission limits for NOx and hydrocarbons.

Table 3

Indicative Emission Reductions to Light Commercial Vehicle Emission Standards

	Percentage Reduction from Current Standard			
	CO	HC	NOx	PM
Gasoline LCVs	30%	40%	40%	-
Diesel LCVs	40%	65%	20%	35%

6.1(c) Heavy duty vehicles

By the beginning of 1997, the Commission will come forward with a proposal to amend Directive 88/77/EEC which concerns diesel engines used principally in heavy duty vehicles. The Commission's proposal will include stricter emission limits for regulated pollutants (see Table 4). As was the case with the light commercial vehicles, the precise values of the emission limits are not yet finalized and therefore the figures given in Table 4 are expressed as approximate percentage improvements as compared to current standards. In addition to the improved emission standards the Commission's proposal may also include the introduction of a new test cycle for measuring emissions as part of the type approval procedure (the effects of the new driving cycle will also need to be reflected in establishing the new emission limits). This new test cycle is intended to represent the real world driving pattern for these type of engines more effectively than the current procedure.

Table 4

Indicative Emission Reductions to Heavy Duty Engine Emission Standards

	Percentage Reduction from Current Standard	
	NOx	PM
Diesel HDVs & Buses	- 30%	- 30%

6.1(d) Alternative propulsion systems

Although Article 4 of Directive 94/12/EC did require that the potential of alternative propulsion systems should be evaluated by the Commission this issue was not addressed as part of the Auto/Oil Programme. However, the Commission is convinced that such systems, may achieve a significant role in the 21st century, recognizing that even more stringent emissions targets may have to be introduced as the effects of automotive emissions on health and global warming become better understood, and to meet the growing threat of global competition in the field of clean propulsion technologies. To this end the Commission has established a Task Force 'The Car of Tomorrow' (see section 8 below) which has as its objective the coordination of research on future technologies with a particular focus on advanced propulsion systems and more rigorous, broad-based comparative assessment of their performance relative to conventional propoulsion.

6.2 Improved fuel quality

The Auto/Oil Programme confirmed that improved fuel quality can have a significant impact upon pollutant emissions from vehicles. The Auto/Oil Programme also identified improved fuel quality standards as being a component part of a cost effective package of Community wide technical measures which would also contribute to the achievement of stringent air quality objectives.

At the present time there exist relatively few Community provisions dealing with the quality of fuel used in road transport (lead and benzene in petrol (Directive 85/210/EEC); oxygenate levels in petrol (Directive 85/536/EEC) and sulphur levels in diesel (Directive 93/12/EEC)). These provisions will now be replaced by a comprehensive set of specifications to come into force in 2000 for both petrol and diesel and set out in the new fuel quality Directive. The impact upon the fuel quality on the European market in the year 2000 which will result from the Commission's proposal for a fuel quality Directive are shown in Tables 5 and 6.

Table 5

Predicted Market Average Fuel Quality in 2000 and Effect of Proposal - Petrol

Parameter	Unit	Market Average Without proposal	Market Average with Proposal
RVP Summer	kPa	68	58
E.100	% v/v	53	53
E.150	% v/v	84	84
Olefins	% v/v	11	11
Aromatics	% v/v	40	37
Benzene	% v/v	2.3	1.6
Oxygen	% m/m	0.6	1
Sulphur	ppm	300	150
Lead	g/l	0.005	0.005

Table 6

Predicted Market Average Fuel Quality in 2000 and Effect of Proposal - Diesel

Parameter	Unit	Market Average without proposal	Market Average with Proposal
Cetane Number	-	51	53
Density	kPa	843	835
Poly-aromatics	% Vol	9	6
T95	°C	355	350
Sulphur	ppm	450	300

Article 4 of Directive 94/12/EC made specific reference to the need to address the problem of the **benzene content of petrol**. In the proposal for a framework Directive on fuel quality, the Commission's position is that the maximum content of benzene should be reduced from 5% as is currently the case under Directive 85/210/EEC, to 2%.

Article 4 of Directive 94/12/EC also required that the Commission should take into account the potential of alternative fuels in developing its future legislative proposals. Alternative fuels such as compressed natural gas (CNG) and liquid petroleum gas (LPG) were considered in the Auto/Oil Programme as potential alternatives to diesel fuel to be used for buses and other 'captive fleets' - waste disposal lorries, taxis etc - in cities (see below under local measures). The Commission's proposed fuel quality framework directive also includes a commitment to explore further the potential of CNG, LPG, biofuels and other alternative fuels and if appropriate to put forward amendments to the Directive.

6.3 Inspection and maintenance

Periodic - annual or bi-annual - inspection and maintenance checks are effective in ensuring that the emission performance of a vehicle does not deteriorate significantly during its life. The Auto/Oil Programme identified all measures targeted at the improved durability of emission control systems - OBD, recall (see section 6.1a above) and improved inspection and maintenance - as being highly cost effective in reducing pollutant emissions indeed such measures were estimated as having the potential to contribute over a third of the emission reduction targets for some pollutants. The Community already has basic requirements for inspection and maintenance as laid down in Directive 92/55/EEC. In the light of the conclusions from the Auto/Oil Programme and the results of an extensive study due to be finalized in 1996, the Commission will, during the course of 1997, come forward with proposals to strengthen the requirements laid down in Directive 92/55/EEC. These proposals to be implemented in 2000, will include improvements to the tests for roadworthiness in order to make these tests more representative of real world conditions and to ensure that the gross polluters in the vehicle fleet(it has been estimated that over 50% of vehicle emissions are produced by 10% of the fleet) are consistently identified. The Commission will also take steps to encorage Member States to implement road-side inspections as a further step towards ensuring that motor vehicles maintain their emission performance throughout their life. Finally, and as explained in section 3, the individual vehicle owner has an important role to play in reducing polluting emissions from road vehicles and the responsibility to keep a vehicle well maintained is a fundamental obligation for all road users.

7. THE TWO-STEP APPROACH

At the time of adoption of Directive 94/12/EC it was recognized that when the Commission came forward with its proposals for measures to apply after the year 2000, it might also be necessary to put forward target values involving a further substantial reduction in emissions (14th "whereas" clause).

In the Commission's proposals relating to the emission standards for passenger cars there are two sets of emission limits. The first set of emission limits will be obligatory and apply as from the year 2000: it is based on the results of the Auto/Oil Programme. The second set of emission limits which is considerably more ambitious than the first, will come into force in 2005. However, these limits will be reviewed by the end of 1998 with regard to their industrial feasibility, taking account of air quality requirements and the availability of improved fuels. The second set of emission limits (the second step) is an essential part of the Commission's policy on reducing vehicle emissions.

The Member States will be able to offer fiscal incentives in order to encourage the marketing of vehicles respecting both the first and second set of emission standards (see below for a more detailed discussion on fiscal incentives). This means that manufacturers will have an incentive to continue to invest in the development of pollution abatement technologies. The second step is therefore designed to encourage the early introduction into the market of cleaner vehicle technologies developed by vehicle manufacturers.

To illustrate the benefit of the second step it is informative to look at the example of the diesel passenger car. Diesel engines are relatively high emitters of particulate matter and oxides of nitrogen (NOx). At present, considerable resources are being invested in the development of new technologies (particulate traps and de-NOx catalysts) which have the potential to significantly reduce the emissions of these pollutants without negative effects on other emissions. However, it is generally accepted that these technologies will not be in large scale commercial production by 2000 and the Commission's proposal for the emission limits for diesel cars for the year 2000 reflects these expectations. In the absence of a second step, manufacturers would have no incentive to push ahead with the development and introduction into the market place of the new pollution abatement technologies.

The Commission also believes that the existence of the second step will provide the Industry with a degree of security concerning the regulatory environment within which it will have to operate over the next 10-15 years. Finally, by establishing challenging standards in the Community with a market of over 350 million people the Commission believes that this will provide the platform for a strong export potential for Community products. In particular the export markets in Asia and North America, will offer opportunities for low emission, fuel efficient vehicles. It is therefore in the Community's economic interest to be at the forefront of technical development: the promulgation of ambitious, technology-challenging standards is an effective instrument to ensure that European Industry remains competitive in the international market place.

With regard to fuels, the Commission intends to come forward with proposals to revise the specifications for petrol and diesel fuels and that these improved specifications should come into effect in 2005 at the same time as the "second step" emission standards for vehicles referred to above.

The Commission's proposal will take into account that improvements to fuel quality have a direct and significant impact on emissions of particulate matter, volatile organic compounds and oxides of nitrogen. All of these pollutants either directly, or as a result of their contribution to ozone formation, result in important impacts on human health and the environment.

In addition, to the direct benefits that improved fuel quality has on vehicle emissions, there is a clear interaction between fuel quality and vehicle technology. With regard to the development of new pollution abatement technologies, such as the de-NOx catalyst, there is evidence that fuels of a certain quality, particularly low sulphur fuels, may well be required if such technologies are to achieve optimal and long-lasting levels of performance.

Accordingly, the Commission foresees that its future proposal to revise the specifications of petrol and diesel fuels should comprise a significant reduction in the content of sulphur for both fuels. Current research and development indicates that a sulphur limit in the order of 50 ppm could be needed for the optimal functioning of the new, vehicle-based pollution abatement technologies as well as contributing to improving emissions from the existing car parc.

While for the reasons outlined above, the Commission is persuaded of the need to revise the fuel specifications for petrol and diesel fuels, it nevertheless considers that it would be premature, given the current state of knowledge, to lay down today the fuel specifications which should apply in the Community in the year 2005. The Commission, therefore, intends to bring forward by the end of 1998, a proposal for a revision of the present fuel quality Directive which will include inter alia a revision of specifications for petrol and diesel which are laid down in the Directive. These revised specifications will come into effect in 2005. The Commission's proposals will be based on a comprehensive cost-effectiveness assessment and review (see below). The determination of the precise value of a revised sulphur specification for petrol and diesel fuels will of course be subject to the outcome of this assessment.

To take account of the possibility that vehicles equipped with new pollution abatement technologies such as the de-NOx catalyst are developed and introduced into the market before 2005, the Commission has also included in its proposal a commitment to bring forward, if appropriate, proposals to ensure that when vehicles equipped with such technologies are placed on the market, fuels of a quality sufficient to guarantee the necessary level of performance of the technology will be widely available. In bringing forward such proposals the Commission will give due regard to considerations of air quality, cost-effectiveness and proportionality. The Commission will also take into account:

(i) the latest information on the interaction between fuel quality and the performance of the new pollution abatement technologies;

(ii) the situation with regard to the development and production of these technologies and the forecasts concerning the marketing of vehicles equipped with such technologies;

(iii) the need to ensure that the measures proposed will neither disrupt the free movement of persons and goods nor unduly distort competition.

The review process

The strategy for the control of vehicle emissions which is described in the present Communication, is based on the methodology of the Auto/Oil Programme. The strategy is designed to produce effects to meet the requirements of Community air quality standards and related objectives at least cost. However, in a domain where knowledge is evolving so rapidly, the strategy cannot be static: it must evolve in response to developing knowledge. For this reason, the Commission has also announced its intention to carry out a comprehensive assessment and review of the strategy taking into account the following considerations:

- trends in air quality;

- noxious pollutant emissions in Europe from transport and non-transport sources and the contribution that existing, pending and potential measures to control emissions from all sources, could make to improve air quality;

- technical developments with regard to:

  * vehicle technologies as well as new propulsion technologies (e.g. electric propulsion, fuel cells);

  * refinery technology;

- the potential of alternative fuels such as compressed natural gas (CNG), Liquid Petroleum Gas (LPG), and Dimethyl Ether (DME) and biofuels to reduce vehicle emissions;

- possible improvements in the test procedures for the type approval of vehicles, in particular the addition of a new test procedure at at low temperatures;

- the potential of technical, non-technical and local measures to reduce emissions: in this context, the contribution of transport and other policy measures such as traffic management, enhanced urban transport and vehicle scrappage schemes should be evaluated;

- the contribution that selective and differentiated fiscal measures could make to reducing emissions , whilst not negatively impacting on the functioning of the internal market;

- the effects of any measures on CO_2 emissions;

- the strategies followed by third countries to improve air quality and the emission values applied therein;

- the situation with regard to the supply and quality of crude oil available to the Community.

On the basis of the comprehensive assessment described above the Commission will, not later than 12 months following the adoption of the two proposals accompanying this Communication and in any event not later than 31 December 1998, bring forward:

- a proposal for a further tightening of the emission standards for passenger cars. This proposal shall establish , inter alia whether the " second step" emission standards for vehicles (see above) and which in the present proposal for the amendment to Directive 70/220/EEC are given as indicative values, should be confirmed as the regulatory limit values to be applied from 1 January 2005;

- a proposal for a revision of the Directive on the quality of petrol and diesel fuels. This proposal should include further improvements to the specifications for petrol and diesel fuels (in particular, a significant reduction in the sulphur content of both petrol and diesel fuels) and will also come into effect on 1 January 2005.

Auto/Oil II Programme

In order to carry out the comprehensive assessment upon which it will base its future proposals to be made at the latest by the end of 1998, the Commission considers that it will be necessary to build upon, improve, and extend the concept of the Auto/Oil Programme. With this in mind the Commission will take contact with Industries, Member States and NGOs with a view to setting up the Auto/Oil II Programme.

8. RESEARCH AND DEVELOPMENT, THE CAR OF TOMORROW

In 1995 the Commission created a task force dedicated to the theme of the Car of Tomorrow, drawn up after extensive consultation with various stakeholders, including representation from the automotive and oil industries, public authorities, transport operators, and utilities. The

aims of this task force include a better focusing of R&D initiatives aimed at the next generation of road vehicles and in particular vehicles which are clean, safe, energy efficient and intelligent. These R&D initiatives will also aim at giving further insights into the development of air quality standards and improving the assessment of risks to health and the environment from vehicle emissions. Arising out of the work of the Task Force the Commission services have developed an Action Plan for the Car of Tomorrow.

The Commission considers that the work of the task force and the recent action plan are directed at initiatives which will take the emission performance of road vehicles up to and far beyond the second step identified in the vehicle emission proposals and will lead ultimately to the development of near zero and zero emission vehicles. The task force will aim to achieve these goals through stimulation of RTD and demonstration of promosing clean propulsion technologies, utilising cleaner fuels. These efforts will be integrated with telematics systems and new technologies for reducing vehicle weight and drag. The RTD will be underpinned by a broad based comparative assessment process based on a life cycle approach, to identify more cost effective routes to reducing harmful vehicle emissions and energy consumption.

9. ECONOMIC INSTRUMENTS

9.1 Fiscal instruments

All taxes influence behaviour. This is independent of whether that is their intended purpose, or whether they are simply a means for raising revenues. A purchase tax, for instance, makes new cars more expensive, and will therefore lead consumers to buy fewer or different cars than otherwise, or may induce them to hold on to their old vehicle for longer. A fuel tax affects a different aspect of transportation. As it increases the fuel costs for each mile driven, people may drive less or use more fuel efficient cars.

One can therefore take advantage of this behavioural effect to design the tax system so that is has the effect of reducing vehicle emissions. To various degrees, Member States already apply a variety of taxes and fees as a means of changing transport behaviour in a desired direction. For instance, gasoline taxes are used to decrease fuel consumption. By analogy, fiscal instruments can encourage emission reductions by steering transport behaviour into a desired direction.

Transport emissions will decrease when people buy cars with clean technology, keep them well-maintained, scrap old and dirty cars, burn cleaner fuels, drive less, participate in car pools, etc. Regulations concerning vehicle emissions and fuel specifications which are designed to harmonize Member States' legislation at a high level of environmental protection can address only a limited number of these behavioural factors. A policy limited to these technological aspects has little impact on behaviour. Therefore, important leverage points to achieve emission reduction would be left out. Economic instruments, by contrast, can have an influence on these behavioural aspects by making undesired behaviour more expensive than desired behaviour. This could be done either by increasing taxes on polluting activities, or by using tax incentives, i.e. by providing tax rebates to activities that decrease emissions.

There are a variety of economic instruments that can be used to do this. For example, vehicle purchase or registration taxes can be differentiated in such a way that dirtier cars are taxed higher than cleaner ones. Similarly, one could differentiate annual circulation taxes according to emission characteristics. The impact of this instrument would not only be limited to new vehicles but it would also affect vehicles already in circulation, which contribute to a significant share of the transport emissions. Potentially, therefore, a structured circulation tax could be a cost-effective measure to complement emission standards, as it could reduce emissions from this part of the vehicle fleet. Scrappage subsidies could also help getting old and dirty vehicles off the road.

Tax differentiation for leaded and un-leaded gasoline, and for high and low sulphur fuels in some countries has shown the effectiveness of fiscal instruments in the fuel market. Driving behaviour can be influenced by increasing kilometre-dependent charges, for instance, through road taxes. For most of these measures the administrative structure is already in place. What is necessary is only to alter the rate structure to obtain the desired behavioural effect.

A number of initiatives in the indirect taxes area are under way or scheduled for the near future where environmental concerns, such as emission levels, may be relevant. These initiatives cover both fuel taxes and vehicle taxes.

All motor fuels are subject to excise duty. Within the excise system, a number of Member States have sought and been granted derogations from the normal rules, under a procedure which requires the approval of the Commission and all Member States (Aticle 8(4) of Directive 92/81/EEC). In some instances, the derogations are related to fuel quality. For example, Denmark, Finland, Greece & Sweden have been granted derogations allowing them to apply reduced rates on environmentally friendly diesel. Finland can apply reduced excise duty rates on reformulated unleaded and leaded petrol. Denmark can apply differential rates of duty between petrol distributed from petrol stations equipped with a return system for petrol fumes and petrol distributed from other petrol stations. A number of applications from other Member States are being processed at present.

Some of the derogations granted under Article 8(4) of Directive 92/81/EEC expire at the end of this year, and all fall to be reviewed in the course of 1996. This review is necessary to ensure continuity and to deal with the evolving situation whereby various Member States wish to introduce rate differentiation, often on environmental grounds. The review will thus provide an opportunity for this aspect to be considered more fully in the short term.

Minimum rates of excise duty are laid down at Community level, with a requirement that they be reviewed every two years in the light of the functioning of the internal market, the real value of the duty rates and the wider aspects of the Treaty. The first review did not make any proposals for change, pending a wide ranging consultation process which was to take account, *inter alia*, of the wider Treaty aspects. That process is now nearing completion, and the second review is due to be carried out later this year.

The Commission's proposal for a framework Directive on fuel will result in a significant improvement in the average quality of fuels sold in the Community. However, it is probable that some Member States, particularly those which have used fiscal measures in the past (see above), may wish to encourage the use of even cleaner fuels as part of their overall strategy to improve air quality. The Commission notes that Directive 92/81/EEC provides a framework within which Member States may apply fiscal incentives.

Discussions on a Commission proposal for a carbon/energy tax failed to reach agreement in the Council. In the absence of agreement, the ECOFIN Council of 11 March 1996 invited the Commission to bring forward new proposals for the taxation of energy products. A large number of Member States have expressed the wish that any such proposals should build on the existing excise structure.Given the obvious link between the requirement to review minimum rates of excise duty and the intention to bring forward new proposals for taxing energy products, it is likely that these two activities will be combined, and it is expected that new proposals will be brought forward by the end of 1996. It is clear that environmental aspects should be an important influence on these proposals.

On the question of vehicle taxation, it is important to note that the tax treatment of vehicles varies enormously from one Member State to another, not just in terms of tax burden but also in terms of mix of tax type.

Furthermore, the factors which influence fiscal policy for vehicles also vary significantly between Member States, often drawing on traditional, social and cultural elements in addition to the more obvious economic and industrial concerns.

The Commission has recently commenced a detailed study of vehicle taxation in the Member States. This study will analyse the various approaches followed in the Member States. It will also examine vehicle taxation from a Community perspective, with a view to ascertaining what Community measures are necessary, or appropriate, in the interests of improving the functioning of the internal market and advancing other policy objectives, including environmental concerns.

9.2 Fiscal incentives used in relation to vehicle emission limits

Article 4 of Directive 94/12/EC does not include any specific reference to fiscal/tax incentives (e.g. tax reductions) among the measures which should be taken into account by the Commission in the preparation of future legislative proposals. It is however stated in Article 4.2 that the Council will decide upon the conditions for granting tax incentives with regard to the future emission standards on the basis of the emission limits proposed by the Commission.

Since the adoption of Directive 89/548/EEC, Community decisions relating to the environmental aspects of motor vehicle emissions have contained a framework for the granting of fiscal incentives to encourage the early application of the new limit values. In these directives a balance has been struck between , on the one hand, the need to encourage the introduction of new technologies as quickly as possible, and, on the other hand, the need to avoid fragmenting the Single Market with diverse fiscal incentive programmes incentivizing different limit values with the consequence that, de facto , there would be simultaneously a multitude of regulatory limit values existing on the market.

The principle adopted in the framework set out in Article 3 of Directive 94/12/EC have been to permit fiscal incentives only for vehicles complying with the Directive and provided that they comply with the provisions of the Treaty and that they are:

- non-discriminatory;
- limited in time and that they terminate when the limit values become mandatory;
- of an amount lower than the additional cost of the technical solutions introduced to ensure compliance with the new limit values and the cost of their installation on the vehicle.

In developing its proposals for vehicle emission standards arising out of the Auto/Oil Programme the Commission has declared its intention to explore a more flexible approach to the use of fiscal incentives.Accordingly, the Commission's proposals relating to vehicle emission standards and arising from the Auto/Oil Programme will include two sets of emission standards (see section 6.1). Member States will be able to use fiscal incentives to encourage the introduction of vehicles conforming to both sets of emission limits. As compared to the present situation, the use of fiscal incentives in the context of a two-step approach has considerable advantages as the emission limits in the second step will be sufficiently ambitious as to ensure that fiscal incentives applied in relation to this step will constitute a genuine encouragement to innovation.

It is possible, despite the two-step approach and the greater freedom allowed in relation to the use of fiscal incentives, that some Member States may object to the principle of Community legislation based on Article 100a, imposing restrictions on their freedom with regard to the use of fiscal/tax incentives. However, the Commission continues to believe that a Community framework for the application of emission related fiscal incentivesis necessary to ensure the integrity of the internal market which could be jeopardized by the proliferation of incentive schemes in the different Member States. Thus, while the Commission is in favour of introducing greater freedom into Community policy on vehicle emissions it would be totally opposed to initiatives which could seriously undermine the principle of the single market and the advantages associated with it.

10. The emission reduction benefits and the costs associated with the Commission's package of measures on vehicle emissions

The package of legislative actions due to come into force in 2000 and described in section 6 will result in considerable reductions in the emissions from road transport over and above those which would be expected from already agreed measures (see Table 7 below).

Table 7

Effect on Road Transport Emissions of Auto Oil Package of Measures

Pollutant	Emissions in 1990		Emissions in 1995		Emissions in 2010 without Auto Oil		Emission in 2010 with Auto Oil Package	
	1000 Tonnes/yr	Percent of 1990 Level	1000 Tonnes/ yr	Percent of 1990 Level	1000 Tonnes/ yr	Percent of 1990 Level	1000 Tonnes/ yr	Percent of 1990 Level
Urban NOx	1 936.68	100	1 940.58	100	1 207.77	62	748.817	38.7
Urban Particulates	124.663	100	137.029	110	69.383	56	42.324	34
Urban CO	25 189.17	100	20 224.04	80	1 1961.25	47	5 980.625	23.7
Urban Benzene	15.91	100	13.88	87	7.78	49	4.0456	25.4
Total VOCs	4 105.72	100	3 688.83	90	1 811.33	44	996.232	24
Total NOx	5 864.84	100	5 581.33	95	3 053.25	52	1 984.613	33.8

While these Community measures may in some localities need to be complemented by targetted local initiatives (see section 3) the Commission is confident that by 2010 and assuming parallel actions to reduce emissions from other sources, that the air quality targets referred to in Table 1 will be respected throughout the Community. While the benefits in terms of human health (mortality, morbidity and quality of life) and the environment (crop production and ecosystem damage) are difficult to quantify, it is clear from the available evidence that these benefits will be considerable.

In addition to the significant emission reduction benfits associated with the measures due to come into force in 2000 further reductions will clearly be associated with the implementation of the second step for vehicle emissions and the future proposal on fuel quality (see section 7).

The Costs[5] of the Commission's package of legislative measures

Costs to industry

Measures to become effective from 2000

Passenger car producers	ECU 3 094 million per annum
Van /light commercial vehicle producers	ECU 373 million per annum
Heavy duty vehicle producers	ECU 675 million per annum
Refining Industry	ECU 765 million per annum
National governments associated with improved inspection and maintenance	ECU 555 million per annum
TOTAL	ECU 5 461 million per annum.

Measures proposed for vehicles for 2005 'the Second Step'

Passenger car/light commercial vehicle producers	ECU 2 500 million per annum
Heavy duty vehicle producers	ECU 500 million per annum

Cost to the consumer

Measures which become effective from 2000

Fuel

Additional cost per litre/1 000 litres

Petrol:	ECU 0.002 per litre:	ECU 2 per 1 000 litres
Diesel:	ECU 0.0018 per litre:	ECU 1.8 per 1 000 litres

Additional cost on the fuel bill of the average motorist

Petrol Car:	ECU 2.3 (assuming 12 600 km per year and 8.61 l/100 km)
Diesel Car:	ECU 1.7 (assuming 12 600 km per year and 7.61 l/100 km)

Increased new vehicle costs

Petrol passenger car		Diesel passenger car	
Small	ECU 200 per new car		
Medium	ECU 225 per new car	Medium	ECU 380 per new car
Large	ECU 290 per new car	Large	ECU 520 per new car

Light commercial vehicles:	ECU 145-290 per vehicle
Heavy duty vehicles:	ECU 530-1 620 per vehicle

Increased maintenance costs

ECU 7.5 - 10 per annum for passenger cars.

Measures proposed for vehicles for 2005 'the Second Step'

Between ECU 150 and 200 per new car as an average

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(5) All costs are in 1995 ECU

ANNEX

REPORT ON THE AUTO/OIL PROGRAMME

1. THE EUROPEAN AUTO/OIL PROGRAMME

1. 1 Phase I - Establishing the framework

In keeping with its commitment to develop a more comprehensive approach to reducing emissions from road transport, the Commission decided at the end of 1992 to initiate a work programme to provide a solid technical foundation upon which to base its future legislative proposals. In accordance with the principle of 'shared responsibility' expressed in the 5th Environmental Action Programme, the Commissioners for Environment, Industry and Energy, invited the European associations of the car (ACEA) and oil (EUROPIA) industries to make available their considerable know-how and expertise and to collaborate in the realization of this work programme. The two industries responded positively to this invitation and together with the Commission designed, planned and executed the programme which subsequently became known as the Auto/Oil Programme.

The objective of the Auto/Oil Programme were defined as:

to provide policy-makers with an objective assessment of the most cost-effective package of measures including vehicle technology, fuel quality, improved durability and non-technical measures, necessary to reduce emissions from the road transport sector to a level consistent with the attainment of the new air quality standards being developed for adoption across the European Union.

1. 2 Work programme

The work programme was divided into a number of inter-related components as follows:

(i) the prediction of future air quality in the Community and in the case where future air quality was predicted to fall below an acceptable standard, the **identification of appropriate emission reduction targets for road transport**;

(ii) the collation and, where necessary, the generation of **data concerning the potential of the various measures** inter alia engine technology, fuel quality, increased durability requirements and complementary measures, to reduce emissions from road transport;

(iii) the collation and, where necessary, the generation of **data concerning the cost of introducing the measures** identified under ii (above);

(iv) on the basis of the data generated in steps ii and iii above to **identify the most cost effective package of measures necessary** to achieve the emission reduction targets identified under step i).

1. 3 Organizational framework

(a) Cooperation Commission/industry

A management group and a number of technical working groups were established comprised of representatives of the Commission and ACEA and EUROPIA. The management group met on a regular basis and was responsible for the oversight and planning of the work programme with regard to content and time. The technical working groups were established for issues requiring further investigation.

At the level of the Commission services a number of Directorates General (principally DGs II, III, XI and XVII with support from DGs VII and XII) were involved in the implementation of the Auto/Oil Programme.

In addition to the involvement in the programme of staff from the Commission and the two industries, external consultants/consultancy companies were commissioned to carry out certain parts of the programme. Their work was specifically related to fuel quality, emissions/air quality and cost-effectiveness issues.

(b) Information Provision to interested parties not directly involved in the Auto/Oil Programme

(i) European Parliament

In 1995 a number of technical briefings with members of various committees of the Parliament were held in order to keep Members of the European Parliament and their staff informed as to the progress of the Auto/Oil Programme.

(ii) Member States

A national expert group on "environmental fuel specifications" (EFEG) was established early in 1993 to follow and to discuss on a regular basis the progress being made with the Auto/Oil Programme. The Commission invited Member States to provide technical advice and support in areas of specific interest to them.

In addition the Motor Vehicle Emissions Group (MVEG) was consulted and informed on various aspects related to vehicle technology and improved durability requirements.

In the course of 1995 the Commission held four combined EFEG/MVEG meetings in order to give full account of the progress and results of the programme.

EFEG/MVEG meetings also provided a forum for a number of industries and non-government environmental organizations. In this way access to information on the programme was also guaranteed to a range of interest groups likely to be effected by future legislation .

2. AIR QUALITY MODELLING

2.1 Introduction

The following atmospheric pollutants were investigated as part of the Auto/Oil Programme:

Carbon Monoxide (CO) - in cities
Particulate matter (PM) - in cities
Benzene - in cities
Nitrogen dioxide (NO2) - in cities
Tropospheric Ozone (O3) - principally at the regional level

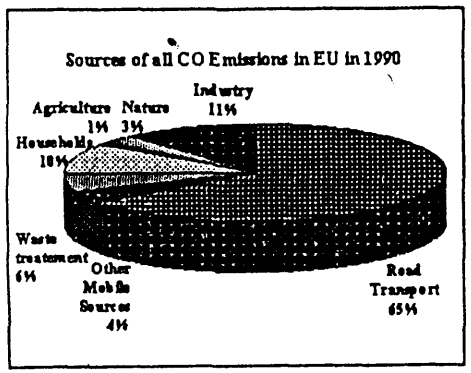
A short description of each of these pollutants, their effects on human health and the environment as well as the contribution of road transport to total emissions is to be found in Box 1.

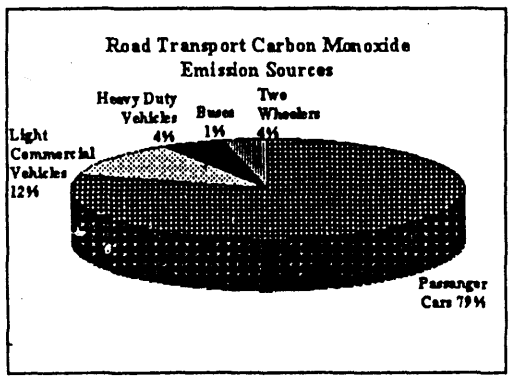
BOX 1

Pollutants Investigated in the Auto Oil Programme their Effects and Sources

Carbon Monoxide (CO)

Colourless, odourless, and tasteless gas. It replaces Oxygen in the blood and thus causes asphyxiation in high concentrations. It is transformed to Carbon Dioxide - a "green house" gas - in the Atmosphere.



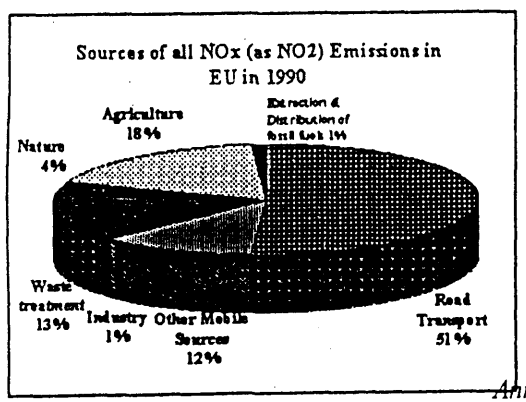


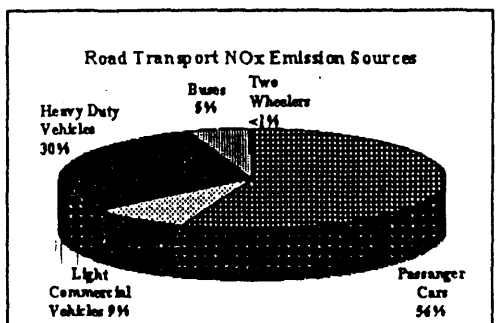
Nitrogen Monoxide / Nitric Oxide (NO)

(Transforms mainly to NO_2)

Nitrogen Dioxide (NO_2-NO_2& NO together are known as NOx)

A reddish-brown gas, it causes a variety of respiratory conditions, especially in vulnerable groups (e.g. children & asthmatics). Contributor to the problem of Acid deposition, and decreases plant growth





Particulate Matter (PM) / Black Smoke (BS)

Any fine particle, the effect of which is dependent on the type of particulate, although there is some evidence that the smaller fractions are, in general, carcinogenic. However, black smoke may not contain the smallest size fractions now associated with carcinogenic effects. Furthermore, many components, e.g. heavy metals, are toxic.

Ozone (O_3)

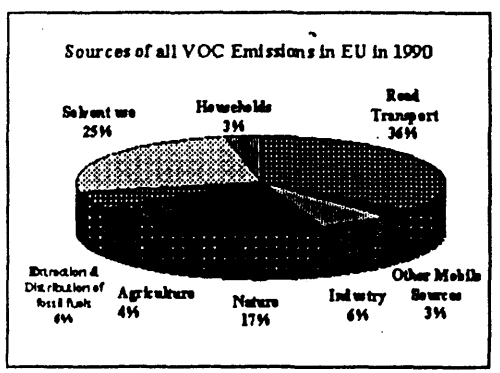
A secondary pollutant formed by the reactions of mainly NOx and VOCs in the presence of sunlight. A strong oxidising agent it induces eye, nose, and throat irritation, chest discomfort, coughs and headaches. It also damages materials and inhibits plant growth.

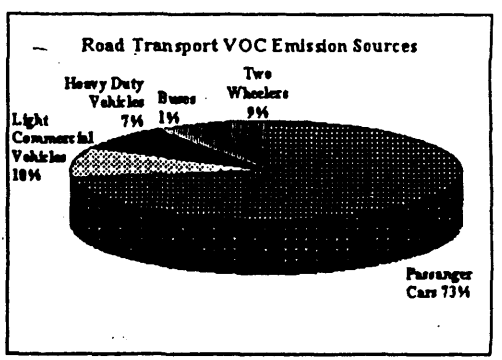
Hydrocarbons (HC)

The complete range of organic compounds - usually gasses - this term includes both VOCs and Benzene.

Volatile Organic Compounds (VOCs)

Any organic compound sufficiently volatile to cause significant emissions into the air via evaporation. The complex interaction of many of the VOCs cause the formation of "secondary" pollutants such as Ozone (see below). VOCs also contribute to the problem of acidity and ethylene is a serious plant growth inhibitor. Contains some Carcinogenic compounds -See Benzene Below.





Benzene (C_6H_6)

Colourless liquid or gas - smells of almonds

Benzene is known to be both toxic and a carcinogen.

2.2 Air quality in cities

Population density, industrial activity and traffic intensity in urban environments can frequently give rise to acute problems of air pollution. In order to investigate the problem of atmospheric pollution in cities, seven European cities - Athens, the Hague, Cologne, London, Lyon, Madrid and Milan - were chosen for detailed study. These cities were considered as being representative in terms *inter alia* of their air quality, geographic location and the characteristics of their vehicle fleets[1]. On the basis of information on the emissions of pollutants from various sources and the relationships between emissions and air quality, computer models were used to predict the air quality in the seven cities in the year 2010[2]. Unfortunately, in the case of particulate matter, the quality of the data was not good enough to permit the prediction of air quality in 2010 in each of the cities. For this reason pollution by particulate matter was dealt with separately (see section 3.3 below)

In order to decide whether the predicted air quality in respect of the three pollutants carbon monoxide, benzene and oxides of nitrogen were satisfactory, air quality standards were defined for each pollutant. In the case of NO_2 and CO air quality standards already exist, laid down either in Community legislation (NO_2: Directive 85/23/EEC) or in WHO guidelines. However, in recognition of the fact that the WHO guidelines for both NO_2 and CO were in the process of being reviewed and that initial recommendations for revised values from scientific expert groups were already available, it was decided to use two air quality standards for the purposes of the Auto/Oil Programme:

- **a less severe** standard based on current air quality standards;

- **a more severe** standard based on the initial recommendations of the expert groups currently reviewing the WHO guidelines.

In the case of benzene there are no existing Community standards and the WHO does not set limit values for substances such as benzene which are regarded as carcinogenic. In the light of existing scientific evidence and recommended limit values which exist in the Member States, the Auto Oil partners agreed upon a less severe and a more severe standard as they had done for CO and NO_2. However, in recognition of the fact that certain Member States have also expressed aspirations to achieve extremely low 'target values ' in terms of benzene concentrations the Commission also insisted upon the inclusion of a third **very severe** standard in relation to this pollutant.

A summary of the air quality standards used for CO, NO_2 and benzene is given in Table 1. A summary of the emission reduction requirements determined to be necessary in each of the seven cities in order to achieve these air quality standards is given in Table 2.

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(1) To enable the Auto/Oil Programme to base air quality predictions on the most reliable data on the future development of the EU vehicle fleet, the Commission made available the FOREMOVE model. The commission funded this model which contains details of vehicle fleets in each Member State (vehicle categories, age, and distance travelled) and generates information concerning the total and percentage emission of major pollutants by each category of vehicle. FOREMOVE also contains assumptions concerning the development of the vehicle fleet in each country over the next 25 years and the predicted effect of current and agreed new legislation on vehicle emissions.

(2) The year 2010 was chosen as reference year because the programme was designed to identify measures which would take effect from 2000. Measures introduced in 2000, such as emission standards for new vehicles, will only have a gradual effect on air quality as the existing vehicle fleet is replaced. By 2010, it will be possible to judge their impact.

2.3 Particulate material

As indicated in Section 2.2 it was not possible to model pollution by particulate material in the same way as the other urban pollutants. There is a lack of basic information concerning the relationship between emissions and air quality and a lack of consistency in the way that particulate matter is measured. However, results are just beginning to emerge which allow some provisional conclusions concerning the likely effects of particulate pollution on human health, tentative air quality standards and the need for emission reductions.

There is increasing evidence that particulate material may contribute significantly to patterns of morbidity and mortality on western Europe. There is also an emerging consensus that the particulate material which causes health effects is to be found in the smaller size fractions: these smaller size fractions are now measured using a parameter called PM_{10} which means those particles with a size of 10 microns or less. With regard to the establishment of an air quality standard sufficient to protect human health, there is as yet no international consensus. However, the UK Government's Expert Panel on Air Quality Standards has recently recommended a value of $50\mu g/m^3$ measured as a 24 hour running average and in the absence of alternative standards this figure will be used for the purposes of the present report.

Table 1
Air Quality Target Values Used in Air Quality Modelling

Pollutant	Standard*
NO2	Less severe standard = 200μg/m^3 as 98 percentile** of hourly values More severe standard*** = 93μ g/m^3 as a 98 percentile of hourly values
CO	Less severe standard = 10mg/m^3 as a 98 percentile of 8 hourly values. More severe standard **** = 5 mg/m^3 as a 98 percentile of 8 hourly values
Benzene	Less severe standard = 16 μg/m^3 as an annual mean More severe standard = 10 μg/m^3 as an annual mean Very severe standard ***** = 2.5μg/m^3 as an annual mean

*To Equate values for the different averaging periods used to determine these standards it was necessary to undertake a statistical analysis of European air quality data using the Commission's Air Pollution Information Service (APIS) database enhanced with additional data from Member States obtained by CONCAWE.

** a 98th percentile value means that only 2% of all values recorded during the year would be above this value. Therefore in the case where measurements are taken on an hourly basis, in any one year there will be a total of 365 x 24 (=8760) separate values. The 98th percentile figure would correspond to the value below which lie 8585 of the hourly readings. Expressed in another manner the 98th percentile value is the value which may be exceeded on 175 hours each year, i.e. a total of 7 days.

***98th percentile value corresponding to a maximum value of 200 μg/m^3 (recommended new standard emerging from WHO working groups). The relationship between maximum values and 98 percentiles was obtained from european air quality records.

****98th percentile value corresponding to a maximum value of 10 mg/m^3 (recommended new standard emerging from WHO working groups). The relationship between maximum values and 98 percentiles was obtained from european air quality records

*****Benzene is of particular concern in a number of Member States who have reflected this by setting very low, long term target values. Recognizing the aspirational nature of these target values, it was agreed that the necessary reductions to achieve a value of 2.5μg/m^3 would be investigated.

Table 2

Air Quality Modelling - Summary of the Emission Reductions

CITY	NO_2*/ NOx		CO		Benzene		
	Percentage Emissions Reduction necessary to achieve air quality targets:		Percentage Emissions Reduction necessary to achieve air quality targets:		Percentage Emissions Reduction necessary to achieve air quality targets:		
	Less severe standard	More severe standard	Less severe standard	More severe standard	Less severe standard	More severe standard	Very severe standard
Athens	0	50	0	0	0	0	50
Cologne	0	20.5	0	0	0	0	0
The Hague	0	0	0	0	0	0	0
London	0	31.5	0	0	0	0	0
Lyon	0	22.5	0	0	0	0	20
Madrid	0	39	0	0	0	0	35
Milan	0	45	0	0	0	0	15

(N/A - Not Available)

* Nitrogen di-oxide is a pollutant with demonstrated direct and indirect effects upon human health and the environment. Air quality standards are therefore expressed in terms of concentrations of NO_2. However, emissions from vehicles and other sources consist of a mixture of nitrogen di-oxide and nitrous oxide (NO). For the purposes of establishing emission limits these two gases are combined under one heading - NOx. Therefore, while the air quality concentrations given in Table 2 are expressed in terms of NO_2 the emission reduction targets are expressed in terms of NOx.

Reliable measurements of ambient air concentrations of particulate matter using the PM10 parameter have only recently started to come available. Some data are available from the UK and additional information has been generated from a major research project undertaken in the context of the European Community's Research Programme: results from the UK and the EU programme are presented in Table 3 below. It would appear from the data summarized in Table 3, that maximum daily mean values for PM_{10} concentrations in many european cities are within the range 100-150 $\mu g/m^3$. This would imply that reductions in the range of 50-65% are required in order to meet the air quality standard of $50\mu g/m^3$. In trying to convert these estimates into tentative conclusions as to the likely magnitude of emission reductions great care must be exercised as the contribution of different sources to the total particulate load is only poorly understood and shows significant variation between regions. Nevertheless it was decided in the Auto/Oil Programme to use the range of 50-65% of 1995 levels as an emission reduction target for 2010[3].

2.4. Regional Tropospheric Ozone

Tropospheric ozone is referred to as a secondary pollutant, this means that it is formed as a result of the interaction between primary pollutants, principally nitrogen oxides and Volatile Organic Compounds (VOCs). The chemical reactions leading to the formation of ozone are accelerated in warm conditions and in the presence of sunlight: ozone is therefore often referred to as 'summer smog'.

Tropospheric ozone is a regional, transboundary problem: high concentrations of ozone frequently being found considerable distances (100s of kilometres) away from the major urban centres which are the principal source of the precursor pollutants, NOx and VOCs . In order to explore the regional aspects of ozone formation, the Auto Oil partners relied heavily on the EMEP model which has been developed to support the various protocols which have been established in the context of the 1979 Geneva Convention on transboundary air pollution.

On the basis of data relating to emissions of primary pollutants, the detailed chemistry of ozone formation and factors such as temperature, wind speed, intensity of solar radiation etc, the EMEP model can be used to predict ozone concentrations throughout Europe. Having taken into account the expected trends in emissions of primary pollutants the predicted air quality values were then compared with the air quality objectives for tropospheric ozone as laid down in Directive 92/72/EC (see Table 4).

If one considers the benefits of improvements which could be expected as a result of across the board decreases in emissions from all sources, some of the results generated from the EMEP model are given in Table 5. These results are expressed as the percentage of the Community's land area in compliance with the various air quality objectives.

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(3) Already agreed measures will reduce particulate emissions across the EU to nearly a half of those in 1995. Therefore the additional emission reductions required in 2010 to achieve the target reduction of 50-65% compared to 1995 levels is equivalent to approximately one-third off the predicted 2010 emissions.

Table 3

Summary of Data from UK and EU Studies on Urban PM Concentrations.

APHEA Project data:						PEACE Project:			UK data:	
City	Measurement	Winter (December, January, February)		Summer (June, July, August)		Country	City	Max. PM_{10} Winter ($\mu g/m^3$)	City	Daily mean PM_{10} ($\mu g/m^3$)
		Min.*	Max.**	Min.*	Max.**					
Athens	Black Smoke	64.0	141.4	41.8	102.4	Finland	Kupio	60	Belfast	191
Barcelona	TSP or PMx	137.5	232.2	117.2	177.7	Germany	Berlin	117	BirminghamA	113
Helsinki	TSP or PMx	33.4	121.8	41.9	91.7	Germany	Zerbst	95	BirminghamB	106
Cologne	TSP or PMx	70.3	83.8	72.1	83.4	Greece	Athens	201	Bristol	83
London	Black Smoke	24.1	94.5	7.2	15.9	Italy	Pisa	131	Cardif	96
Lyon	PM13	48.6	87.8	29.8	55.7	Italy	Torre del Lago	149	Edinburgh	65
Milan	TSP or PMx	187.9	199.7	81.7	85.1				Hull	84
Paris	TSP or PMx	36.4	67.3	37.6	47.8	NL	Amsterdam	123	Leeds	114
Rotterdam	Black Smoke	15.6	29	9.4	20.4	Sweden	Malmö	59	Liverpool	84

* Mean from the station giving the minimum annual measurements levels for each city.
**Mean from the station giving the maximum annual measurements levels for each city.

(Mean figure from above data is: 112.6)

Table 5 also indicates the predicted impact of 50%, 60%, 70%, and 80% emission reductions in both NOx and VOCs from all anthropogenic sources as compared to 1990

The nature of ozone formation is such that dramatic reductions from all sources for all precursors are required before complete compliance with air quality standards can be expected. Indeed it is only when an 80% emission reduction (compared to 1990) of precursors from all sources is achieved that over 90% of the EU land area is predicted to have a 1 hour maximum ozone concentration below 180µg/m³. With regard to the 99 percentile 1 hour mean 180 µg/m³ standard, across the board reductions in ozone precursor emissions of 60% and 70% correspond to a percentage land area compliance of 95 and 99% respectively. It was decided that for the Auto/Oil Programme an overall emission reduction target for ozone precursors in 2010 would be 70% of 1990 levels[4].

Table 4
Comparative Values: reactive pollutant modelling

Guidelines	Air Quality Standard	Relevance
Directive 92/72/EEC	110 µg/m³ 8-hour average	Health protection threshold
Directive 92/72/EEC	180 µg/m³ 1-hour average	Threshold level over which information / warnings have to be issued by the authorities to the general public.
WHO Air Quality Guidelines 1995	120 µg/m³ 8 hour average	Protection of health threshold

(4) Already agreed measures will reduce ozone precursor emissions across the EU to nearly a half of those in 1990. Therefore the additional emission reductions required in 2010 to achieve the target of 70% reductions compared to 1990 is equivalent to approximately one-third off the predicted 2010 emissions.

Table 5
EU Compliance with Ozone Air Quality Standards

	Percentage of EU Land Area (measured in EMEP grid squares) in Compliance with Standards			
	1 h mean 100 percentile	1 h mean 99 percentile	8 h mean 100 percentile	8 h mean 99 percentile
Scenario	% > 180 $\mu g/m^3$	% > 180 $\mu g/m^3$	% > 120 $\mu g/m^3$	% > 120 $\mu g/m^3$
1990 basecase	37	73	not known	10
2010 Basecase	53	87	5	19
1990 basecase -50%	62	89	8	25
1990 basecase - 60%	73	95	11	28
1990 basecase - 70%	81	99	18	37
1990 basecase - 80%	92	100	26	46

The following are the conclussions from the Auto Oil Study with respect to each of the pollutants which were investigated:

(1) **Carbon Monoxide;** the impact of already agreed measures (in particular the increasing penetration of the three way catalyst) will already, by 2005 reduce urban background concentrations in all the cities studied to below the level of the most stringent air quality standard. On the basis of these results regulating for further reductions in vehicular emissions of this gas would not be a priority.

(2) **Benzene;** the results indicate that as with carbon monoxide, the impact of the three way catalyst will result in a marked improvement of urban background concentrations over the coming years. Only in the case where an air quality standard of 2.5 $\mu g/m^3$ is used as a basis for comparison are emission reductions foreseen to be necessary in a number of the most polluted cities.

(3) **Oxides of Nitrogen;** the air quality modelling results clearly demonstrate that if one uses the more stringent air quality standard for nitrogen dioxide as a basis for comparison it will still be necessary in 2010 to make further reductions in emissions of between 0 and 50% dependent upon the city.

(4) **Particulates;** emission reductions of particulate matter from road transport in urban environments in the range 50-65% as compared to todays levels were considered necessary in order to achieve suitable air quality targets.

(5) **Regional Ozone Pollution;** the most important messages to be taken from this analysis are:

- that the emission reductions resulting from already agreed measures will by 2010 bring about a considerable improvement with regard to regional ozone pollution;
- that to reduce ozone pollution beyond that achieved by already agreed measures will require significant emission reductions of NOx and VOCs emissions of the order of 70-80% as compared to 1990;
- that further emission reduction measures applied to traffic will, in the absence of parallel measures applied to other sources particularly sources of VOCs , have at most a marginal impact.
- that for the purpose of the Auto/Oil Programme an emissions reduction target of at least 70% compared to 1990 levels of both total NOx and total VOCs across the EU would be used.

3. THE COSTS AND POTENTIAL BENEFITS OF MEASURES TO REDUCE POLLUTANT EMISSIONS FROM VEHICLES.

3. 1. The European Programme on Environmental Fuels and Engines (EPEFE)

One of the first steps taken in the Auto/Oil Programme was to review all available data concerning the relationships between vehicle emissions fuel properties, and engine technologies: this review included the results of the U.S Auto/Oil Programme. The conclusions from this review were published in 1994 in the report entitled "Effect of Fuel Qualities and Related Vehicle Technologies on European Vehicle Emissions"[5].

In reviewing existing information on the relationship between fuel quality, engine technology and exhaust gas emissions it became apparent that gaps existed concerning certain fuel and vehicle interactions. As such knowledge was vital for the completion of the Auto/Oil Programme, the European Oil and Vehicle industries collaborated in the realization of an extensive research initiative designed to generate the missing data. This research programme was known as the "European Programme on Emissions, Fuels and Engine Technologies" (EPEFE)

The EPEFE programme was extremely successful and has allowed important insights into the relationships between fuel quality and emissions. These relationships are complex, indeed it was observed that in some cases changing certain fuel parameters would decrease emissions of one pollutant while increasing emissions of another. Such insights are of vital importance when selecting fuels with the object of attacking priority pollutants.

The EPEFE programme is one of the most ambitious studies of this type ever carried out. It has assisted in the quantification of the relationship between certain important fuel parameters (e.g sulphur content, aromatics content, distillation characteristics for gasoline; cetane number, density, polyaromatics content, and distillation characteristics in the case of diesel) and pollutant emissions. The EPEFE programme represented a significant investment on the part of the industrial partners in the Auto/Oil Programme and it is unlikely that such an ambitious undertaking would have taken place without the impetus of the Auto/Oil Programme.

The results of the EPEFE programme have been published by the Industry[6]. The individual test results from the tens of thousands of measurements taken during the EPEFE programme are also available upon request.

3. 2 **Fuel quality changes** - Costs and potential benefits

Combined with already existing data, the EPEFE programme constituted a solid foundation upon which to make reliable estimates of the effects of changing fuel quality upon vehicle emissions. This allowed the Auto Oil partners to design fuels and to be confident in predicting the impact each fuel would have on the emission profiles of different classes of vehicles.

In order to carry out a cost analysis it was necessary to combine the information concerning the effects of different fuel qualities on engine emissions (the benefits) with information concerning the additional costs of producing fuels corresponding to new, environmentally driven, specifications.

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(5) This report - the report of "sub-Group 1" - is available on request from the European Commission.

(6) European Programme on Emissions, Fuels and Engine Technologies, Final Report. ACEA/EUROPIA, 9.10.1995.

On the basis of information provided by the Industry and the evaluation carried out by the independent contractor engaged by the Commission, the cost to the Industry of making changes to the composition of the gasoline and diesel fuels produced by EU refineries was assessed.

A summary of some of the data concerning the benefits (emission reductions) and costs of cleaner gasoline and diesel fuels is presented in Tables 6 and 7 below. Complete details of the costs and benefits of fuel reformulations are to be found in the consultants report and the summary report of the Auto/Oil Programme.

Table 6

Costs and Emissions Benefits of Cleaner Fuels - Gasoline:

Emissions Reduction Potential for vehicles equiped with a 3-way catalyst.	NOx* 7.12% ↑↓ -6.36%	VOCs 18.62% ↑↓ 4.31%	CO 17.16% ↑↓ 5.36%
Cost to Industry per annum**	ECU 327 - 1 450 million/year		
Cost per litre	ECU 0.003478/litre → ECU 0.010964/litre		
Cost to the motorist***	ECU 3.77 per year → ECU 11.89 per year		

* Negative emissions reduction for NOx in cases where fuel reformulation would cause an increase in emissions (from catalyst equipped vehicles) compared to current average fuel quality.

** Costs in Net present value in millions of 1995 ECU, discounted over period 1996 - 2015 at 7% per annum.

*** Average costs assuming fuel use of 8.6ll / 100km and annual travel of 12, 000km.

Table 7

Costs and Emissions Benefits of Cleaner Fuels - Diesel in Passenger Cars and LCVs:

Emissions Reduction Potential per vehicle	NOx	1.8% ↓↓ 0.5%	VOCs	34.3% ↓↓ 10.7%	CO	36.1% ↓↓ 10.6%	PM	30% ↓↓ 10%
Cost to industry per annum*	ECU 260 - 1742 million/year							
Cost per litre	ECU 0.001761 / litre ➡ ECU 0.01301/litre							
Cost to the motorist**	ECU 1.69 per year ➡ ECU 12.47 per year							

* All costs expressed as Net present value in millions of 1995 ECU, discounted over the period 1996 - 2015 at 7% per annum.

** Average costs assuming fuel use of 7.6ll / 100km and annual travel of 12, 000km.

3. 3 **Changes to vehicle technology** - Costs and potential benefits

European vehicle manufactures were asked to provide estimates of the additional costs involved in equipping their vehicles with the technology necessary to achieve progressively more severe emission reductions.

The manufacturers were invited to provide this information for a total of 16 different sub-categories e.g Gasoline cars - small, medium and large; heavy duty diesel vehicles - small, medium and large etc. The information provided by the manufacturers was evaluated by the independent contractors engaged by the Commission and was also cross-checked against information obtained from component manufacturers.

A summary of some of the data concerning the emissions reduction benefit and associated costs is presented in Tables 8 and 9 below. Complete details of the costs and benefits of improved vehicle technology are to be found in the consultants report and the summary report of the Auto/Oil Programme.

With regard to the potential of diesel engines to achieve further emission reductions, the figure used in the analysis are based on the assumption that the de-NOx catalyst will probably not be available for production models by the year 2000. Clearly if such technology were available in a reliable form, the potential for NOx emission reductions would be increased significantly.

Table 8

Costs and Emissions Benefits of Improved Vehicle Technology - Gasoline Passenger Cars

Emission Reduction Benefits as compared to existing standards:						
	NOx	65% ↓↓ 20%	HC*	65% ↓↓ 20%	CO	45% ↓↓ 20%

Costs:		Additional Cost per vehicle	Percentage of Purchase Price	Annual Cost to Industry
	Small	ECU 43 → 237	0.5 - 2%	ECU 574 → 3 262 million
	Medium	ECU 42 → 256		
	Large	ECU 72 → 341		

* HC = Hydro-Carbons - a high proportion of which will be VOCs

Table 9

Costs & Emissions Benefits of Improved Vehicle Technology - Diesel Passenger Cars

Emission Reduction Benefits as compared to existing standards:									
PM	50% ↓↓ 20%	NOx	20% ↓↓ 20%	HC*	65% ↓↓ 10%	CO	50% ↓↓ 25%		

Costs:		Additional Cost per vehicle	Percentage of Purchase Price	Annual Cost to Industry
	Medium	ECU 203 → 367	0.5 - 2.5%	ECU345 →605 million
	Large	ECU 227 → 402		

* HC = Hydro-Carbons - a proportion of which will be VOCs

3. 4 **Improved durability of Emission Control Systems** - Costs and potential benefits

As a vehicle gets older its performance including that of the emission control system deteriorate. Significant reductions in vehicle emissions can potentially be achieved by reducing the rate of detioration in the emission control systems. There are several mechanisms by which such improvements can be achieved.

- increased severity and frequency of compulsory inspection and maintenance checks;
- manufacturers liability for the performance of the emission control systems extended from 80 000 km to 160 000 km;
- electronic sensors installed on the vehicle to monitor the performance of the emission control systems -referred to commonly as on-board diagnostics;
- re-call procedures whereby models can be re-called and re-fitted if their emission performance deteriorate beyond an acceptable level;
- improved mechanisms for the remote-roadside detection of vehicles emitting above acceptable levels.

As part of the Auto/Oil Programme data were collected with regard to the cost and the emission's benefit of the various mechanisms designed to reduce the rate of detioration of the emission control systems.

A summary of some of the data concerning the emissions reduction benefit and associated costs of improved durability of emission control systems is presented in Table 10 below.

Table 10

Costs and Emissions Benefits of Improved Emission Control System Durability

Emission Reduction Potential:						
	Total NOx	15.9% ⇅ 0%	Total VOCs	30% ⇅ 0%	Urban PM*	10% ⇅ 0%
Costs:**	ECU 290 million/year ➡ ECU 1 112 million/year					

* Emission reductions from diesel vehicles assumed to apply only to particulate emissions.

** Costs expressed as Net Present Value in 1995 ECU, discounted at 7% between 1996 and 2015.

4. COMPLEMENTARY LOCAL TECHNICAL AND NON-TECHNICAL MEASURES - COSTS AND POTENTIAL BENEFITS

Article 4 of Directive 94/12/EC required that the Commission when developing future proposals should also take into account the potential of complementary non-technical measures such as traffic management and enhanced public transport as well as the use of alternative fuels. Non-technical instruments are geared towards changing the behaviour of transport users. As the analysis carried out by the Commission showed (see below), such behavioural changes are needed especially in cities with severe air quality problems where more stringent vehicle emission control, better fuel quality and improved durability of emission control systems alone are not sufficient to meet air quality targets. Many of these complementary measures would, of course, be applied at the Member State, regional or local level and decided by the corresponding authorities. The Commission has acknowledged the importance of these measures by promoting research, development and demonstration projects relating especially to urban transport through a number of channels (e.g. the THERMIE and SAVE II Programmes) and by fostering the exchange of experience between European cities in order to promote "best practice" in local transport planning (e.g. through the Commission's Urban Environment Expert Group and the Sustainable Cities Campaign). Most recently, the Commission presented two Green Papers on the Citizen's Network and the use of pricing mechanisms in the transport area to stimulate the discussion on these issues at the European level.

The instruments looked at included both local measures (traffic bans, speed regulation, cheaper public transport, alternative fuels), certain non-fiscal economic instruments (road pricing, scrappage subsidies) and the use of fuel taxes, vehicle purchase taxes and annual vehicle circulation taxes to influence transport users. In the final analysis, road pricing, traffic bans, the subsidy of public transport, scrappage subsidies and the conversion of urban buses to alternative fuels (LPG, CNG) were included. Information on the costs and the effectiveness of these instruments were collected, drawing on the experience in their application in different countries. The EUCARS passenger transport model developed by the Commission (Directorate-General II) was used to estimate the behavioural responses associated with the different instruments[7]. Besides the investment and operating costs associated with some of the measures, non-monetary costs to society ("welfare costs") were taken into account which arise from the behavioural changes imposed on European citizens (e.g. their loss of freedom to drive by car into the city centre) and changes in tax revenues. Citizens adapt their behaviour in different ways in response to the non-technical measures studied, for example through reduced car usage, the purchase of less polluting vehicles or the better maintenance of vehicles.

As compared to the evaluation of technical improvements, the assessment of non-technical measures is compounded by a number of difficulties. The responses of transport users cannot be predicted exactly and are often determined by local factors; the definition of measures is not as precise which makes it more difficult to assess their costs and effectiveness; many of the measures are interdependent and their costs and benefits are affected by external influences (e.g. economic development). Therefore, the quantification of the costs and benefits of local transport measures and economic instruments entails considerable uncertainties.

The analysis done showed that the non-technical measures considered had very different investment, operating and welfare costs. The analysis pointed to the fact that a reform of vehicle-related taxation in line with environmental criteria could make a cost-effective contribution to the reduction of transport-related air pollution. Under certain conditions, road pricing could even yield additional benefits beyond that of emission reduction by increasing

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(7) European Commission (Directorate-General II), "A Welfare Cost Assessment of Various Measures to Reduce Pollutant Emissions from Passenger Road Vehicles for the Year 2010" (Final Report, 12.10.1995) See also the consultants report from the cost effectiveness analysis.

the overall efficiency of the transport system. With due consideration to the uncertainty inherent in the assessment of these measures, it was concluded that local technical (LPG/CNG buses) plus non-technical measures (road pricing, cheaper public transport, traffic bans and scrappage subsidies, but excluding taxation instruments) can reduce urban NOx emissions by 10 to 25% beyond the reductions achieved through fuel quality changes, changes to vehicle technology and improved durability of emission control systems. The potential contribution of local technical and non-technical measures to emission reduction of other pollutants was not assessed in the same detail as for urban NOx but is likely to be of a similar magnitude.

5. COST-EFFECTIVE SOLUTIONS TO ACHIEVE AIR QUALITY TARGETS

The most important step in the Auto/Oil Programme involved the exploitation of the data compiled on the costs and benefits of the various emission reduction measures (sections 4 and 5) in order to identify the most cost effective solutions to achieve the emission reduction targets identified in section 2 (see Figure 2).

In the original concept of the Auto/Oil Programme it was foreseen that emission reduction targets would be generated in a consistent manner for all pollutants and that least cost solutions would be generated simultaneously in order to satisfy these multiple emission reduction objectives. However, as described in sections 2.3, it was not possible to determine precise emission reduction targets for particulate matter in each of the seven cities although a tentative objective of a reduction in the range of 50-65% as compared to present levels was identified. Similarly reduction targets for total NOx and total VOCs as precursors of regional ozone were difficult to establish: again tentative reduction targets in the range 70-80% for both pollutants compared to 1990 were identified.

In the absence of compatible emission reduction targets for all pollutants, the analysis was conducted in a step wise manner looking first at the three pollutants- NOx, CO and Benzene - for which it had been possible to identify precise emission reduction targets in the 7 cities. Subsequently, strategies for reducing urban particulate emissions were explored. Finally, approaches for reducing emissions of total NOx and total VOCs as contributors to regional ozone were examined.

With regard to the attainment of the emission reduction targets for urban pollutants, one important consideration was the achievement of an effective balance between on the one hand EU wide, largely technical, measures such as emission standards, fuel quality and inspection and maintenance and on the other hand local, largely non-technical measures such as road pricing, increased public transport, scrappage schemes and the replacement of diesel buses and trucks with LPG/CNG fuelled vehicles.

The objective was to identify the most cost-effective series of interlocking measures such that a certain proportion of the background levels of pollution would be removed by EU wide technical measures and that as and where appropriate these technical measures would be supplemented by national and/or local measures in localities with elevated levels of pollution - the objective being to achieve the desired emission reductions at the least cost for the Community as a whole.

The details of the technical procedures used to identify the least cost combination of measures are described in the consultants report on the cost-effectiveness study and the consolidated report of the Auto/Oil Programme.

Proposal for a

EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE **96/0163 (COD)**

relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC

EXPLANATORY MEMORANDUM

1. BACKGROUND

The European Union has a long standing history in reducing vehicle emissions. Directive 94/12/EC[1] is the latest amendment of base Directive 70/220/EEC[2], laying down new emission standards for passenger cars. When the provisions of Directive 94/12/EC come into effect in 1996/97, emissions of regulated pollutants from new passenger cars will be reduced by over 90% as compared to the standards which prevailed in the early 1970s.

However, despite these considerable achievements with regard to the emission reduction of individual vehicles, increased traffic activity (increased numbers of vehicles, increased kilometers travelled) are likely to counteract these improvements thereby preventing the emission reductions necessary to achieve future air quality objectives.

The likelihood of further action to reduce vehicle emissions necessitated a reassessment of the existing policy approach; it being apparent that the emission reduction potential offered by further improvements in vehicle technology was limited and possibly very costly in comparison to other potential solutions.

In the light of the above considerations a new, comprehensive and integrated approach was developed. Directive 94/12/EC, Article 4 outlines the main elements of this new approach:

"In these proposals *[future proposals designed to reduce emissions from traffic which the Commission is requested to submit]* the Commission shall take the following approach:

* the measures shall be designed to produce effects to meet the requirements of the Community's air quality criteria and related objectives;

* an assessment of the cost-effectiveness of taking each measure shall be undertaken; in this global assessment full account shall be taken, *inter alia*, of the contributions that:

  - traffic management, for example by spreading the environmental costs appropriately,

  - enhanced urban public transport,

  - new propulsion technologies (e.g. electric transmission),

  - the use of alternative fuels (e.g. biofuels), could make to improving air quality,

* the measures shall be proportional and reasonable in the light of the intended objectives."

Article 4 of Directive 94/12/EC stipulates that measures to be assessed with regard to their benefits and costs shall include improved vehicle technology, more appropriate mechanisms to reduce the in-use deterioration of emission control systems and "improvements in fuel quality as far as vehicle emissions of dangerous substances (in particular benzene) are concerned".

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(1) OJ No L 100, 19.4.1994, p. 42.

(2) OJ No L 76, 6.4.1970, p.1.

The importance of fuels with regard to the release of atmospheric pollutants such as lead, benzene and sulphur dioxide from vehicles has been recognized for some time. EU-wide legislation aimed at limiting the detrimental health and environmental effects of these pollutants already exist. The limit values currently in place are laid down in Directive 85/210/EEC[3] concerning the lead and benzene content of petrol and the sulphur content of diesel fuels is regulated under Directive 93/12/EC[4].

The use of fuels for transportation purposes is however also linked to the release of other air pollutants such as volatile organic compounds (VOCs), nitrogen oxides (NOx), carbonmonoxide (CO) and particulate matter (PM) which directly or as precursors of ozone can have detrimental health and environmental effects.

Therefore, assessment of the cost-effectiveness of fuel quality changes as a measure to reduce vehicle emissions must include a wider range of fuel components than those already legislated for.

2. THE EUROPEAN AUTO/OIL PROGRAMME

In keeping with its commitment towards the development of a more comprehensive approach to reducing emissions from road transport and in conformity with the principles set out in Article 4 of Directive 94/12/EEC the Commission, at the end of 1992, decided to initiate a technical work programme for the purpose of providing a solid technical foundation upon which to base its future legislative proposals. In accordance with the principle of 'shared responsibility' expressed in the 5th Environmental Action Programme, the Commissioners for Environment, Industry and Energy, invited the European associations of the car (ACEA) and oil (Europia) industries to make available their considerable know-how and expertise and to collaborate in the realization of this technical programme. The two industries responded positively to this invitation and together with the Commission designed, planned and executed the programme which subsequently became known as the Auto/Oil Programme.

The content and the structure of the Auto/Oil Programme is described in the Communication which accompanies this proposal. A short description of the programme and the conclusions derived from it is presented below.

The objective of the Auto/Oil Programme was defined as:

to provide policy-makers with an objective assessment of the most cost-effective package of measures to reduce emissions from the road transport sector to a level consistent with the attainment of the new air quality standards being developed for adoption across the European Union.

- The Auto/Oil Programme explored cost-effective combinations of measures sufficient to achieve, by 2010, stringent air quality standards with respect to the following pollutants:

  * oxides of nitrogen (NOx) in cities
  * benzene in cities
  * carbonmonoxide (CO) in cities
  * particulate matter (PM) in cities
  * tropospheric ozone and thereby emissions of total NOx and Volatile Organic Compounds (VOCs).

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(3) OJ No L96, 03.4.1985, p. 25.

(4) OJ No L74, 27.3.1993, p. 81.

- The Auto/Oil Programme demonstrated that in the absence of futher measures to significantly reduce emissions from road transport, concentrations of nitrogen oxides, particulate matter and tropospheric ozone would constitute a continuing threat to human health and the environment into the next millenium. In contrast, the impact of already agreed measures was predicted to reduce concentrations of carbonmonoxide and benzene to acceptable levels.

- The Auto/Oil Programme explored the cost and the emission reduction potential of a variety of different measures *inter alia* improved vehicle technology, inspection and maintenance schemes, changes in the quality of fuels and a number of non-technical measures such as scrappage schemes and road pricing.

Drawing on the results of the Auto/Oil Programme the Commission has decided upon a package of legislative proposals to be submitted to the European Parliament and the Council.

- a proposal on a moderate reformulation of petrol and diesel fuels (this proposal);

- a proposal to strengthen the existing emission limits for passenger cars (Directive 70/220/EEC, as last amended by Directive 94/12/EC (accompanying this proposal);

- a proposal to strengthen the emission limits for light duty vehicles (Directive 70/220/EEC as last amended by Common Position No 3/96, [in 1997])[5];

- a proposal to strengthen the emission limits for heavy duty vehicles (Directive 88/77/EEC[6] as last amended by Directive 91/542/EEC[7]);

- a proposal with regard to the strengthening of the current legislation on inspection and maintenance (Directive 92/55/EC[8] [in 1997]).

The proposals enumerated above foresee the simultaneous entry into force of a series of measures as from 1 January 2000.

The Commission estimates that the measures coming into effect in 2000 will, in 2010, reduce emissions from the road transport sector by:

urban NOx = 39%		urban particulates	= 39%
urban CO = 51%		total NOx	= 35%
urban benzene = 48%		total VOCs	= 46%

as compared to what the emissions would have been in the absence of the measures.

3. EMISSION REDUCTION FROM OTHER THAN MOBILE SOURCES

The package of measures is part of an integrated Commission strategy to reduce atmospheric emissions from all sources and which was developed on the basis of the 5th Environmental Action Programme. While emission reductions from mobile sources are an important contribution to the achievement of future air quality targets they will not be sufficient to solve the problem of ozone pollution and acidification.

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(5) OJ No C 37, 9.2.1996, p. 23.
(6) OJ No L 36, 9.2.1988, p. 1.
(7) OJ No L 295, 25.10.1991, p. 1.
(8) OJ No L 225, 10.8.1992, p. 68.

The Commission is therefore pursuing complementary measures aimed at emission reduction from stationary sources such as power plants, industrial installations, households, etc.. The revision of the large combustion plant directive[9] and the proposed directive on Integrated Pollution Prevention and Control[10] are steps in this direction. Further action, especially with regard to the reduction of volatile organic compounds as a precursor for ozone formation, are needed to complement the beneficial effects gained from traffic related measures.

4. THE EUROPEAN MARKET FOR PETROL AND DIESEL FUELS

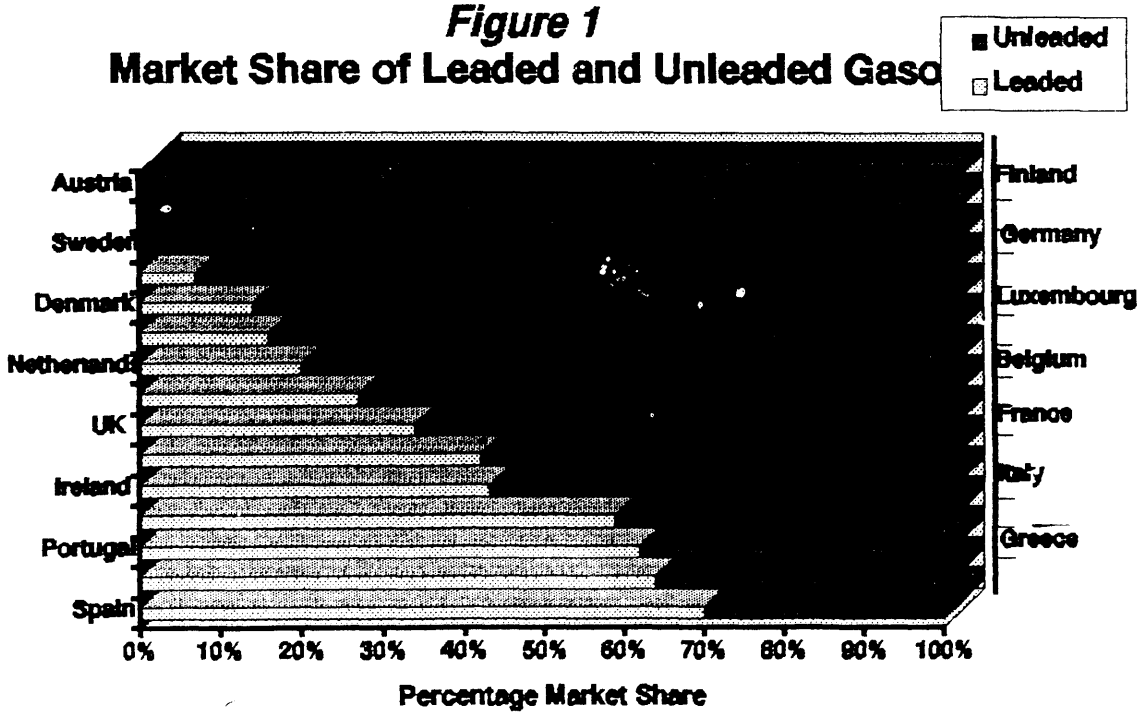
The Community's total energy demand is covered by several sources of which almost half is supplied by liquid fuels. The annual turnover is approximately ECU 40 billion/year.

In 1990, energy demand for transport activities amounted to about 30% of total final energy consumption. More than 83% of the energy needed for transport is consumed by road transport in the form of fuels. The principal fuels are petrol and diesel with other fuels such as Liquified Petroleum Gas (LPG) and Compressed Natural Gas (CNG) only taking up a small share of the market.

According to the latest oil industry figures gasoline and diesel consumption in 1995 amount to around 170 000 respect. 120 000 million litres. The consultancy company A.D. Little has estimated that over the period 2000-2015, EU consumption of petrol and diesel fuels will amount to 2 540 respectively 2 572 thousand million litres. These forecasts are likely to be overestimated in view of the Commission's aim of bringing forward policy measures to reduce CO_2 emissions from cars.

Figure 1

Market Share of Leaded and Unleaded Gaso



(9) Revision of Directive 88/609/EEC: OJ No L 336, 7.12.1988, p. 1.

(10) COM 96/C87/02

Leaded v unleaded petrol

The market for petrol is divided into leaded and unleaded petrol, of which the latter has gained an increasing market share over the last years. In 1995 the average market share of unleaded petrol in the EU reached about 68%. However, this figure does not reflect the wide difference of the use of unleaded petrol in the Member States. While in countries like Austria, Finland and Sweden 100% of the petrol pool consists of unleaded petrol, in Spain, Greece and Portugal the latter only represents 30-40%. An overview of the share of leaded and unleaded petrol in the market in 1995 is provided in *Figure 1.*

With the introduction of the catalytic converter the market share of unleaded petrol will increase further with an estimated growth rate of approx. 8% of the 1995 market share per year.

Unleaded petrol is provided in the market as 'unleaded regular' (91/92 RON [Research Octane Number]), 'unleaded premium/super' (RON 95) and 'unleaded super plus' (RON 98) Table 1 is the oil industry's estimate of the market share of each type calculated as percentage of total unleaded petrol and as percentage of total petrol.

Table 1 (Estimate Europia 1995)

TYPE unlead.	% of total unleaded petrol	% of total petrol pool
RON 91/92	13.5	9
RON 95	68.5	47
RON 98	18.0	12

Fuel quality

The quality of unleaded petrol and diesel fuels in Europe is subject to European standards as laid down by the European Committe for Standardisation (CEN) [see chapter 12, p.22]. Requirements specified by the CEN standards are set with a view to improved performance of the engine/vehicle. While the establishment of European standards has led to a certain degree of harmonization current data on fuel quality in the market show that there are considerable variations with regard to locations (north, south, central) and seasons (winter/summer).

The predicted average fuel quality of petrol and diesel fuels by the year 2000 and in the absence of any legislative action is shown in Tables 2 and 3 below.

Table 2: Predicted Average Values for Fuel Parameters of Market Fuel (unleaded petrol)

Parameter	**Unit**	**Predicted Market Average in the year 2000 without new measures**
RVP Summer	kPa	68
E.100	% v/v	53
E.150	% v/v	84
Olefins	% v/v	11
Aromatics	% v/v	40
Benzene	% v/v	2.3
Oxygen	% m/m	0.6
Sulphur	ppm	300
Lead	g/l	0.005

Table 3: Predicted Average Values for Fuel Parameters of Market Fuels (diesel)

Parameter	**Units**	**Predicted Market Average in the year 2000 without new measures**
Cetane Number	-	51
Density	kg/m3	843
Polyaromatics	vol%	9
T95	°C	355
Sulphur	ppm	450

5. THE EMISSIONS BENEFITS AND COSTS OF CHANGES IN FUEL QUALITY

The Auto/Oil Programme demonstrated clearly that changes of fuel components such as sulphur, aromatics and benzene content and vapour pressure for gasoline and sulphur, cetane number, density and polyaromatic content of diesel can have a significant benefit in terms of reducing emissions of priority pollutants from vehicles. In the context of the Auto/Oil Programme the relationship between the benefits in terms of reduced emissions and the costs were explored for unleaded petrol and diesel fuels modified to increasing degrees of severity.

The Commission's proposal

As described in Chapter 2. the Auto/Oil Programme identified moderate changes in the quality of petrol and diesel fuels as part of a cost-effective integrated package of measures.

The fuel specifications proposed by the Commission for petrol and diesel fuel and foreseen to come into force in 2000 are shown in Tables 4 and 5. The specifications are expressed as maximum and minimum for various parameters of environmental relevance. The tolerances of the refinery production process mean that in order to ensure that the product complies with the prescribed specifications the average quality of the fuel placed on the market will be better than the specifications. Tables 4 and 5 also indicate the Commission's estimates of the market average fuel quality which will result from the application of the proposed specifications. A comparison with the predicted average market values for petrol and diesel fuels by the year 2000 in the absence of legislation (see Tables 2 and 3 on pages 6 and 7) shows improvements with regard to Reid Vapour Pressure (RVP), aromatics, benzene and sulphur in petrol and with regard to cetane number, density, polyaromatics, T95 (distillation) and sulphur in diesel fuel.

Table 4: Proposed Fuel Specifications for Petrol to Come into Effect in 2000 and the Corresponding Predicted Market Average Values

Parameter	Unit	Average Market Values of Proposed Fuel Package	Limit Values of Proposed Fuel Package	
			Minimum	Maximum
RVP Summer	kPa	58	-	60
E.100	% v/v	53	46	-
E.150	% v/v	84	75	-
Olefins	% v/v	11	-	18*
Aromatics	% v/v	37	-	45
Benzene	% v/v	1.6	-	2
Oxygen	% m/m	1	-	2.3
Sulphur	ppm	150	-	200
Lead	g/l	0.005	-	0.005

[* Except for unleaded petrol regular for which the maximum olefin content shall be 21% v/v.]

Table 5: Proposed Fuel Specifications for Diesel to Come into Effect in 2000 and the Corresponding Predicted Market Average Values

Parameter	Unit	Average Market Values of Proposed Fuel Package	Limit Values of Proposed Fuel Package	
			Minimum	Maximum
Cetane Number	-	53	51	-
Density	kPa	835		845
Poly-aromatics	% Vol.	6	-	11
T95	°C	350	-	360
Sulphur	ppm	300	-	350

Emission reductions

The emission reductions which are achieved by the proposed petrol and diesel specifications foreseen in 2000 are shown in Table 6.

Table 6: Emission Reductions Achieved From Different Vehicle Classes by Expected Petrol and Diesel Fuel Quality Changes

Pollutant	% emission reduction achieved by the proposed change in petrol	% emission reduction achieved by the proposed change in diesel fuel (LDVs)*	% emission reduction achieved by the proposed change in diesel fuel (HDVs)*
NOx	- 7.12	- 0.53	- 2.15
VOCs	- 8.44	- 10.68	- 2.20
CO	- 8.89	- 10.60	- 0.39
PM	--	- 9.95	- 3.22
Benzene	- 20.7	---	----

* The difference in emission reduction between light duty (LDVs) and heavy duty vehicles (HDVs) is due to the difference in the test cycle which reflects the different engine technologies of the two vehicle categories and the different loads under which they operate.

In addition to the proposed Community-wide measures, supplementary emission reduction measures might be taken by Member States at national, regional or local level in order to achieve established EU or national air quality standards everywhere in the Community (see also 'Fiscal Measures' below).

Leaded petrol

The Auto/Oil Programme only investigated the cost and emission effects of unleaded petrol grades. With the increasing number of cars equipped with catalytic converters the share of leaded petrol in the total pool will diminish significantly. While today the share of leaded petrol is around 30% of the total pool the estimated growth rate of the market share of unleaded petrol (see chapter 4, p.5) suggests that by the year 2000 only a very small amount of leaded petrol (2%) will be in the market. In addition, it is estimated that by the year 2000 the entire car fleet will be able to run on unleaded petrol except the socalled 'Oldtimers'. These cars can be run on unleaded petrol containing a lead substitute which can be added to the petrol tank. These lead substitutes are already available at the petrol station where they can be purchased and added by the consumer.

In the light of the above and in recognition of the significant human health risk associated with lead pollution, the Commission has proposed a general ban on the marketing of leaded petrol as from 1. January 2000. However, in recognition of the fact that for certain Member States such a rapid phase- out may result in severe socio-economic problems, the Commission's proposal also provides for a limited, two year derogation.

Benzene

The current limit value of the benzene content in petrol is 5% as regulated under EC Directive 85/210. With a number of Member States producing petrol containing benzene levels well below this limit, the European average market value today is about 2.3% (see Chapter 4, p.6).

Air quality modelling results obtained as part of the Auto/Oil Programme have shown that by the year 2010 atmospheric benzene levels will be sufficiently low even without the application of additional measures if this average value is being maintained.

However, the Commission is aware that atmospheric benzene pollution is likely to persist in the short to medium term, in areas with high traffic density (inner cities, cross-roads, etc.).

For this reason countries like Austria, Finland, Germany, Italy and Sweden have in an Environment Council meeting in December 1994 demanded that a reduction of the benzene level in petrol to 1% be introduced at European level as the most effective measure to mitigate existing benzene pollution in those problem areas. Directive 94/12/EEC, Article 4 requires the Commission to particularly investigate the emission effects with regard to a change in benzene content.

Austria, in the accession negotiations, was allowed to maintain its national benzene limit value of 3% for a transitional period. Sweden and Finland were permitted to continue a tax incentive scheme with which the benzene content of petrol has been reduced to 3% and 1% respectively.

The Commission in its response to Member States' concern on atmospheric benzene levels is taking a positive stance when proposing a considerable reduction of the current benzene limit value from 5% to 2%. However, in view of the air quality from the Auto/Oil Programme and summarised in chapter 2., the Commission does not see the need to mandate for a EU-wide benzene limit value of 1%.

Review Process

Within 12 months of the adoption of the Directive and in any event not later than 31 December 1998 the Commission will bring forward proposals to revise the provisions of the Directive. This proposal will be based on the comprehensive assessment to be carried out in conformity with the requirements of Article 4 of the proposed amendment to Directive 70/220/EEC. The purpose of that assessment is to develop a strategy designed to

produce effects to meet the requirements of Community air quality standards and related objectives, at least cost. In developing such a strategy, the Commission will take full account of:

- trends in air quality;

- noxious pollutant emissions in Europe from transport and non-transport sources and the contribution that existing, pending and potential measures to control emissions from non-transport sources , could make to improve air quality;

- technical developments with regard to:

  * vehicle technologies as well as new propulsion technologies (e.g. electric propulsion, fuel cells),

  * refinery technologies;

- the potential of alternative fuels such as compressed natural gas (CNG), Liquid Petroleum Gas (LPG), and Dimethyl Ether (DME) and biofuels to reduce vehicle emissions,

- possible improvements in the test procedures for the type approval of new vehicles, in particular the addition of a new test procedure at low temperatures;

- the potential of technical, non-technical and local measures to reduce emissions: in this context, the contribution of transport and other policy measures such as traffic management, enhanced urban public transport and vehicle scrappage schemes should be evaluated;

- the contribution that selective and differentiated fiscal measures could make to reducing emissions, whilst not negatively impacting the functioning of the internal market;

- the effects of any measures on CO_2 emissions;

- the strategies followed by third countries to improve air quality and the emission values applied therein;

- the situation with regard to the supply and the quality of crude oil available to the Community.

The proposal to revise the provisions of the Directive based on a comprehensive assessment and as an integral part of the strategy described above, will include, inter alia, a revision of the specifications for petrol and diesel fuels as laid down in Annexes I and ~~II~~ of this Directive.These revised specifications would come into effect on January 1, 2005.

The Commission's proposal will take into account that improvements to fuel quality have a direct and significant impact on emissions of particulate matter, volatile organic compounds and oxides of nitrogen. All of these pollutants either directly, or as a result of their contribution to ozone formation, result in important impacts on human health and the environment.

In addition to the direct benefits that improved fuel quality has on vehicle emissions there is a clear interaction between fuel quality and vehicle technology. With regard to the development of new pollution abatement technologies such as the de-NOx catalyst there is evidence that fuels of a certain quality, particularly low sulphur fuels, may well be required if such technologies are to achieve optimal and long-lasting levels of performance.

Accordingly, the Commission foresees that its future proposal to revise the specifications of petrol and diesel fuels should comprise a significant reduction in the content of sulphur for both fuels. Current research and development indicates that a sulphur limit of the order of 50 ppm could be needed for the optimal functioning of the new vehicle-based pollution abatement technologies as well as contributing to improving emissions from the existing car parc. While this proposal does not specify a limit value for the sulphur content in petrol and diesel fuels for 2005 the establishment of these values will of course be based on the outcome of the cost-effectiveness assessment to be carried out prior to the development of the Commission's future proposal.

To take account of the possibility that vehicles equipped with new pollution abatement technologies such as the de-NOx catalyst are developed and introduced into the market before 2005, the Commission has also included in its proposal a commitment to bring forward, if appropriate, proposals to ensure that when vehicles equipped with such technologies are placed on the market, fuels of a quality sufficient to guarantee the necessary level of performance of the technology will be widely available. In bringing forward such proposals the Commission will give due regard to considerations of air quality, cost-effectiveness and proportionality. The Commission will also take into account:

(i) the latest information on the interaction between fuel quality and the performance of the new pollution abatement technologies;

(ii) the situation with regard to the development and production of these technologies and the forecasts concerning the marketing of vehicles equipped with such technologies.

(iii) the need to ensure that the measures proposed will neither disrupt the free movement of persons and goods nor unduly distort competition.

Fiscal Measures

While the Commission's proposal will result in a significant improvement in the average quality of fuels sold throughout the Community, it is likely that some Member States, particularly those in which fiscal incentives have been applied in the past, may wish to encourage the use of even cleaner fuels as part of their overall strategy to improve air quality. The Commission would not wish to impede national or local initiatives aimed at improving air quality on condition that such initiatives were compatible with the provisions of Directive 92/81/EEC dealing with mineral oil structures. According to Directive 92/81/EEC[11], mineral oils used as a motor fuel shall be taxed at a single rate per product category. The excise duty rate for each product is to be decided by the individual Member States provided they respect the Community minimum rates as outlined in the Mineral Oils Rates Directive 92/82/EEC[12].

Should Member States wish to use fiscal incentives and apply differential rates, other than those provided for in article 8(2) of Council Directive 92/81/EEC, they have the possibility to request a derogation from the general regime according to Article 8(4) of the same Directive. Such requests must be authorized by the Council.

For motor fuels, Denmark, Finland, Greece and Sweden have been granted derogations allowing them to apply reduced rates on environmentally friendly diesel. Finland can apply reduced excise duty rates on reformulated unleaded and leaded petrol. Denmark can apply differential rates of duty between petrol distributed from petrol stations equipped with a return system for petrol fumes and petrol distributed from other petrol stations. A number of applications from other Member States are presently being evaluated.

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(11) OJ No L 316, 31.10.1992, p. 12.

(12) OJ No L 316, 31.10.1992, p. 19.

Derogations - Special Fuels

Notwithstanding the possibilities open to Member States to encourage the marketing of cleaner fuels through fiscal measures, there may be specific locations such as large urban areas where atmospheric pollution constitutes or may reasonably be expected to constitute a serious and recurrent problem for human health and/or the environment. In such locations Member States may consider it appropriate to require the marketing of special fuels as part of a strategy to combat air pollution. The Commissions proposal therefore foresees the possibility for Member States to be granted a derogation in order to require the use of such special fuels.

The Commission's proposal also foresees that Member States wishing to make use of this derogation will be required to motivate their proposed measures on the basis of air quality measurements and the improvement in air quality that the measures are expected to bring. The Member State should also provide evidence that the proposed measures respect the principle of proportionality with particular attention being given to their impact upon the internal market and competition.

6. THE EUROPEAN REFINING INDUSTRY

The European Union (15) has 106 refineries with a total distillation capacity of 13 212 833 barrels per day. In the past, refineries have been categorized in three types: simple, catalytic cracking and full upgrading.

However, these categories no longer represent the range of refineries operational in Europe. Over the last three to five years, some refiners have upgraded their installations in response to tighter product specifications such as the reduction of lead in petrol and the lowering of the sulphur content in gas oil and diesel fuel.

The currently existing refinery types are best categorised as follows:

* Simple - including thermal operations & some vaccum distillation
* Fluid Catalytic Cracking (FCC)
  - with or without feed pretreatment
  - with or without C6-Isomerisation
* Hydrocracking
* Fluid Catalytic Cracking (FCC) and hydrocracking
* Others (e.g. lube oil production, etc.)

The latter category is without importance for petrol and diesel production and will therefore be excluded from the further analysis.

The refinery type most common in Europe is the fluid catalytic cracking (FCC) type (with or without pretreatment and with or without C6-Isomerisation but not including the combination FCC plus Hydrocracker) accounting for around 61% of total atmospheric distillation capacity in the European Union.

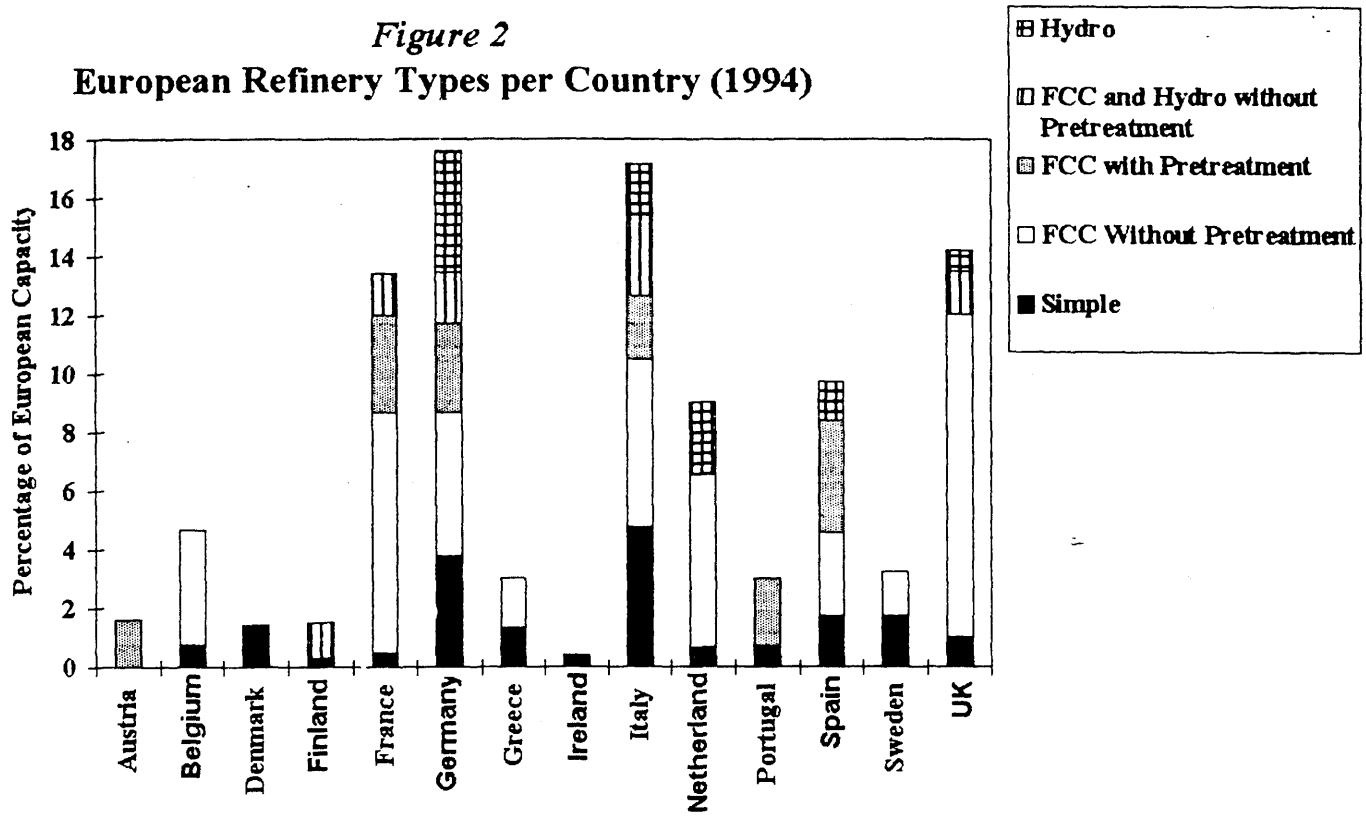
Table 7 provides an overview of European refinery types and their percentage share of total European distillation capacity. Figure 3 shows the types of refinery existing in each country and their total distillation capacity.

Table 7: European Refinery Types and Their Share of European Distillation Capacity (1994)

Refinery Type	Number of Refineries	Total Atmospheric Distilliation Capacity (b/cd)	% of European Capacity in Each
Simple without thermal or C6 Isomerization	18	969 030	7.3%
Simple without thermal but with C6 Isomerization	3	244 000	1.8%
Simple with thermal but without C6 Isomerization	10	737 118	5.6%
Simple with thermal and C6 Isomerization	9	696 700	5.3%
Hydrocracker without C6 Isomerisation	7	881 160	6.7%
Hydrocracker with C6 Isomerization	3	494 000	3.7%
FCC without Pretreatment or C6 Isomerization	19	3 218 500	24.4%
FCC without Pretreatment but with C6 Isomerisation	17	2 793 000	21.1%
FCC with Pretreatment but without C6 Isomerisation	8	1 454 025	11.0%
FCC with Pretreatment and C6 Isomerization	3	598 300	4.5%
FCC and Hydrocracker without pretreatment or C6 Isomerization	4	737 000	5.6%
FCC and Hydrocracker without Pretreatment but with C6 Isomerization	2	390 000	3.0%
Other	3	0	0%
Total in Europe	**106**	**13 212 833**	

Figure 2

European Refinery Types per Country (1994)



It can be seen from Figure 2 that in Austria, Belgium, France, Italy, the Netherlands, the UK and Spain the various types of FCC refineries predominate. Greece's distillation capacity is divided between simple and FCC refineries however, one of the FCC refineries also has some hydrocracking capacity which increases its flexibility with regard to the fuel quality changes required. German refineries have the biggest hydrocracking capacity of all EU Member States. Finland has a simple and a FCC/hydrocracking refinery. Denmark and Ireland only operate simple refineries. Sweden's distillation capacity is nearly equally divided between the simple and the FCC refinery type. One of the latter however has some hydrocracking capacity.

The refinery configuration has a major influence on the oil industry's ability to meet product specifications and is the key indicator as to the technical capacity of an individual refinery to cope with tighter specifications as a consequence of European environmental legislation.

In general tighter limit values for diesel specifications and for petrol specifications such as sulphur and olefin content can more easily be met by simple and hydrocracking than by other refinery types. FCC and combined FCC/hydrocracker refineries are better suited to the tightening of certain petrol components such as benzene and aromatics.

Projected costs of legislative fuel specifications to the refining industry

The financial implications incured by the proposed specifications are presented in Table 8 for the European refining industry (EU 12). They provide an overview of the estimated total costs over 15 years expressed as the net present value, indicate the overall capital investment costs and the yearly incured fixed operating and energy costs.

Table 8: Cost Implications* for Proposed Petrol and Diesel Fuel Specifications in 2000 (EU12) (ECU) million

Net present Value (over 15 years)	Total Capital Investment Costs	Fixed operating Costs/Year	Energy Costs/Year
11 380	7 223	291	146

* The costs are based on the value of the ECU in 1995 and a project life of 15 years from 2000 onwards.

Not included in this cost analysis are the financial implications for the refinery industries in Austria, Finland and Sweden since they were not members of the European Union at the time when the Auto/Oil Programme began. However, all three new Member States have already undertaken action with regard to a change of certain parameters of petrol and diesel fuels. This is particular so for Sweden and Finland where a number of fuel specifications are much stricter than those proposed in this Directive. It can be expected that costs for the Swedish and Finnish refinery sector will not increase as a result of the forthcoming European legislation. For Austria however, some costs will occur.

While the aggregated total costs for EU-12 do not reflect individual refinery and regional variations, these aspects have nevertheless been studied. It can be expected that the results for individual refineries and for regions show a wide difference.

However, the variation is not uniform because the impact of the quality parameter changes depends on both feedstock and refinery configuration.

Therefore, it is likely that the Mediterranean region with its higher sulphur feedstock will face higher costs than the aggregate for removal of sulphur. North West Europe and the atlantic region on the other hand will have to pay more than the aggregate costs for removal of benzene and aromatics because their feedstock contains a high amount of these compounds.

It is expected that the aggregated costs can vary between ± 25% depending on refinery type and region.

7. TRADE IMPLICATIONS

In order to produce a range of fuels and satisfy local demand it is often necessary for a refiner to trade in feedstock and/or a certain amount of their refinery products. This enables refiners to balance refinery configuration and design against fuel demand and the nature of the crude oil supply.

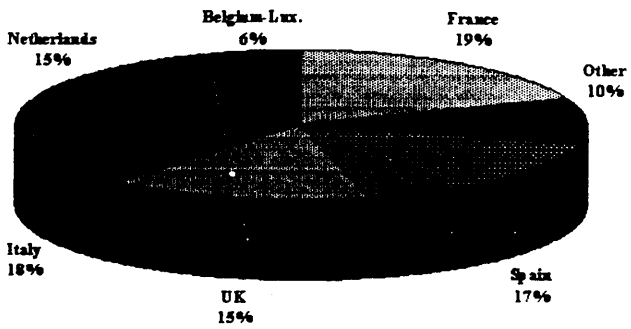
This trade occurs among Member States and between Member States and non-European countries.

Petrol

Over the last ten years the EU trade balance of petrol has been positive with total exports to third countries increasing from 6.7 to 15.0 million tonnes. The U.S.A. and Canada are one of the major export markets of the EU for petrol. While in 1992 and 1993 exports were low because additional MTBE production in those countries replaced some of the previously imported petrol, in 1994 exports started to recover and rose to about 6.8 million tonnes. Figure 3 shows the contribution of individual Member States towards these exports.

It is difficult to predict the future development of these exports since they are influenced not only by the forthcoming changes of fuel quality in the EU but also by the evolution of the 'reformulated gasoline' programme in the USA.

Figure 3
1994 Petrol Exports to USA and Canada



Source:
ETSU/
High and Watt Associates, 1995.

Gasoil/diesel fuel

The EU- trade balance of gas/diesel oil between 1985 and 1994 has turned from negative to positive with net exports to third countries totalling about 1 million tonnes in 1994. Of the total imports the biggest share of 30% is coming from Russia. Another important supplier of gas/diesel oil is Egypt with 20%.

No statistics on the breakdown of imports between diesel and other gas oil are available. However, the diesel share of total gas oil production increases. The rise has been from 49% in 1993 to 50% in 1994. For 1995 the share of diesel is projected to be 53%.

Changes in diesel fuel quality as proposed in this Directive will make it more difficult to meet sulphur and density specifications in diesel and are likely to lead to an increasing demand on low sulphur (sweet) crudes. In the mid and long term North West Europe and the Atlantic region will become short on their reserves of low sulphur crude oil. It is therefore reasonable to expect the price differential to widen between low sulphur (sweet) and high sulphur (sour) crudes and imports of low sulphur crudes into the Community to rise. These developments will favour the North African crude oil suppliers while the Russian and most West African crudes are generally higher in sulphur.

8. IMPLICATIONS FOR THE CONSUMER

The incurred European-wide costs for a change in the quality of fuel as illustrated in Chapter 5. will ultimately be borne by the consumer. For her/him the additional costs per litre at the pump will be around ECU 0.002 for a petrol or diesel car for measures to be introduced in 2000. For a motorist who drives around 12 600 km/year this amounts to additional costs of around ECU 2/year for a petrol or diesel car.

This increase in price is well below price changes which occur on a regular basis for other market reasons (e.g. changes in crude oil and feedstock products).

9. IMPACT ON EU-WIDE C0, EMISSIONS

Changes in fuel quality require the use of additional energy which in turn increases CO_2 emissions. It is estimated that CO_2 emissions per year will rise by 6 million tonnes across the EU (12) when the proposed fuel quality changes will become mandatory for 2000.

These 6 million tonnes represent around 0.2% of total CO_2 emissions and 0.8% of CO_2 emissions from transport sources in 1993.

10. SUBSIDIARITY

10.1 What are the Objectives of the Proposed Measure in Relation to the Obligations Placed Upon the Commission?

The objectives of the measure are to achieve a basic level of harmonization of the considerable market of transport fuels (about 290.000 million litres in 1995).

Despite the existance of norms laid down by the European Committee for Standardization (CEN) for certain fuel components, the majority of the petrol and diesel fuel marketed is characterized by numerous permissible levels for a number of fuel components (e.g. sulphur, aromatics, benzene). The proposal asserts an increased level of harmonization to replace the existing range, thus ensuring the proper functioning of the internal market.

Harmonization will be even more important in the future as environmental concerns may lead many Member States to introduce new restrictions on some of the above mentioned fuel components. Unilateral measures could produce differences in product specifications in the various Member States thereby hindering the free flow of goods.

The role of transport fuels with regard to their potential of reducing vehicle emissions has been discussed in Chapter 5. For the purpose of considerable emission reductions necessary to achieve future urban and regional air quality objectives, changes in fuel quality have proven to be a cost-effective means. Only legislative action on Community level can ensure that the emission reduction potential of fuels is used to the extent needed.

10.2 Does the Proposed Action relate to a Matter of Exclusive Community Competence or Competence Shared with the Member States?

The matter concerns harmonization of the internal market and therefore is an issue of exclusive Community competence.

10.3 What Forms of Action are Available to the Community?

The only realistic form of action is legislation based either on a Directive or a Regulation.

10.4 Is a Uniform Regulation Necessary or will a Directive Imposing General Objectives with the Execution being Left to Member States Suffice?

A directive imposing general objectives and with the detailed implementation being left to the Member States will achieve the necessary objectives while at the same time allowing the Member States considerable freedom with regard to practical details of implementation.

11. RESULTS OF CONSULTATION WITH AFFECTED PARTIES

Consultation with Member States

During the course of the Auto/Oil Programme which was to serve as the technical and scientific basis for legislation on car emissions and fuel quality, DG XI and DG III have conducted a series of meetings with national experts.

The purpose of the meetings was to fully inform Member States about all aspects of the programme and to ensure that their comments were taken into consideration.

In a meeting on 7 December experts from Member States were consulted on the proposed fuel quality specifications laid down in this directive. The experts in general welcomed the Commission's initiative to put forward legislative proposals on the quality of petrol and diesel fuels.

Experts from Austria, Denmark, Finland, Germany, Sweden and the Netherlands expressed their strong view of most of the petrol and diesel fuel specifications not being strong enough. Especially Finland and Sweden voiced the concern that the high quality fuel specifications currently in place in their countries could be endangered by the Commission's proposal for only moderate changes of fuel quality.

Experts from Ireland, France, Spain and Portugal were of the opinion that some fuel parameters in particular the sulphur content of both petrol and diesel fuel would be difficult for their refineries to achieve.

Consultation with the European oil and car industries (Europia and ACEA)

Both, the European associations of the oil (Europia) and the car (ACEA) industries were partners in the Auto/Oil Programme. The work carried out in the framework of the programme was based on the consensus of all partners involved. At a final technical meeting of the Auto/Oil Programme on 20 March 1996, the database and the methodology used for carrying out the cost-effectiveness ananlysis were approved.

The oil industry was also consulted on a number of technical questions which arose in the discussion on transposing the fuel parameter values used in the cost-efectiveness analysis into limit values.

With regard to the proposed specifications the oil industy has expressed its strong opposition concerning the intention to already indicate the need to make significant cuts in the sulphur content of petrol and diesel fuels in 2005. Europia considers this as a violation of the cost-effectiveness principle. With regard to the benzene content of petrol. Europia maintains its position that in view of the results of the air quality modelling carried out within the context of the Auto/Oil Programme a reduction of the current EU average market value of about 2.3% is not justified.

The car industry however considers the proposed fuel specifications for the year 2000 as too moderate and would like to see more severe limit values in particular with regard to the sulphur content of diesel fuels. ACEA claims that with the current proposal on fuel quality which amounts to yearly costs of around ECU 880 million for the oil industry puts the bulk of the total financial burden of ECU 5 326 million/year for the overall package of emission reduction measures on the car industry.

12. DESCRIPTION OF LEGISLATIVE SITUATION IN MEMBER STATES

Current European legislation on fuel quality

European legislation on fuel quality is currently limited to Directive 85/210/EEC on the lead and benzene content of petrol and EC Directive 93/12/EEC on the sulphur content of diesel fuel.

Directive 85/536/EEC sets out the framework for the addition of oxygenates into petrol. Member States have to permit a certain amount of oxygenates in the petrol and can allow those in excess of it.

According to the legislation referred to above Member States have to adhere to the following values:

Petrol

lead content (g/l) in leaded petrol:	> 0.15 - < 0.40
lead content (g/l) in unleaded petrol:	< 0.013
benzene content%V/V:	< 5.0

Diesel

sulphur content% m/m	0.2
	0.05 (1/10/1996)

Temporary derogations for new EU Member States at the time of their accession

The following countries were given temporary derogations with regard to some fuel components for which national legislation already existed:

Austria	benzene in petrol	3%
	sulphur in diesel	500 ppm
	ban of leaded petrol	
Sweden/Finland	ban of leaded petrol/continuation of currently existing tax incentive scheme for environmentally higher quality fuels.	

Additional national legislation

Some Member States have extended the existing European legislation to other fuel parameters and have given legal status to the technical norms set by the European Committee for Standardisation (CEN) for a range of fuel parameters. Tables 9 and 10 give an overview of the countries which enforced CEN-norms as legally binding, the fuel types and the environmentally important fuel components to which they apply.

Table 9

Diesel Fuel	
Specifications	**Limit values**
Density (kg/m3) Cetane number Distillation, T 95%	≥ 820 ≤ 860 ≥ 49 (temperate climate) ≤ 370 C° (temperate climate)

Countries: Finland, France, Germany, United Kingdom, Italy

Table 10

Unleaded Petrol (regular/premium)	
Specifications	**Limit values**
Sulphur content (%m/m) Reid vapour pressure (kPa) Distillation (E100) (%v)	≤ 0.05 ≥ 35 ≤ 100 (depending on seasonal and geographical conditions) ≥ 40 ≤ 70 (dep. on seasonal and geographical conditions)

Countries: Austria, France, Germany, and the United Kingdom. The CEN-norms for unleaded regular and premium petrol have also been applied for the super grade.

Denmark, Finland, Greece and Sweden have under Directive 92/81/EEC been granted derogations with regard to the introduction of reduced excise rates on environmentally friendly fuels. Applications from other Member States such as Ireland and the United Kingdom on the same issue are currently being evaluated by the Commission (see Chapter 5 'Fiscal Measures'). Tables 11 and 12 provide a comparison between the different diesel and petrol fuel qualities of some of these countries with the specifications proposed in this Directive.

Table 11: Comparison of Gasoline Fuel Parameters

Parameter	**(Units)**	**Sweden**	**Finland**	**Austria**	**EU specifications proposed for 2000**
Sulphur(max)	ppm	100	100	100	200
E. 100(min)	%	47	43	-	46
RVPsummer (max)	Kpa	70	70	58	60
Benzene(max)	Vol %	2	1	3	2.0
Aromatics (max)	Vol %	46	-	-	45
Olefins(max)	Vol %	-	-	-	I8*
Oxygen(max)	% m/m	2.0	2.7	-	2.3
Lead(max)	g/l	0.005	-	-	0.005

[* Except for unleaded petrol regular for which the maximum olefin content shall be 21/v/v.]

Table 12: Comparison of Diesel Fuel Parameters

Parameter	**(Units)**	**Sweden (*Category 1*)**	**Finland (*City Diesel*)**	**Denmark Ultra light (*Bus Fuel*)**	**EU Specifications proposed for 2000**
Cetane Number(min)	No.	50	49	50	51
Density(max)	kg/m3	820	850	855	845
Distillation 95% point (max)	°C	285	-	320	360
Polycyclic-aromatic hydrocarbons	% m/m	0.017	-	-	11
Aromatics	Vol %	5	20	-	-
Sulphur (max)	ppm	10	50	500	350

13. EXPLANATION OF PROVISIONS OF THE PROPOSAL

The scope of the Directive (Article 1)

The scope of the proposal is to use harmonization of the various national legislation and/or fuel quality norms to ensure, on the one hand, a high level of protection against urban and regional air quality problems caused by vehicles through the use of petrol and diesel fuels and, on the other hand, the functioning of the internal market. The proposed measures will not eliminate the negative environmental impacts, but reduce them to some degree.

Definitions (Article 2)

The definitions of the various fuels are made as close as possible to the current EU definitions.

Petrol (Article 3)

3.1 Lead is a harmful air pollutant and a poison for the catalytic converter required to fulfil the latest passenger car emission standards. By 1995 the market share of leaded petrol throughout the European Union has gone down to about 30% of the total petrol pool and is expected to be down at about 2% by the year 2000. By that time it is also estimated that the entire European car fleet will be able to run on unleaded petrol. The Commission therefore foresees the phasing out of leaded petrol by the year 2000.

3.2 The European Auto/Oil Programme has identified the potential of certain petrol fuel quality changes for emission reduction and therefore the improvement of air quality. The limit values proposed are in accordance with the fuel quality measures identified by the cost-effectiveness analysis.

3.3-
3.6 These paragraphs allow for a temporary, two-year derogation from the 1 January 2000 ban on leaded petrol in those Member States where this may result in severe socio-economic difficulties.

Diesel Fuels (Article 4)

As for petrol the European Auto/Oil Programme has identified the potential of certain diesel fuel quality changes for emission reduction and therefore the improvement of air quality. The limit values proposed are in accordance with the fuel quality measures identified by the cost-effectiveness analysis.

Free circulation (Article 5)

This Article is to ensure that Member States do not prohibit, prevent or restrict the marketing of fuels complying with the specifications set out under the Directive. This applies also in the case of Member States making use of the derogations under Article 6 where stricter specifications may be encouraged through the application of tax incentives.

Derogations-Special Fuels (Article 6)

This Article provides for the situation where, in specific locations which are subject to special air quality conditions, Member States may be granted derogations in order that they may require the use of cleaner "special" fuels

Change in supply of crude oils (Article 7)

The reformulation capacity required by refineries in each Member State will relate closely to their supplies of a certain crude oil quality. In order to avoid problems posed by a sudden change in the supply of crude oil petroleum products, the Commission can authorize higher limit values for one or more fuel components for a period not exceeding six months.

Monitoring compliance system and reporting (Article 8)

Member States are required to establish national compliance monitoring systems to ensure that the fuel quality limit values are respected in the market. For this purpose a uniform system should be developed for which the assistance of the European Committee for Standardisation (CEN) might be requested.

From the year 2002 onwards Member States are required to submit a yearly report on the market quality of petrol and diesel fuels.

Review of progress achieved (Article 9)

Within 12 months of the adoption of the proposed Directive and at the latest by 31 December 1998 the Commission will come forward with proposals for a revision of the Directive. This revison will be based on a comprehensive assessment carried out in accordance with Article 4 of the proposed amendment to Directive 70/220/EEC. The proposal will include a revised set of specifications for petrol and diesel fuels for the year 2005, including a significant reduction in the maximum sulphur content of both fuels. The proposal will also take account of possible action on alternative fuels.

Procedure for adaptation to technical progress and Committee procedures (Article 10 and 11)

Adaptation to technical progress with regard to the measuring methodes laid down in annexes I and II of this directive will be carried out by a Commission Committee established in accordance with Article 12 of Council Directive 96/.../EC[13].

Repeal of the existing directives related to the fuel quality of petrol and diesel fuels (Article 12)

All relevant regulations in the current directive related to certain petrol and diesel fuel components (85/210/EEC, 93/12, Article 1(b), Article 2(1) and (2) and 85/536/EEC) are transferred to the new proposal.

The existing Directive 93/12/EEC will remain valid with respect only to gas oils.

Transposition into National Legislation and Entry into Force (Articles 13 and 14)

These Aticles contain standard conditions.

Article 15

This Article contains standard wording.

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(13) Proposal submitted by the Commission on Ambient Air Quality Assessment and Management - COM(94) 109 final, 94/0106 (SYN), OJ No C 216, 6.8.1994, p. 4.

Proposal for a
EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE 96/0163 (COD)
relating to the quality of petrol and diesel fuels, and amending
Council Directive 93/12/EEC

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 100a thereof,;

Having regard to the proposal from the Commission[1],

Having regard to the opinion of the Economic and Social Committee[2],

Acting in accordance with the procedure referred to in Article 189b of the Treaty,

(1) Whereas disparity between the laws or administrative measures adopted by the Member States on specifications of conventional and alternative fuels used in spark-ignited and diesel vehicles creates barriers to trade in the Community and may thereby have a direct impact on the establishment and functioning of the internal market; whereas in accordance with the provisions of Article 3b of the Treaty, it therefore appears necessary to approximate the laws in this field;

(2) Whereas, Article 100a(3) of the Treaty envisages that Commission proposals aimed at the establishment and functioning of the internal market and concerning environmental protection will take as a base a high level of protection;

(3) Whereas primary air pollutants such as nitrogen oxides, unburnt hydrocarbons and particulate matter are emitted in significant amounts through the exhaust and evaporative fumes of motor vehicles thereby posing directly and indirectly through the development of the secondary pollutant ozone, a considerable risk to human health and the environment;

(4) Whereas despite the increasing stringency of vehicle emission limit values laid down by Council Directive 70/220/EEC[3], as last amended by Directive 96/ /EC of the European Parliament and of the Council[4], and by Council Directive 88/77/EEC[5], as last amended by Directive 96/1/EC of the European Parliament and of the Council[6], further measures to reduce atmospheric pollution caused by vehicles and other sources are necessary in order to achieve satisfactory air quality;

(5) Whereas Article 4 of Directive 94/12/EC of the European Parliament and of the Council[7] introduced a new approach with regard to emission reduction policies for and beyond the year 2000 and required the Commission to examine *inter alia* the contribution that improvements in the quality of petrol and diesel and other fuels could make to reducing air pollution;

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(1)

(2)

(3) OJ No L 76, 6.4.1970, p. 1.

(4) See p. of this Official Journal.

(5) OJ No L 36, 9.2.1988, p. 33.

(6) OJ No L 40, 17.2.1996, p. 1.

(7) OJ No L 100, 19.4.1994, p. 42.

(6) Whereas the European Auto/Oil Programme, the details of which are outlined in the Commission's Communication[8] on a future strategy for the control of atmospheric emissions from road transport, provides the scientific, technical and economic basis for the introduction at Community level of new environmental fuel specifications for petrol and diesel fuels;

(7) Whereas the introduction of environmental fuel specifications for petrol and diesel fuels is an important element of the cost-effective package of European-wide and national/regional/local measures identified by the European Auto/Oil Programme;

(8) Whereas the implementation of a combination of European-wide and national/regional/local measures to reduce vehicle emissions is part of the Commission's overall strategy to reduce air emissions from mobile and stationary sources in a cost-effective and balanced way;

(9) Whereas this Directive should apply without prejudice to the provisions of Council Directive 92/81/EEC[9], as last amended by Directive 94/74/EC[10], and in particular Article 8(4) thereof;

(10) Whereas fuel specifications aiming at the reduction of both exhaust and evaporative emissions are generally lacking;

(11) Whereas, it is to be expected that by 2000 all petrol-driven road vehicles should be able to run on unleaded petrol and whereas, therefore, leaded petrol should, as from that date, no longer be marketed;

(12) Whereas the need for vehicle emission reduction and the availability of the necessary refinery technology justify the setting of environmental fuel specifications for the marketing of unleaded petrol and diesel fuels;

(13) Whereas, in order to protect human health and/or the environment in specific locations with special problems of air quality, Member States should be permitted to require the marketing of special fuels;

(14) Whereas, in order to ensure compliance with the fuel quality standards required under this Directive, Member States should introduce monitoring systems. Such monitoring systems should be based on common procedures for sampling and testing;

(15) Whereas, on the basis of a comprehensive assessment, the Commission should, within 12 months of the adoption of this Directive, but in any case no later than 31 December 1998, come forward with a proposal to amend the provisions of this Directive;

(16) Whereas further developments with regard to reference methods for measuring the specifications set out in this Directive may be desirable in the light of scientific and technical progress; whereas to this end, provision should be made in order to adapt the Annexes to this Directive to technical progress;

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[8] OJ No C

[9] OJ No L 316, 31.10.1992, p. 12.

[10] OJ No L 365, 31.12.1994, p. 46.

(17) Whereas Council Directive 85/210/EEC of 20 March 1985 on the approximation of the laws of the Member States concerning the lead content of petrol[11], as last amended by the Act of Accession of Austria, Finland and Sweden, Council Directive 85/536/EEC of 5 December 1985 relating to crude-oil savings through the use of substitute fuel components in petrol[12], as amended by Commission Directive 87/441/EEC[13], and Article 1(1)(b) and Article 2(1) of Council Directive 93/12/EEC of 23 March 1993 relating to the sulphur content of certain liquid fuels[14], should be repealed accordingly,

HAVE ADOPTED THIS DIRECTIVE:

Article 1

Scope

This Directive sets technical specifications on health and environmental grounds for all fuels - conventional and alternative - to be used in spark-ignition and diesel vehicles.

Article 2

Definitions

For the purpose of this Directive:

1. "petrol" means any volatile mineral oil intended for the operation of internal combustion spark-ignited engines used for the propulsion of vehicles and falling within CN Codes 2710 00 27, 2710 00 29, 2710 00 32, 2710 00 34 and 2710 00 36.

2. "diesel fuels" means gas oils falling within CN Code 2710 00 69 and used for self-propelling vehicles as referred to in Directive 70/220/EEC, Directive 88/77/EEC and Council Directive 74/150/EEC[15] and those used for engines in non-road mobile machinery[16], which means any machine or vehicle with or without body work, powered by a compression ignition engine, with the exception of those vehicles intended for the use of passenger - or goods - transport on the road and agricultural tractors as defined in Article 1 of Directive 74/150/EEC, having a power output of not more than 560 kW^2.

Article 3

Petrol

1. As from 1 January 2000 Member States shall prohibit the marketing of all leaded petrol within their territory.

2. Member States shall ensure that within their territory petrol can be marketed only if, with regard to certain parameters of environmental relevance, they comply with the specifications set out in Annex I.

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(11) OJ No L 96, 3.4.1985, p. 25.
(12) OJ No L 334, 12.12.1985, p. 20.
(13) OJ No L 238, 21.8.1987, p. 40.
(14) OJ No L 74, 27.3.1993, p. 81.
(15) OJ No L 84, 28.3.1974, p. 10.
(16) OJ No C 328, 7.12.1995, p. 1.

3. By way of derogation from the provisions of paragraph 1, Member States may continue to permit the marketing of leaded petrol in their territory until three years after the adoption of this Directive, but in any case not later than 1 January 2002, if it can be demonstrated that the introduction of a total ban on the marketing of leaded petrol as from 1 January 2000 would result in severe socio-economic difficulties.

Member States wishing to make use of the derogation, must inform the Commission before 1 January 1999. The Member State shall also provide the Commission with a justification of the need for such a derogation.

The Commission may authorize the derogation for the marketing of leaded petrol.

The Commission shall notify the Member States and inform the Council of its decision.

Article 4

Diesel fuels

Member States shall ensure that within their territory diesel fuel can be marketed only if, with regard to certain parameters of environmental relevance, they comply with the specifications set out in Annex II.

Article 5

Free circulation

No Member States may prohibit, restrict or prevent the placing on the market of fuels which comply with the requirements of this Directive as from the date of application laid down in Article 13(1).

Article 6

Special fuels

1. By derogation from the provisions of Articles 3, 4 and 5, Member States may in specific areas in which atmospheric pollution constitutes or may reasonably be expected to constitute a serious and recurrent problem for human health and/or the environment, require the marketing of fuels of a higher quality than those foreseen in this Directive.

2. Member States wishing to make use of the derogation provided for in paragraph 1 must inform the Commission in advance, of the measures it intends to take. The Member State shall also provide the Commission with data on ambient air quality for the area in question as well as the predicted effects on air quality of the measures proposed. In addition, the Member State shall also provide the Commission with evidence that the proposed measures respect the principle of proportionality and that they will neither disrupt the free movement of persons and goods nor unduly distort competition.

The Commission, after informing the other Member States of the information received, may authorize the specific measures for the marketing of cleaner fuels as proposed by the Member State in question.

The Commission shall notify the Member States and the Council of its decision.

Any Member State may refer the Commission's decision to the Council within one month of its notification.

The Council, acting by a qualified majority, may take a different decision within one month of the matter being referred to it.

Article 7

Change in supply of crude oils

If a sudden change in the supply of crude oils or petroleum products renders it difficult for the refineries in a Member State to respect the fuel specification requirements of Articles 3 and 4, that Member State shall inform the Commission thereof. The Commission after informing the Member States, may authorize higher limit values in that Member State for one or more fuel components for a period not exceeding six months.

The Commission shall notify the Member States and the Council of its decision.

Any Member State may refer the Commission's decision to the Council within one month of its notification.

The Council, acting by a qualified majority, may take a different decision within one month of the matter being referred to it.

Article 8

Monitoring compliance system and reporting

1. Member States will establish programmes to monitor compliance with the requirements of Article 3(2) and Article 4.

2. The analytical methods used to determine the concentration/level of a substance/parameter in the fuel will be the standard methods specified in Annexes I and II.

3. The Commission will promote the development of a uniform system for compliance monitoring programmes. The Commission may for the purposes of developing such a system request the assistance of CEN.

4. Within 12 months after the date of entry into force of this Directive, Member States will submit to the Commission a detailed description of their national compliance programme.

5. As from the year 2002, Member States will submit to the Commission by 30 June each year a summary of the results from the national compliance monitoring programme from the previous calendar year. The Commission will establish a common format for the submission of such summary results.

Article 9

Review process

1. The Commission will, periodically and for the first time not later than 12 months from the date of adoption of this Directive but in any event not later than 31 December 1998, and in the light of the assessment carried out in conformity with the requirements of Article 5 of Directive 96/ /EC, submit to the European Parliament and the Council a proposal for a revision of this Directive. This proposal will include further, cost effective, improvements to the specifications for petrol and diesel fuels with regard to the parameters laid down in Annexes I and II to this Directive and should comprise, in particular, a significant reduction in the sulphur content of both petrol and diesel fuels, to come into effect on 1 January 2005. This action will form

an integral part of a strategy designed to produce effects to meet the requirements of the Community air quality standards and other related objectives at least cost.

2. In addition to the provisions of paragraph 1, the Commission may bring forward proposals to ensure the necessary availability and sufficient distribution throughout the Community before 2005, of fuels of a quality compatible with the effective functioning of the new pollution abatement technologies. In preparing such proposals the Commission shall have regard in particular, to considerations of air quality, cost-effectiveness and proportionality, and shall also take into account:

   - the latest information with regard to the interaction between fuel quality and the performance of new pollution abatement technologies such as the de-NOx catalyst;

   - the situation with regard to the development and production of the new pollution abatement technologies and the forecasts with regard to the marketing of vehicles equipped with such technologies;

   - the need to ensure that the measures proposed will neither disrupt the free movement of persons and goods nor unduly distort competition.

3. The proposal referred to in paragraph 1 shall be submitted to the European Parliament and the Council at the same time as the proposal referred to in Article 5 of Directive 96/ /EC; the measures shall enter into effect at the same time as the measures provided for in the proposal to be submitted in accordance with Article 5 of Directive 96/ /EC.

Article 10

Procedure for adaptation to technical progress

Any amendments which are necessary in order to adapt the measuring methods as laid down in Annexes I and II to this Directive, to take account of technical progress, shall be adopted by the Commission assisted by the Committee established in accordance with Article 12 of Directive 96/.../EC[17] and in accordance with the procedure laid down in Article 11 of this Directive.

Article 11

Committee procedure

The representative of the Commission shall submit to the committee a draft of the measures to be taken. The committee shall deliver its opinion on the draft, within a time limit which the chairman may lay down according to the urgency of the matter, if necessary by taking a vote.

The opinion shall be recorded in the minutes; in addition, each Member State shall have the right to ask to have its position recorded in the minutes.

The Commission shall take the utmost account of the opinion delivered by the committee. It shall inform the committee of the manner in which its opinion has been taken into account.

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(17) Proposal submitted by the Commission on Ambient Air Quality Assessment and Management - COM(94) 109 final, 94/0106 (SYN), OJ No C 216, 6.8.1994, p. 4.

Article 12

Repeal and amendment of the existing directives related to the fuel quality of petrol and diesel fuels

1. Directive 85/210/EEC and Directive 85/536/EEC are repealed as from the date of application laid down in Article 13(1).

2. Directive 93/12/EEC is amended by deleting Article 1(1)(b) and Article 2(1) as from the date of application laid down in Article 13(1).

Article 13

Transposition into national legislation

1. Member States shall adopt and publish the laws, regulations and administrative provisions necessary to comply with this Directive not later than 1 July 1999. They shall immediately inform the Commission thereof.

   Member States shall apply these provisions from 1 January 2000.

   When Member States adopt these provisions, these shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The procedure for such reference shall be adopted by Member States.

2. Member States shall communicate to the Commission the texts of the provisions of national legislation which they adopt in the field covered by this Directive.

Article 14

Entry into force of the Directive

This Directive shall enter into force on the twentieth day following that of its publication in the Official Journal of the European Communities.

Article 15

Addressees

This Directive is addressed to the Member States.

Done at Brussels,

For the European Parliament
The President

For the Council
The President

ANNEX I

ENVIRONMENTAL SPECIFICATIONS FOR MARKET FUELS TO BE USED FOR VEHICLES EQUIPPED WITH POSITIVE IGNITION ENGINES

Type: Petrol

Parameter	Unit	Limits[1]		Test Method[2]
		Minimum	Maximum	
Reid vapour pressure, . summer period[3]	kPa	--	60.0	EN 12
Distillation[4]: evaporated at 100 °C evaporated at 150 °C	% v/v	46.0 75.0	-- --	ISO 3405
Hydrocarbon analysis: . olefins . aromatics . benzene	% v/v	-- -- --	18.0* 45.0 2.0	ASTM D1319 EN 238
Oxygen content	% m/m	--	2.3	prEN 1601
Sulphur content	ppm	--	200	ISO 8754
Lead content	g/l	--	0.005	EN 237

(1) The values quoted in the specification are "true values". In establishment of their limit values the terms of ISO 4259 "Petroleum products - Determination and application of precision data in relation to methods of test" have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account (R - reproducibility).
Should it be necessary to clarify the question as to whether a fuel meets the requirements of the specification, the terms of ISO 4259 should be applied.

(2) Equivalent ISO methods will be adopted when issued for all properties listed above.

(3) The summer period extends from 1 April to 30 September of each year and relates to all volatility classes as specified under EN228.

(4) The figures quoted show the evaporated quantities (percentage recovered + percentage loss).

[* Except for unleaded petrol regular (minimum motor octane number (MON) of 81 and a minimum research octane number (RON) of 91) for which the maximum olefin content shall be 21% v/v].

ANNEX II

ENVIRONMENTAL SPECIFICATIONS FOR MARKET FUELS TO BE USED FOR VEHICLES AND NON-ROAD MOBILE MACHINERY EQUIPPED WITH COMPRESSION IGNITION ENGINES

Type: Diesel fuel

Parameter	Unit	Limits[1]		Test Method[2]
		Minimum	Maximum	
Cetane number		51.0	--	ISO 5165
Density at 15 °C	kg/m^3	--	845	ISO 3675
Distillation [3]: 95% point	°C	--	360	ISO 3405
Polycyclic aromatic hydrocarbons	%m/m	--	11	prIP391
Sulphur content	ppm	--	350	ISO 8754

(1) The values quoted in the specification are "true values". In establishment of their limit values the terms of ISO 4259 "Petroleum products - Determination and application of precision data in relation to methods of test" have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account (R - reproducibility).
Should it be necessary to clarify the question as to whether a fuel meets the requirements of the specification, the terms of ISO 4259 should be applied.

(2) Equivalent ISO methods will be adopted when issued for all properties listed avove.

(3) The figures quoted relate to the evaporated quantities (percentage recovered + percentage loss).

FINANCIAL STATEMENT

SECTION I - FINANCIAL CONSEQUENCES (PART B OF THE BUDGET).

1. TITLE OF OPERATION

Proposal for a European Parliament and Council Directive relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC.

2. BUDGET HEADING INVOLVED

B4-304 Environmental Legislation and other general actions based on the 5th Action Programme relating to the environment [Projects (XI.D.3].

3. LEGAL BASIS

EU Treaty Article 100a, Resolution of the Council and the Representatives of the Governments of the Member States meeting within the Council of 1 February 1993 on a Community programme of policy and action in relation to the environment and sustainable development (OJ No C 138, 17.5.1993, p. 1).

4. DESCRIPTION OF OPERATION

4.1 General objectives

The European Union has a longstanding history in reducing vehicle emissions. However, despite the considerable achievements with regard to the emission reduction of individual vehicles, increased traffic activity (increased number of vehicles, increased kilometers travelled) is likely to counteract these improvements thereby preventing the emission reductions necessary to achieve future air quality objectives.

The likelihood of further action to reduce vehicle emissions necessitated a reassessment of the existing policy approach; it being apparent that the emission reduction potential offered by further improvements in vehicle technology was limited and possibly very costly in comparison with other potential solutions.

Therefore a new, comprehensive and integrated approach was developed which is set out in Directive 94/12/EC, Article 4. Article 4 stipulates that measures to be assessed with regard to their benefits and costs shall include improved vehicle technology, more appropriate mechanisms to reduce the in-use deterioration of emission control systems and "improvements in fuel quality as far as vehicle emissions of dangerous substances (in particular benzene) are concerned".

The changes in the quality of both, petrol and diesel fuels, legislated for in this proposal will considerably reduce emissions of pollutants such as benzene, volatile organic compounds (VOCs), nitrogen oxides (NOx), carbon monoxide (CO) and particulate matter (PM). With these emission reductions a significant contribution will be made to the achievement of future air quality objectives.

4.2 Period covered and arrangements for renewal or extension

The proposed Directive requires:

* *that Member States:*

  - will ensure that as from 1st January 2000 only fuels which correspond to the specifications laid down in the Directive can be marketed within their territory;

  - will establish programmes to monitor compliance with the Directive;

  - as from the year 2002 the Member States will submit to the Commission a summary of the results from the national compliance monitoring programme;

* *that the Commission:*

  - will promote the development of a uniform system for compliance monitoring programmes. For the purpose of developing such a system the assistance of the European Committee for Standardization might be requested;

  - submits a report to Council and Parliament assessing the need for further action in the field of fuel quality, including possible action on alternative fuels;

  - prepares a revised proposal on the sulphur content of diesel fuel which will be necessary at a time when new vehicle technologies such as the de-NOx catalyst are on the market;

  - convenes the meeting of the Committtee for Adaptation to technical progress.

5. CLASSIFICATION OF EXPENDITURE OR REVENUE

DNO and CD

6. TYPE OF EXPENDITURE

- Technical work directly linked to the development of a uniform system for compliance monitoring programmes;

- Technical work linked to the development of new proposals, in particular those dealing with alternative fuels and the relationship between new vehicle technologies and fuel quality;

- Technical work linked to the preparation of Commission Directives through the Committee procedure.

7. FINANCIAL IMPACT

7.1 Method of calculating total cost of operation (definition of unit costs)

- Technical assistance with the development of a uniform fuel quality monitoring system through CEN. Total costs would amount to ECU 250 000.

- Technical assistance with regard to the development of new proposals, in particular those dealing with alternative fuels and the relationship between new vehicle technologies and fuel quality. The costs would amount to ECU100 000/year between 1998 and 2000.

7.2 Itemized breakdown of cost (in ECU)

ECU million
(money of the day)

Breakdown	Year n	n+1	n+2	n+3	n+4	n+5 and subseq.	Total
- Technical assistance uniform fuel quality monetary system - CEM		0.11	0.11 0.1	0.03 0.1	0.1		
- Technical assistance development new proposals							
Total		0.11	0.21	0.13	0.1		0.55

7.3. Indicative schedule of appropriations

	Year n	n+1	n+2	n+3	n+4	n+5 and subseq.	Total
Comitment appropriations		0.11	0.21	0.13	0.1		0.55
Payment appropriations							
n n+1 n+2 n+3 n+4 n+5 and subseq.		0.077 0.033	0.147 0.063	0.091 0.039	0.07 0.03		
Total		0.11	0.21	0.13	0.1		0.55

8. ANTI-FRAUD DISPOSITIONS

- It will be explicitly specified in contracts that all work performed is the property of the Commission.

- Final payment of contractors will only take place after reception and examination of the reports and services requested.

SECTION II - ELEMENTS OF COST-EFFECTIVENESS ANALYSIS

9.1 Specific and quantifiable objectives; target population

The general objective of the operation is to increase the protection of:

- human health, ecosystems, vegetation and material against the impact of various air pollutants such as nitrogen oxides, hydrocarbons and ozone;

- human health additionally against the impact of particulate matter;

- ecosystems additionally against the impact of nitrogen oxides deposition ("acid rain") on land and water.

According to the results of the European Auto/Oil Programme which provided the technical basis for the present directive, changes in the quality of both petrol and diesel fuels can make a significant contribution to the reduction of exhaust and evaporative fumes of motor vehicles. This Directive foms part of a package of measures derived from the Auto/Oil Programme. The package of measures is designed to deliver reductions in the emissions from road transport compatabile with the attainment of rigorous air quality standards for carbonmonoxide (5 $\mu g/m^3$ as a 98 percentile of 8 hourly values), nitrogen dioxide (93 $\mu g/m^3$ as a 98 percentile of hourly values), benzene (10 $\mu g/m^3$ as an annual mean), particulate matter (50$\mu g/m^3$ as a 24-hour running average) and regional ozone (180$\mu g/m^3$ as a 1-hour average).

This proposal will contribute to emission reductions across Europe in the range of 70% for oxides of nitrogen and volatile organic compounds, 65% for urban particulates and 75% for urban carbon monoxide.

9.2 Grounds for the operation

While some fuel components such as lead and benzene in petrol and sulphur in diesel have been subject to Community legislation, fuel quality as a whole as covered by this Directive has not. According to the considerations that are described above and in Chapter 4 of the Explanatory Memorandum changes in the quality of both petrol and diesel fuels contribute significantly to improved air quality with regard to nitrogen oxides, particulate matter, benzene and ozone.

Thus it would be unreasonable to neglect this source of pollutants which can be reduced in a cost-effective way as the results of the Auto/Oil Programme have shown.

9.3 Monitoring and evaluation of the operation

Monitoring compliance system

In order to ensure compliance with this Directive, Member States are required to establish national compliance monitoring systems.

The Commission will promote the development of a uniform system as a common basis for Member States to carry out these programmes and to be in a position to forward to the Commission this information on a comparable base.

For this purpose the Commission is likely to seek the assistance of the European Committee for Standardization (CEN).

The Member States are required to submit 12 months after the date of entry into force of the Directive a detailed description of their national compliance programme and as from the year 2002, by 30 June of each year, a summary of the results from these programmes for the previous calendar year.

Air quality

The Commission, in cooperation with the Member States, will monitor the development of air quality on an urban and regional level in order to verify the air quality predictions which have guided the currently proposed legislative measures.

The results of this monitoring exercise will be one of the main elements of a report the Commission is required to bring forward at the latest by 30 June 2002 and *inter alia* will be the basis for deciding whether proposals for amendments and/or extensions to this Ddirective will be necessary.

SECTION III - ADMINISTRATIVE EXPENSES (PART A OF THE BUDGET)

10. ADMINISTRATIVE EXPENDITURE (Part A of section III of the Budget)

10.1 Increase in staff

Type		Human Resources		Human Resources		Length
		Permanent jobs	Temporary jobs	Existing human resources in the DG or service	Additional human resources	
Civil servants or temporary agents	A B C					
Other						
Total		0	0	0	0	

10.2 Financial global impact of additional human resources

	Amounts	Mode of computation
Civil servants Temporary agents Other resources	0 0 0	
Total (ECU)	0	

10.3 Increase of other operative expenses

Budget item	Amounts	Mode of computation
A-2510 (Travel for the Committee foreseen under Article 11 of the proposal	20 850	15 x ECU 695/meeting x 2 meetings/year
Total (ECU)	20 850	

IMPACT ASSESSMENT FORM

The Impact of the proposal on business with special reference to small and medium-sized enterprises (SMEs)

TITLE OF THE PROPOSAL

Proposal for a European Parliament and Council Directive on environmental fuel specifications with regard to gasoline and diesel.

Reference Number (Repertoire):

1. **TAKING INTO ACCOUNT THE PRINCIPLE OF SUBSIDIARITY, WHY IS COMMUNITY LEGISLATION NECESSARY IN THIS AREA AND WHAT ARE ITS MAIN AIMS?**

The matter concerns harmonization of the internal market and therefore is an issue of exclusive Community competence. The market in transport fuels is considerable (about 290 00 million litres in 1995) and despite the existence of norms laid down by the European Committee for Standarization (CEN) for certain fuel components, the majority of the petrol and diesel fuel market is characterised by numerous permissible levels for a number of fuel components (e.g. sulphur, aromatics, benzene). The proposal asserts an increased level of harmonization to replace the existing range, thus ensuring the proper functioning of the market.

The main aim of the Directive is to reduce vehicle emissions in order to achieve future EU-wide air quality objectives and is part of a legislative package which the Commission intends to put forward for this purpose. The directive is part of the outcome of the European Auto/Oil Programme which explored cost-effective combinations of measures sufficient to achieve, by 2010, stringent air quality standards with respect to the most important urban and regional pollutants such as nitrogen oxides, particulate matter and ozone. The programme investigated the cost and the potential of a variety of different measures inter alia improved vehicle technology, inspection and maintenance schemes, changes in the quality of fuels and a number of non-technical measures such as scrappage schemes and road pricing.

Drawing on the results of the Auto/Oil Programme, the Commission has decided upon a package of legislative proposals to be submitted to Council and Parliament:

- a proposal on a mild reformulation of petrol and diesel fuels (this proposal);
- a proposal to strengthen the emission limits for passenger cars (a proposal accompanying this proposal);
- proposals to strengthen the emission limits for light and heavy duty vehicles (1996/ 1997);
- a proposal with regard to the strengthening of the current legislation on inspection and maintenance (in 1997).

With this legislative package the Commission estimates that by 2010, the above pollutants will be reduced considerably as compared to what the emissions would have been in the absence of these measures.

2. WHO WILL BE AFFECTED BY THE PROPOSAL?

- **Which sectors of business?**

  Changes in the quality of gasoline and diesel fuels affect refiners and therefore oil companies, the petrochemical industry and individual consumers driving a gasoline or diesel vehicle.

  There may also be effects for traders' organization who import petrol and/or diesel fuels from regions with less strict environmental fuel specifications.

- **Which sizes of businesses?**

  All oil and petrochemical companies can be considered to be large. Traders' organizations are small/medium enterprises.

- **Are there particular geographical areas of the Community where these businesses are found?**

  Refineries, petrochemical companies and traders' organizations are found in all regions of the Community.

3. WHAT WILL BUSINESS HAVE TO DO TO COMPLY WITH THE PROPOSAL?

Refineries will have to change their refinery processes, install new process units and/or have to undertake blending operations in order to achieve the changes in gasoline and/or diesel fuel quality as required by the directive. The mechanisms used to control each of the fuel parameters are all currently available and proven technologies.

Some changes can also be met by changes in crude oil diet e.g. to low sulphur crude types, such as North Sea, which tend to be high in benzene and aromatics content, or to low benzene/aromatics crude types such as Middle East (which tend to be high in sulphur).

There are no obligations posed on petrochemical companies and individual fuel users associated with the proposed Directive.

4. WHICH ECONOMIC EFFECTS IS THE PROPOSAL LIKELY TO HAVE?

- **On employment?**

  The proposal will require significant investment for the refining industry (see below). Given the current over-capacity and narrow operating margins for the industry it is possible that the proposal may have a negative efffect on employment in the refining industry.

  However, in the area of feed-stock production (such as oxygenates) and of research and development a positive employment effect is likely to be seen. Production of oxygenates needs to be improved considerably in order to meet the required blending capacity. Some of this additional production capacity will be installed in Europe. In the area of research and development it can be expected that the search for more competitive, less costly refinery processes will stimulate the engineering/construction business which might have some positive effects on employment.

For the petrochemical industry estimations with regard to employment development are difficult to make. An oversupply in benzene through fuel reformulation is likely to have a negative effect on Europe's main benzene source for aromatic production of pygas. Ethylene producers might therefore loose some of their competitiveness. However, ethylene producers are in most cases also producers of aromatics and with the cheaper feedstock of benzene might be able to increase the aromatics production. The effect on employment is uncertain.

There are unlikely to be any significant employment effects for the traders' organizations.

- **On investment and creation of new business?**

According to cost estimations carried out under the Auto/Oil Programme, the achievement of the presently proposed fuel specifications requires refineries to invest a total of about ECU 8 442 million. The costs are based on the value of the ECU in 1995 and a project life of 15 years from 2000 onwards. Investments are envisaged to take place over 4 years between 1996 and 1999 with 15% being invested in 1996 and 1999 and 35% in each of the years 1997/98. In addition to the capital investment costs, fixed operating costs of ECU 342 million and energy costs of ECU 171 million will have to be borne by the European refining industry. .

All costs are aggregated costs which do not reflect individual refinery and regional variations. The variations in costs due to these individual and regional differences are not estimated to be uniform because the impact of the quality parameter changes depends on both feedstock and refinery configuration. The size of the refinery with regard to cost variations is likely to play a relatively small role compared to the influence of feedstock availability and refinery configuration.

New business can be expected with regard to the production of oxygenates as a feedstock product. As shown earlier, the need for this product in order to compensate for octane loss through reduction of benzene and aromatics will increase considerably. Refineries themselves might expand their production of oxygenates through better technologies (new catalysts) and/or new production units.

For petrochemical companies it is difficult to predict whether a loss of feedstock production (pygas) can be compensated by higher aromatic production and what consequences these developments would have for the employment situation.

- **On the competitiveness of businesses?**

The impact of the proposal on individual refineries will vary considerably as a function of the current technical configuration. While in the case of some refineries only minimal investment will be required others will need extensive upgrading dependent upon their technical configuration.

On the petrochemical side, increased availability of benzene from gasoline reformulation could adversely affect the production of an important feedstock product - pygas. Pygas is the biggest source of benzene for the aromatics market in Europe and if the value of pygas were to fall in view of over supply of benzene from other sources, the European ethylene producers would be at a competititve disadvantage.

The competitiveness of traders' organizations might be affected if their import of petrol and diesel fuels mainly comes from sources with less strict or no environmental fuel specifications. Traders can maintain or regain competitiveness if they ensure sufficient diversity of import sources.

5. DOES THE PROPOSAL CONTAIN MEASURES TO TAKE INTO ACCOUNT THE SPECIFIC SITUATION OF SMALL AND MEDIUM-SIZE FIRMS (REDUCED OR DIFFERENT REQUIREMENTS, etc.) ?

All refineries and petrochemical companies in Europe can be considered to be large enterprises.

Traders' organizations have sufficient means to maintain their position in the market e.g. by diversification of import sources.

The users of reformulated fuels will be insignificantly affected by negligibly increased prices for these fuels.

Thus particular measures in favour of small and medium-sized companies appear to be unnecessary.

6. CONSULTATION

List of organizations which have been consulted with regard to the proposal and outline of their main views:

- Europia (European Petroleum Industry Association);

- ACEA (European Automobile Manufacturers Association);

- APA, a sector group of CEFIC (Aromatics Producer Association).

Europia/ACEA

Both, the European associations of the oil (Europia) and car (ACEA) industries were partners of the Auto/Oil Programme. The work carried out in the framework of the programme was based on the consensus of all partners involved. At a final technical meeting of the Auto/Oil Programme on 20 March 1996, the database and the methodology used for carrying out the cost-effectiveness analysis were approved.

The oil industry was also consulted on a number of technical questions which arose in the discussion on transposing the fuel parameter values used in the cost-effectiveness analysis into limit values.

With regard to the proposed specifications the oil industy has expressed its reservations concerning the limit values for the sulphur content of both fuels in particular those for petrol claiming that the emission benefits are not in proportion to the costs incured. Another area of concern for the oil industry is the benzene content of petrol. Europia maintains its position that in view of the results of the air quality modelling carried out within the context of the Auto/Oil Programme a reduction of the current EU average market value of about 2.3% is not justified.

The car industry on the other hand considers the proposed fuel specifications as too moderate and would like to see more severe limit values in particular with regard to the sulphur content of diesel fuels. ACEA claims that with the current proposal on fuel quality which amounts to yearly costs of around 880 million ECU for the oil industry puts the bulk of the total financial burden of ECU 5 326 million/year for the overall package of emission eduction measures on the car industry. However, this argument of burden sharing between the two industries is not in line with the request for a cost-effective solution to future air quality problems which is required by Directive 94/12/EC, Article 4.

APA

APA's concern is that with increasing amounts of benzene from gasoline reformulation in Europe and the U.S. Pygas production, as a major benzene source for aromatics production in Europe, would be significantly reduced. In addition, while aromatics production could be increased in principle due to cheaper benzene feedstock prices, APA fears that developments of the aromatic markets in other parts of the world will prevent Europe from finding an adequate export market.

Proposal for a

EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE **96/0164 (COD)**

relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directives 70/156/EEC and 70/220/EEC

EXPLANATORY MEMORANDUM

A. Objective of the proposal

The objective of this proposal is to strengthen Community requirements aimed at limiting new passenger car polluting emissions. These are governed by Directive 70/220/EEC, as last amended by Directive 94/12/EC. The proposal forms part of a global Community strategy which will include strengthened requirements for passenger cars, light commercial vehicles and heavy duty vehicles[1] from year 2000, new minimum standards for motor fuels and enhanced in-use vehicle emission requirements. This set of measures, in combination with additional measures taken at local level, represents, in view of the Commission, an optimal package of legislative actions which will ensure that the Air Quality targets identified in the course of the implementation of the Auto/Oil Programme will be met by year 2010. In addition, this proposal includes a revision of the framework for emission-related fiscal incentives and emissions values corresponding to the foreseen Stage 2005 car emission standards. The Auto/Oil Programme itself is described in a separate auto/oil Communication.

B. Legal basis

The measures are proposed on the basis of Article 100a of the Treaty of the Union. They are consistent with the Council recommendation on the 5th Environmental Action Programme, which announced the need for a further improvement of car emission standards from the year 2000. The measures form part of the European Type-Approval system for cars and compliance with them will be mandatory for new approvals to be issued by national authorities. The measures reflect the traditional legislative approach followed in this sector namely total harmonization of all relevant technological prescriptions. The measures set the performance standards, leaving to the producers themselves, the design and manufacture of equipment necessary to ensure that these are met. This legislative approach is fully supported by the operators in the market.

The text is relevant for the EEA Treaty.

C. Background

Much progress has been achieved in improving air quality in Europe through the successive tightening of emission standards. Since the first emission directive of 1970, the overall reduction of emissions from new passenger cars has been in the order of 90%, depending on the pollutant concerned (carbon monoxide emissions (CO), unburned hydrocarbons and nitrogen oxides emissions (HC + NOx)).

The Auto/Oil Programme was set up, because it was recognized that, since additional reductions of emissions from new vehicles from the year 2000 would be increasingly difficult to achieve technologically and would be costly, future standards would have to be established on a more scientific basis which would allow for full account to be taken of the potential advantages and disadvantages of all possible measures to reduce emissions.

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(1) Directive 88/77/EEC, as last amended by Directive 96/1/EC.

1. Article 4 of Directive 94/12/EC: the multi-faceted approach

Directive 94/12/EC adopted by the European Parliament and the Council on 23 March 1994, which set new emission limit values for new types of passenger cars from 1996, stipulated in Article 4 that the Commission should propose new measures to be implemented in the year 2000, according to a new multi-faceted approach, based on a comprehensive assessment of costs and effectiveness of all measures aimed at reducing road transport pollution. The Article stated that the proposal should include, besides tightened car emission standards, complementary measures, such as improvements in fuel quality and a strengthening of inspection and maintenance programmes for the car fleet.

Article 4 of Directive 94/12/EC requires that the Commission base its proposals on two pillars:

- the establishment of air quality criteria and associated emission reduction objectives;
- an evaluation of the cost/efficiency of each proposed measure, taking into account the potential contribution of other measures such as:
- traffic management;
- enhancement of urban public transport;
- new propulsion technologies;
- the use of alternative fuels.

Thus, Article 4 requires that the cost/effectiveness assessment should be carried out not only for the measures which will be proposed by the Commission (improvement of new vehicle technology, of fuels, technical inspection), but also encompassing all measures permitting the reduction of pollution by road traffic, regardless whether they are of the responsibility of Member States or of local authorities.

This multi-faceted cost/effectiveness approach differs from the usual approach based on the assessment of the Best Available Technology. However, Article 4 also stipulated to the Commission that the Stage 2000 proposal would need to achieve a "substantial" reduction in emissions. The next stage will also continue to be founded on Article 100a of the Treaty, i.e. the proposal should be based on a "high level" of environmental protection. There is thus, to some degree, a need to reconcile these two different concepts. However, application of the Best Available Technology principle independently for each separate measure would lead in all likelihood to a sub-optimal set of measures, economically as well as environmentally. The multi-faceted approach therefore aims at determining the best cost/effective package of measures with a view to achieving a high level of protection.

2. The Auto/Oil Programme

In accordance with the principle of shared responsibility expressed in the 5th Environmental Action Programme, the Commissioners for Energy, Environment and Industry, at the end of 1992, decided to initiate a technical scientific work programme for the purpose of providing a solid technical foundation upon which to base its future legislative proposals. The Commission invited the European Automobile manufacturers and Oil industry trade associations (ACEA and EUROPIA) to make available their considerable know-how and expertise. The two industries responded positively to this invitation and together with the Commission services designed, planned and executed the programme which subsequently became known as the Auto/Oil Programme.

The objective of the Auto/Oil Programme was to provide policy-makers with an objective assessment of the most cost-effective package of measures including vehicle technology, fuel quality, inspection and maintenance measures and non-technical measures, necessary to reduce emissions from the road transport sector to a level consistent with the attainment of the new air quality standards being developed for adoption across the European Union.

The work organization, assumptions and outcomes of the Auto/Oil Programme are described in the accompanying Commission Communication on the Auto/Oil Programme and Future Strategies to Reduce Emissions[2].

3. Changes to vehicle technology

Within the framework of the Auto/Oil Programme, European vehicle manufacturers were asked to provide estimates of the additional costs which would be required in order to equip their vehicles with the technology necessary to achieve a series of progressively more stringent emission scenarios.

The main findings of the cost analysis of vehicle technologies are that:

- significant reductions in pollutant emissions are possible through improved vehicle technology;
- applying the most stringent reduction scenario to all vehicle categories would represent an annual cost of ECU 5.5 billion (in 1995 ECU) to the Union;
- when expressed as a cost per vehicle, the most stringent packages for which cost data were provided equate to an increase of 3-5% on current purchase price (excluding taxation).

In addition, as part of the Auto/Oil Programme, data were collected with regard to cost and to the efficiency of the various mechanisms designed to reduce the rate of deterioration of the emission control systems.

Two technical devices by which such improvements can be achieved have been studied:

- electronic sensors installed on the vehicle to monitor the performance of the emission control systems - referred to commonly as on-board diagnostics (OBD);
- "In-use compliance testing" procedures whereby vehicles can be recalled by authorities and if necessary repaired if their emission performance deteriorates beyond an acceptable level;

Inspection and maintenance requirements have also been shown to be particularly cost-effective.

4. Cost effectiveness optimization

On the basis of the data available on the costs and potential benefits of the various technical measures (engine technology, fuel quality and improved inspection and maintenance of emissions control systems), it has been possible to identify the most cost/effective packages of technical measures necessary to achieve a significant reduction of urban NOx, particulate matters in the most polluted areas and ozone precursors at European level.

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(2) COM(96) ..... of ..... June 1996.

D. Consultations of interested parties

1. Position of industry

The motor and oil industries were associated and were consulted throughout the Auto/Oil Programme. These industries accepted the methodology as well as the majority of the results. The car manufacturers would have liked a method of calculation from the emissions giving more weight to measures with an immediate effect, by the taking into account of an emission carry over method or "emission discounting". However, the Commission considers that a sustainable policy of improvement of the air quality shall be based on balanced mix of immediate and long-term measures which is the objective with the overall 2000 Stage strategy. The car manufacturers consider that the main cost burden falls on it and that a certain rebalancing of the measures should be carried out. The Commission considers nevertheless that the proposed measures have to fulfil cost/effectiveness criteria. In this respect, the optimisation made during the programme shows that, in general, the measures affecting the vehicles are the most effective ones.

2. Position of the Member States

Member States were informed and were consulted regularly throughout the programme. They considered that the orientations described by the Commission, in particular at an informal meeting on 7 December 1995, were in general acceptable. Half of the Member States could support of stricter measures than those envisaged at the time, in particular for the petrol cars.

The principle of a later "Stage 2005" serving as a basis for granting tax incentives was not disputed. A majority of the Member States experts were in favour of an ambitious regulatory stage with a review clause.

3. Position of the European Parliament

Four specific meetings were organized to inform the Members of the European Parliament of the work carried out. While the members of the European Parliament expressed their sympathy with the principles underlying the programme, they expressed some regret that certain interested parties had been less consulted, notably equipment suppliers, the fuel additive producers and non governmental organizations. Members also regretted the delay in presenting of the proposals. They are awaiting the specific proposals before to take formally taking a position with the expectation that proposals will take into account of the precautionary principle of as well as the need to harmonize on the basis of the best available technology.

E. Content of the proposal

1. Passenger car emission standards - modification of Directive 70/220/EEC

In accordance with the results of the Auto/Oil Programme, the Commission proposes that emissions standards for passenger cars are tightened and improved by the adding of new requirements. It is proposed that these measures (discussed below in detail) should apply from the year 2000 for new vehicle types and from 2001 for all new vehicles. A second regulatory stage should also be envisaged to be applied from 2005 for new vehicle types and from 2006 for all new vehicles. This should however be confirmed (see below).

1.1 Test of the tailpipe emissions after a cold start ("type I test")

The Type I test constitutes the main element of the Directive. It aims at the effective limitation of the air-polluting emissions of motor vehicles with a total mass up to 3 500 kg driven in typical urban and extra-urban traffic conditions.

The driving cycle which simulates such traffic conditions for the purpose of carrying out this test in the laboratory will be modified in order to better represent a typical vehicle cold start. As suggested by the Commission's Motor Vehicle Emission Group, the 40 second warm up period before the sampling of the exhaust gases permitted in the current test will be deleted. This change will result for gasoline vehicles in a considerable increase of the emissions of carbon monoxide (up to 40%) and hydrocarbons measured during the test. Notwithstanding changes of the limit values, this measure by itself constitutes a significant severisation of the requirements of the Type I test.

1.2 Limit values in the year 2000

The proposed new limit values to be applied from the year 2000 represent reductions, against Stage 1996 emissions standards, of:

- 40% nitrogen oxides, 40% hydrocarbons, 30% carbon monoxide for petrol engined passenger cars;

- 20% nitrogen oxides, 20% for the combined value for hydrocarbons plus nitrogen oxides, 40% carbon monoxide, 35% particulate matter for diesel passenger cars equipped with indirect injection engine;

- 40% nitrogen oxides, 40% for the combined value for hydrocarbons plus nitrogen oxides, 40% carbon monoxide, 50% particulate matter for diesel passenger cars equipped with direct injection engines which presently comply with less stringent limit values.

These reductions correspond to scenarios evaluated in the Auto/Oil Programme, as described in the Auto/Oil Communication. The new limit values for diesel vehicles no longer make a distinction between indirect and direct injection engines, since direct injection technology will be mature by year 2000 and will therefore be able to comply with the general requirements for diesel vehicles.

In applying these reductions to the present limit values of Directive 94/12/EC the combined limit value for hydrocarbons and nitrogen oxides has to be broken down. In the past it has been assumed that the ratio of these pollutants in the exhaust emissions was 55 to 45 for petrol cars and 20 to 80 for diesel cars. These ratios were established when the limit values for hydrocarbons and nitrogen oxides were combined for the first time in Directive 83/351/EEC. Recent data shows, however, that for modern diesel engines, in particular when equipped with oxidation catalysts, a ratio of 10 to 90 is more representative.

For petrol cars separate limit values are now proposed for hydrocarbon and nitrogen oxide emissions, in order to achieve specific emission reductions for both pollutants. However, a combined limit value for these pollutants is still maintained for diesel cars for which the Stage 2000 standards are particularly demanding, in order to assure the flexibility necessary for the engineering of future diesel engines and associated emissions reduction technologies. In addition diesel cars emit unburned hydrocarbons at a very low level. However, in accordance with the emphasis which the Commission attributes to the control of nitrogen oxide emissions, the combined value is completed by a separate limit value for nitrogen oxides emissions.

The incremental costs of the proposed Stage 2000 standards have been assessed in the Auto-oil cost/effectiveness study, as has the technology require to fulfil these standards. The mean calculated costs are from ECU 113 for a small gasoline car to ECU 402 for diesel cars. The standards will require technologies like close coupled catalyst, improved injection, dual oxygen sensor for gasoline vehicles, and fully electronic pump and electronically-controlled exhaust gas recirculation for diesel vehicles. The Auto/Oil Programme has shown that they will be available by the year 2000.

The proposed Stage 2000 limit values are therefore:

	Petrol cars		
Stage:	Directive 94/12/EC	Directive 94/12/EC Corrected values[3]	Stage 2000
CO	2.2	2.7	2.3
HC+NOx	0.5		
HC		0.341	0.20
NOx		0.252	0.15

(limit values in g/km)

	Diesel cars		
Stage:	Directive 94/12/EC	Directive 94/12/EC Corrected values	Stage 2000
CO	1.0	1.06	0.64
HC + NOx	0.7/0.9[4]	0.71/0.91	0.56
NOx		0.63/0.81[4]	0.50
PM	0.08/0.10[4]	0.08/0.10[4]	0.05

(limit values in g/km)

1.3 Test of evaporative emissions ("type IV test")

This test became part of the European emission standards in 1991 in order to control the losses of hydrocarbons by evaporation from the fuel system of a petrol car. For this purpose the test simulates the conditions of a car which is parked after use under hot weather conditions.

Following the recommendation of the Commission's Motor Vehicle Emission Group, the test will be improved to better represent the real conditions which determine the evaporative emissions as well as the state of the art of the relevant laboratory techniques. Based on the review of available emission and meteorological data, it is proposed to up-grade the test with more severe specifications for pre-conditioning the test vehicles, and with a new 24-hour diurnal test after soaking for an extended period at hot temperatures.

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(3) Corrected to take account of change in test cycle caused by elimination of the 40 second idling period.

(4) For vehicles equipped with direct injection engine.

1.4. Measures for ensuring the durability of the emission control systems

There are three important ways in which the durability of emission control systems can be assured, relevant to the proposed directive:

1.4.1 Onboard Diagnostic Systems (OBD)

OBD systems have been identified by the Auto/Oil Programme as a cost-effective means of assuring that the emissions of a car are effectively controlled during its useful life. OBD systems have a double purpose. They detect failures of the anti-pollution equipment of the car and indicate these to the driver so that he can have the vehicle fixed in a repair shop. In addition, they record the detected failures allowing stations carrying out the annual roadworthiness inspections to verify that the relevant repairs have been carried out.

A new Annex XI in the directive incorporates the technical provisions necessary for the approval of OBD systems. The proposed OBD specifications do not require the direct measurement of emissions, but aim at ensuring a monitoring, through electronic computing and sensing, of the performance of related component or systems. While the technology has already been proven for gasoline powered vehicles, OBD technologies are at a far less developed stage for diesel vehicles. The Directive stipulates, therefore, that requirements for these vehicles are, in a first stage, optional. The proposal takes into account the most recent technological developments for both categories of vehicles.

OBD requirements shall necessarily include anti-tampering provisions. A clause has been added to avoid that anti-tampering features preclude the use of aftermarket parts which give an equivalent level of emission control.

1.4.2 Control of compliance of vehicles in service

The Auto/Oil Programme has highlighted the favourable cost/effectiveness potential of systems for verifying the compliance of vehicles in service with the regulatory requirements in force when these vehicles are approved. Such systems exist in the United States, in Sweden and, on a voluntary basis, in the Netherlands. The EC type-approval procedure contains, at present, only provisions allowing the control of conformity of production.

The Commission is therefore proposing to introduce in the EC type-approval procedure for motor vehicles, provisions which will verify the compliance of manufacturer's vehicles with the durability requirements of the present directive with the help of surveys carried out on vehicles in service which have accumulated up to 80 000 km and/or an age of five years. In order to assure the application of such provisions at EU level, they must be closely linked to existing provisions relating to the responsibilities of the national authorities with respect to the control of conformity of production.

The introduction of the proposed new system necessitates not only amendments of the present directive but also amendments of the framework directive relating to EC type-approval (70/156/EEC). The amendments to the latter directive and the detailed provisions relating to the statistical aspects of the surveys of vehicles in service and the remedial measures that should apply in case of non-compliance (e.g."recall") will be subject of the new Annex X of this Directive.

1.4.3 Test for verifying the durability of anti-pollution devices ("type V test")

This test was introduced in Directive 91/441/EEC in order to verify the requirement that the emission control measures taken by the manufacturers remain effective throughout the normal life of the vehicles and under normal conditions of use. The test is intended to simulate the ageing of anti-pollution devices during an operation of 80 000 km in accordance with a specified driving pattern.

The experience made by industry and the national approval authorities with this test has, however, shown a considerable lack of representativity in the way that emission control devices deteriorate of the concerned devices under actual driving conditions. The Commission has decided therefore to refrain from proposing an extension of this test to 160 000 km which would merely increase the costs of emission approvals of cars without noticeable environmental benefits. Hence, the present provisions of the Directive relating to the type V test remain unchanged.

1.5 Reference fuels

The characteristics of the reference fuels used for emission testing are also modified to reflect evolution of the specifications of the commercial fuels in year 2000.

1.6 Low temperature testing

The Commission does not propose that specific requirements relating to the emission performances of vehicles at low temperatures be introduced, because the typical conditions simulated by this test were not covered in the Auto/Oil Programme. Nevertheless, in the light of the interest shown by some Member States for such a new test, the Commission will study its potential costs and effectiveness at a later stage, and will, if necessary, bring forward proposals.

2. Second stage 2005

The proposal also sets out indicative limit values to be applied for a second Stage to reduce vehicle emissions in the year 2005.

The purpose of the second stage is twofold. Firstly by setting indicative, but realistic limit values which could be applied from the year 2005, the Commission is giving advance notice to the automobile industry as to the measures it anticipates will need to be applied from that date. Secondly, the year 2005 values are proposed in order to provide uniform targets to Member States which would like to stimulate the improvement of environmental technologies through the granting of fiscal incentives.

In view of the anticipatory nature of the second stage, the Commission proposes that the limit values proposed should be confirmed by decision of the European Parliament and the Council. To this end, the Commission will bring forward proposals to the Council and the Parliament within twelve months of the adoption of this Directive, but not later than 31 December 1999, as required in Article 4 of this proposal.

Contemporaneously with the new proposals on vehicles, the Commission will also propose new fuels quality specification for application also in year 2005. The proposals on fuels and vehicles to reduce emissions for the year 2005, will be based on a further analysis of trends in air quality, technical developments in vehicle and refinery technologies, the potential for alternative fuels to reduce vehicle emissions and the relative cost/effectiveness of the measures concerned.

The indicative limit values are based on the most stringent packages of measures examined in the Auto/Oil Programme but not selected for the year 2000. The costs of the technologies necessary to meet these second stage standards are not precisely known at the present time.

Stage 2005 proposed standards will require, especially for diesel vehicles, the development of technologies like deNOx catalytic converters which are not yet industrially proven. These will require the availability of improved fuels (for instance, low sulphur diesel fuel). This is another reason why the second stage on vehicles needs to be accompanied by a second stage on fuels.

The proposed Stage 2005 limit values are therefore:

	Petrol cars		
Stage:	Directive 94/12/EC Corrected values	Stage 2000 Regulatory values	Stage 2005 Indicative values
CO	2.7	2.3	1.00
HC	0.341	0.20	0.10
NOx	0.252	0.15	0.08

(limit values in g/km)

	Diesel cars		
Stage:	Directive 94/12/EC Corrected values	Stage 2000 Regulatory values	Stage 2005 Indicative values
CO	1.06	0.64	0.50
HC + NOx	0.71/0.91[5]	0.56	0.30
NOx	0.63/0.81[4]	0.50	0.25
PM	0.08/0.10[4]	0.05	0.025

3. Emission based fiscal incentives

Since the adoption of Directive 89/458/EEC, Community decisions relating to the environmental aspects of motor vehicle emissions have contained a framework for the granting of fiscal incentives to encourage the early application of the new limit values. In these directives a balance has been struck between, on the one hand, the need to encourage the introduction of new technologies as quickly as possible, and, on the other hand, the need to avoid fragmenting the Single Market with diverse fiscal incentive programmes incentivising different limit values with the consequence that, de facto, there would be simultaneously a multitude of emission standards existing in the market.

The principles adopted in the framework set out in Article 3 of Directive 94/12/EC have been to permit fiscal incentives only for vehicles complying with the Directive and provided that they comply with the provisions of the Treaty and that they are:

- non-discriminatory;
- limited in time and that they terminate when the limit values become mandatory;
- of an amount lower than the additional cost of the technical solutions introduced to ensure compliance with the new limit values and the cost of their installation on the vehicle.

(5) For vehicle equipped with direct injection engine.

It should be noted that this fiscal framework has been established within the context of a directive based on Article 100a of the Treaty a point which has been contested by a number of Member States. Legally speaking however this is perfectly justified since the main subject matter of the directive concerns questions of the internal market (harmonization of legislation). The fiscal incentive framework does not aim at harmonizing taxes but rather at preventing obstacles to the functioning of the Internal Market in this sector. Without a Community framework there would be nothing to prevent Member States, within the limits of the Treaty, from incentivising a wide range of emission limit values. This would be damaging for the proper functioning of the internal market. It is for this reason that Member States have agreed to establishing a framework within which fiscal incentives could be given. The Commission believes that it is essential that this policy continues in the future. The Commission has however re-examined the modalities of the framework with a view to ascertaining if any additional flexibility could be introduced into it without prejudicing the objectives outlined above.

The Commission notes in this context that in the course of the discussions on Directive 94/12/EC it stated that with regard to the inclusion of pollutant emissions in the basis for calculating the annual road tax, any adjustment should be progressive and be based upon the actual performance of each vehicle. Fiscal incentives should not be given to incentivise limit values not agreed at Community level (e.g. US standards) but can be given in the context of annual road taxes to incentivise actual emission standards.

In the last whereas clause of Directive 94/12/EC the Council and the Parliament requested the Commission, when putting forward measures to apply after the year 2000, to put forward, if necessary, target values involving a further substantial reduction of emissions. Such target values clearly would be used for purposes of fiscal incentivisation.

In examining the relative merits of such an approach the Commission notes that for some time a number of Member States - notably Germany and Sweden - have advocated the establishment of target limit values for incentivisation purposes. Sweden indeed has applied such a system (by means of environmental Classes I/II/III) despite the fact that it is in contradiction with current Community legislation. The European Parliament has also been in favour of a second stage. Against this a number of Member States have made clear their preference for the maintenance of a single stage of incentivised limit values, which has been the approach followed up to now.

This issue was discussed by the Commission in 1991 during which time the responsible Commissioners agreed that there was a case for providing a second stage target limit value for fiscal incentive purposes which would be based upon the most advanced technologies. The Auto/Oil Programme has provided data on the most advanced technologies and the information therefore exists on which to base a second stage for incentivisation purposes. In addition this information has been gathered on a European wide basis and hence is likely to provide a sounder basis for a second stage than figures put forward in the past by Member States individually which would reflect their own national industries' capabilities.

On balance therefore the Commission considers that there are strong grounds for liberalising the current framework and providing for a second stage of incentivisation. It has to be acknowledged that allowing a second level of incentivisation contains certain risks in terms of internal market. However since, given the legislative timetable, this proposal is unlikely to be applied before 1998 by Member States on an optional basis for vehicle types approved to Stage 2000 standards. This is only a short time before vehicles will mandatorily have to conform to emission performances corresponding to Stage 2000 standards. As a practical matter therefore, there will be only a very short period when, theoretically, there are three simultaneous standards existing in the market (actual, Stage 2000, indicative Stage 2005). This has to be seen in the light of the far greater danger in terms of negative effects on the internal market which would result from a failure to agree to any framework at all. This later scenario would have the consequence that unbridled fiscal incentives measures would be permitted leading to the risk of a proliferation of standards in the market and a threat to the functioning of the internal market.

The two-stage approach towards incentivisation should be permitted on the clear understanding that these and only these limit values will be permitted to be incentivised and not others such as US standards or variants thereof. Article 4 of the draft Directive provides that the regime governing fiscal incentives for the year 2005 will, if necessary, be revised, in the course of the proposals conforming or revising the limit values to be applied in 2005.

With regard to fiscal incentive measures given in the context of annual road taxes the Commission proposes that the policy it outlined in the course of the adoption of Directive 94/12/EC should be maintained.

F. New measures for other categories of vehicles

A proposal will be submitted in 1996 to modify the light commercial vehicles (LCV) standards included in Directive 70/220/EEC. In order to ensure parallelism and coherence between light commercial vehicles and passenger cars, limit values for these vehicles will be an extrapolation of limit values in this proposal. The Commission will examine closely the issue of whether limit values for Class I and II LCV should be the same.

A proposal aimed at achieving a 30% NOx and particulate reduction will also be proposed in 1996, for heavy duty diesel engines approved according Directive 88/77/EEC. Limit values will take into account the on-going discussions on revising the heavy vehicle test procedure. The implementation dates will be the same as those for passenger cars. As for passenger cars and light commercial vehicles, it is also foreseen to propose target values for 2005 for heavy duty vehicles. Provisions for LPG/CNG technologies in buses and city vehicles will also be developed.

G. Subsidiarity

1. Objective of the proposed measures in relation to the obligations placed upon the Commission

The objective of the measures is to adapt existing measures to the technical progress as well as to new knowledge in the field of environment. These existing measures have largely contributed to achieving the harmonization of the Community vehicle market since 1970. Their adaptation is explicitly requested by Directive 94/12/EC and is an element of a global consensus which had permitted the adoption of the last directive.

2. Compared competence of the Community and of the Member States

With the Council Directive 89/458/EEC, the Community has decided to harmonize all emission related requirements for new vehicle type-approval on the base of total harmonization. The matter is therefore an issue of exclusive Community competence.

3. Forms of actions available for the Community

The only realistic form of action is legislation based either on a directive or a regulation. As a separate directive permitting the application of the EU type-approval put in place by Directive 70/156/EEC, the proposal adopts the legal forms of all requirements in this field.

4. Availability of an approach with general objectives leaving execution to Member States

A uniform detailed regulation is necessary to be coherent with the requirements of the framework Directive 70/156/EEC.

H. Conclusions

With this present proposal for a European Parliament and Council Directive, the highest degree of environmental protection, consistent with a economically sound global approach, will be ensured.

The proposals will contribute to the improved protection of public health within the Community by setting ambitious but realistic objectives, whilst giving a sufficient lead time to the automobile and components industries to develop the relevant technologies.

The Commission has moreover taken care of the need to provide a stable framework for operators in the market, and the proposals have been made with this objective in mind.

The ambitiousness of the changes will put the Community squarely at the head of the global effort to reduce emissions. Nevertheless, alongside measures taken out at the level of the European Union, cost effective measures implemented at local level will be necessary to achieve air quality objectives.

Proposal for a

EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE 96/0164 (COD)

relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directives 70/156/EEC and 70/220/EEC

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 100 thereof,

Having regard to the proposal from the Commission[1],

Having regard to the opinion of the Economic and Social Committee[2],

Acting in accordance with the procedure referred to in Article 189b of the Treaty[3],

Whereas measures should be adopted within the framework of the internal market;

Whereas the first programme of action of the European Community on protection of the environment[4], approved by the Council on 22 November 1973, called for account to be taken of the latest scientific advances in combating atmospheric pollution caused by gases emitted from motor vehicles and for directives adopted previously to be amended accordingly; whereas the fifth programme of action, which in its general approach was approved by the Council in its resolution of 1 February 1993 ([5]), provides for additional effort to be made for a considerable reduction in the present level of emissions of pollutants from motor vehicles; whereas this fifth programme also set targets in terms of emission reduction for various pollutants in the understanding that emissions from both mobile and stationary sources would have to be reduced;

Whereas Council Directive 70/220/EEC[6] lays down the limit values for carbon monoxide and unburnt hydrocarbon emissions from the engines of such vehicles; whereas these limit values were first reduced by Council Directive 74/290/EEC[7] and supplemented, in accordance with Commission Directive 77/102/EEC[8], by limit values for permissible nitrogen oxides; whereas the limit values for these three types of pollution were successively reduced by Commission Directives 78/665/EEC[9], 83/351/EEC[10] and 88/76/EEC[11]; whereas limit values for particulate pollutant emissions from diesel engines were introduced by Council Directive 88/436/EEC[12]; whereas more stringent European standards for the emissions of gaseous pollutants of motor vehicles below 1 400 cm^3 were introduced by Council Directive 89/458/EEC[13]; whereas these standards have been extended to all passenger

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(1) OJ No C

(2) OJ No C

(3) Opinion of the European Parliament of ....., Common Position of the Council of ....., and Decision of the European Parliament of .....

(4) OJ No C 112, 20.12.1973, p. 1.

(5) OJ No C 138, 17.5.1993, p. 1.

(6) OJ No L 76, 6.4.1970, p. 1.

(7) OJ No L 159, 15.6.1974, p. 61.

(8) OJ No L 32, 3.2.1977, p. 32.

(9) OJ No L 223, 14.8.1978, p. 48.

(10) OJ No L 197, 20.7.1983, p. 1.

(11) OJ No L 36, 9.2.1988, p. 1.

(12) OJ No L 214, 6.8.1988, p. 1.

(13) OJ No L 226, 3.8.1989, p. 1.

cars independently of their engine capacity on the basis of an improved European test procedure comprising an extra-urban driving cycle and, whereas requirements relating to evaporative emissions and to the durability of emissions-related vehicle components as well as more stringent particulate pollutant standards for motor vehicles equipped with diesel engines which were introduced by Council Directive 91/441/EEC[14]; whereas Directive 94/12/EC of the European Parliament and of the Council[15] introduced more stringent limit values for all pollutants and a modification of the control of conformity of the production; whereas passenger cars designed to carry more than six passengers and having a maximum mass of more than 2 500 kg, light commercial vehicles, and off-road vehicles, covered by Directive 70/220/EEC, which benefited until then from less stringent standards, have been submitted by Council Directive 93/59/EEC[16] and Directive 96/.../EC of the European Parliament and of the Council[17], to standards as severe as the respective standards for passengers cars, taking into account the specific conditions of these vehicles;

Whereas Article 4 of Directive 94/12/EC requires that the Commission proposes standards which will be enforced after the year 2000, according to a new multi-faceted approach, based on a comprehensive assessment of costs and efficiency of all measures aimed at reducing road transport pollution; whereas the proposal should include, besides car emission standard tightening, complementary measures, like an improvement in fuel quality and a strengthening of the car fleet inspection and maintenance programme; whereas the proposal should be based on the establishment of air quality criteria and associated emission reduction objectives and an evaluation of the cost/effectiveness of each package of measures, taking into account the potential contribution of other measures such as, *inter alia*, traffic management, enhancement of urban public transport, new propulsion technologies, or the use of alternative fuels;

Whereas the Commission has implemented a European programme on air quality, road traffic emissions, fuels and engines technologies (the Auto/Oil Programme[18]) with a view to fulfilling the requirements of Article 4 of Directive 94/12/EC; whereas the European car and oil industries have carried out the European Programme on Engines Fuels and Emissions (EPEFE) to determine the contribution which can be made both by future vehicles and the fuels which propels them; whereas the auto/oil and EPEFE programmes strove for ensuring that proposals for directives on polluting emissions seek the best solutions for both the citizen and for the economy; whereas a cost/effectiveness study within the Auto/Oil Programme has shown that a further improvement of car emission technology was necessary with a view to achieving air quality in year 2010 as described in the Communication by the Commission on the Auto/Oil Programme;

Whereas improvement of requirements for new passenger cars in Directive 70/220/EEC constitute a part of a consistent global Community strategy which will also include a revision of standards for light commercial vehicles and heavy duty vehicles from year 2000, an improvement of motor fuels and more accurate assessment of in-use vehicle emission performances; whereas alongside these measures, additional cost/effective local measures will nevertheless be needed to achieve the air quality criteria in the most polluting areas;

Whereas Directive 70/220/EEC is one of the separate directives under the type-approval procedure laid down by Council Directive 70/156/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers[19], as last amended by Directive 96/27/EC of the European Parliament and of the Council[20]; whereas the objective of reducing the level of

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(14) OJ No L 242, 30.8.1991, p. 1.
(15) OJ No L 100, 19.4.1994, p. 42.
(16) OJ No L 186, 28.7.1993, p. 21.
(17) OJ No L
(18) Commission Communication ...
(19) OJ No L 42, 23.2.1970, p. 1.
(20) OJ No L 169, 8.7.1996, p. 1.

pollutant emissions from motor vehicles cannot be sufficiently achieved by individual Member States and can therefore be better achieved by the approximation of the law of the Member States relating to measures to be taken against air pollution by motor vehicles;

Whereas reductions of the Type I test limits applicable from year 2000 corresponding to abatements of 40% nitrogen oxides, 40% total hydrocarbons, 30% carbon monoxide for gasoline passenger cars, 20% nitrogen oxides, 20% for the combined value for hydrocarbons plus nitrogen oxides, 40% carbon monoxide, 35% particulate matters for indirect injection diesel passenger cars and 40% nitrogen oxides, 40% for the combined value for hydrocarbons plus nitrogen oxides, 40% carbon monoxides and 50% particulate matters have, for direct injection diesel passenger cars, been identified as key measures to achieve sufficient medium-term air quality; whereas these reductions have been applied to hydrocarbons and nitrogen oxides with the assumption that nitrogen oxides represent respectively 45% and 80% of the weight of the combined value measured for gasoline/diesel light duty vehicles complying with Directive 94/12/EC; whereas separate limit values are now normally fixed for gasoline vehicles in order to monitor the emissions of both pollutants; whereas a combined limit value is maintained for diesel vehicles for which the Stage 2000 standards are the most demanding, with a view to facilitating engineering of future engines; whereas these reductions will take into account the effect on real emissions of a modification also adopted for the test cycle with a view to better representing emissions after a cold start ("deletion of 40 s");

Whereas new provisions for on-board diagnostics (OBD) should be introduced with a view to permitting an immediate detection of failure of anti-pollution vehicle equipment and thus allowing a significant up-grading of the maintenance of initial emissions performances on in-use vehicles through periodical or kerbside control; whereas, however, OBD are at a less developed stage for diesel vehicles and can be fitted on such vehicles only as an option;

Whereas the Type IV test which makes it possible to determinate the evaporative emissions of spark-ignition engines can be improved to better represent real evaporative emissions as well as the status of measuring techniques;

Whereas the characteristics of the reference fuels used for emission testing should reflect the evolution of the market fuel specifications to be available in year 2000, following legislation on the quality of petrol and diesel fuels;

Whereas a new method for conformity of production checking on in-use vehicles has been identified as a cost/effective accompanying measure; and is included in the emission directive with the objective of implementation in year 2001; whereas Directive 70/156/EEC should be amended accordingly;

Whereas Member States should be allowed to encourage, by means of tax incentives, the introduction of vehicles which satisfy the improved requirements of this Directive;

Whereas, it is necessary to establish indicative limit values to be applied from 2005 which can also be used for the purposes of, *inter alia*, encouraging the early introduction of vehicles containing the most advanced anti-pollution equipment;

Whereas these indicative limit values should be confirmed by a directive of the European Parliament and of the Council on the basis of a proposal to be made by the Commission not later than 31 December 1998; whereas the Commission will simultaneously propose measures to improve the quality of fuels for the year 2005; whereas both directives should enter into force together in 2005;

Whereas Directive 70/220/EEC should be amended accordingly,

HAVE ADOPTED THIS DIRECTIVE:

Article 1

Directive 70/156/EEC is amended as follows:

1. Article 10 is amended as follows:

Article 10

(a) the heading is replaced by the following:

"Conformity of production and in-service compliance arrangements"

(b) the following paragraph 3 is added:

"3. A Member State granting type-approval in relation to separate directives which contain quantified provisions for in-service durability of the systems, components or technical units, covered by these directives, shall make the necessary arrangements for verification to ensure compliance with these provisions by survey on vehicles in service in accordance with the procedures laid down in the directives concerned."

2. Article 11 is amended as follows:

(a) the heading is replaced by the following:

"Non-conformity and non-compliance"

(b) the following paragraph 4a is inserted:

"4a. There shall be failure to comply with quantified durability provisions of a separate directive where a survey on vehicles in service, carried out in accordance with the relevant specifications of the directive, establish that a vehicle type concerned does not meet these durability requirements.

If a Member State which has granted type-approval finds that vehicles in service accompanied by a certificate of conformity do not comply with the quantified durability provisions of a separate directive pursuant to which they have been type-approved, it shall decide on measures to be taken in order to ensure that vehicles in service will again comply with these provisions. The approval authorities of the Member State shall advise those of the other Member States of the measures planned. The relevant authorities in each Member State are competent to decide on the advisability of implementation in their territory of the planned measures.

If a Member State demonstrates that vehicles in service accompanied by a certificate of conformity do not comply with the quantified durability provisions of a separate directive pursuant to which they have been type-approved, it shall request the Member State which granted the type-approval to verify that by survey on vehicles in use, if necessary in cooperation with the competent authorities of the other Member States vehicles in service comply with these provisions. Such action shall be taken as soon as possible and in any case within the six months of the date of the request.

When non-compliance for a vehicle in service is established in accordance with the third subparagraph, the vehicle approval authority takes the measures referred to in the second subparagraph."

(c) paragraphs 5 and 6 are replaced by the following:

"5. The approval authorities of the Member States shall inform each other within one month of any withdrawal of type-approval and of the reasons for such a measure. In case of in-service survey under Article 10(2), the approval authorities of the Member State shall inform each other of the decisions taken on the basis of the results of the survey.

6. If the Member State which granted type-approval disputes the failure to conform or to comply demonstrated to it, the Member States concerned shall endeavour to settle the dispute. The Commission shall be kept informed and shall, where necessary, hold appropriate consultations for the purpose of reaching a settlement."

3. In Article 12, the following subparagraph is added:

"All decisions taken pursuant to the provisions adopted in implementation of this Directive and adopting planned measures to restore the conformity of vehicles in service, shall state in detail the reasons on which they are based. The competent authorities of each Member State which decide to initiate the planned measures shall notify the party concerned who shall, at the same time, be informed of the remedies available to him under the laws in force in the Member States and of the time limits allowed for the exercise of such remedies."

Article 2

The Annexes to Directive 70/220/EEC are amended in accordance with the Annex hereto.

Article 3

1. Subject to the provisions of Article 6, with effect from 1 January 1998, no Member State may, on grounds relating to air pollution by their emissions:

- refuse to grant EC type-approval pursuant to Article 4(1) of Directive 70/156/EEC, or

- refuse to grant national type-approval, or

- prohibit the registration, sale or entry into service of vehicles,

if the vehicles comply with the requirements of Directive 70/220/EEC, as amended by this Directive.

2. Subject to the provisions of Article 6, with effect from 1 January 2000, Member States:

- may no longer grant EC type-approval pursuant to Article 4(1) of Directive 70/156/EEC, and

- shall refuse national type-approval,

for a new type of vehicle on grounds relating to air pollution by emissions if it fails to comply with the provisions of Directive 70/220/EEC, as amended by this Directive.

For the Type I test the limit values set out in row A of the Table in Section 5.3.1.4 of Annex I to Directive 70/220/EEC are to be used.

3. With effect from 1 January 2001, Member States shall:

- consider certificates of conformity which accompany new vehicles pursuant to Directive 70/156/EEC as no longer valid for the purpose of Article 7(1) of that Directive, and

- refuse the registration, sale or entry into service of new vehicles which are not accompanied by a certificate of conformity in accordance with Directive 70/156/EEC,

on grounds relating to air pollution by emissions, if the vehicles fail to comply with the provisions of Directive 70/220/EEC, as amended by this Directive.

For the Type I test the limit values set out in row A of the Table in Section 5.3.1.4 of Annex I to Directive 70/220/EEC are to be used.

Article 4

Member States may make provision for tax incentives only in respect of motor vehicles which comply with Directive 70/220/EEC, as amended by this Directive. Such incentives shall comply with the provisions of the Treaty and satisfy the following conditions:

- they shall apply to all new vehicles offered for sale on the market of a Member State which comply in advance with either the mandatory limit values set out in row A of the Table in Section 5.3.1.4 of Annex I to Directive 70/220/EEC, as amended by this Directive, or, the indicative limit values set out in row B of the same Table;

- they shall be terminated with effect from the mandatory application of the emission limit values laid in Article 3(3) for new motor vehicles, or by 1 January 2005 in the case of the indicative limit values set out in row B of the Table in Section 5.3.1.4 of Annex I to Directive 70/220/EEC, as amended by this Directive;

- for each type of motor vehicle, they shall be for an amount lower than the additional cost of the technical solutions introduced to ensure compliance with the values set in Article 3(3), or the indicative limit values set out in row B of the Table in Section 5.3.1.4 of Annex I to Directive 70/220/EEC, as amended by this Directive, and of their installation on the vehicle.

The Commission shall be informed in sufficient time of plans to institute or change the tax incentives referred to in the first paragraph, so that it can submit its observations.

Article 5

The Commission will propose to the European Parliament and the Council a further tightening of the emission standards of vehicles falling within the scope of this Directive no later than 12 months from the date of adoption of this Directive but in any event not later than 31 December 1998. It shall be based on a revised and enhanced version of the methodology used to prepare measures for this Directive.

The strategy put forward in the proposal shall be designed to produce effects to meet the requirements of the Community air quality standards and related objectives at least cost and shall take account of:

- trends in air quality;

- noxious pollutant emissions in Europe from transport and non-transport sources and the contribution that existing, pending and potential emission reduction measures from all sources could make to improve air quality;

- technical developments with regard to vehicle technologies as well as new propulsion technologies (e.g. electric propulsion, fuel cells); and refinery technologies;

- the potential of alternative fuels such as compressed natural gas (CNG), Liquid Petroleum Gas (LPG), Dimethyl Ether (DME) and biofuels to reduce vehicle emissions;

- possible improvements in the test procedures, in particular the addition of a new test procedure at low temperatures;

- the potential of technical, non-technical and local measures to reduce emissions; in this context the contribution of transport and other policy measures such as traffic management, enhanced urban public transport and vehicles scrappage schemes should be evaluated;

- the contribution that selective and differentiated fiscal measures could make to reducing emissions, whilst not negatively impacting the functioning of the internal market;

- the effects of any measures on CO2 emissions;

- the strategies followed by non-member countries to improve air quality and the emission limit values applied therein;

- the supply situation and qualities of crude oil available to Europe.

The proposal shall contain, *inter alia*, mandatory emission limit values to be applied from 1 January 2005 confirming or modifying the indicative limit values stipulated in Section 5.3.1.4, row B of Annex 1 to Directive 70/220/EEC, as amended by this Directive. In addition, the proposal shall establish whether the framework under which Member States can make provision for tax incentives established in Directive 70/220/EEC, as amended by this Directive, should be revised.

The proposal shall be submitted to the European Parliament and the Council at the same time as the proposal referred to in Article 9 of Directive 96/ /EC of the European Parliament and of the Council [(21) on the quality of petrol and diesel fuels]; the measures shall enter into effect at the same time as the measures foreseen in the proposal to be submitted in accordance with Article 9 of that Directive.

Article 6

The provisions of this Directive will enter into force simultaneously with and in accordance with the same timetable for the introduction of measures specified in the Directive for a European Parliament and Council Directive related to the quality of petrol and diesel fuels.

Article 7

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive before 31 December 1997. They shall immediately inform the Commission thereof.

   When Member States adopt these provisions, these shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The procedure for such reference shall be adopted by Member States.

(21) See p. of this Official Journal.

2. Member States shall communicate to the Commission the texts of the main provisions of national law which they adopt in the field covered by this Directive.

Article 8

This Directive shall enter into force on the twentieth day following that of its publication in the Official Journal of the European Communities.

Article 9

This Directive is addressed to the Member States.

Done at Brussels,

For the European Parliament
The President

For the Council
The President

ANNEX

AMENDMENTS TO THE ANNEXES TO DIRECTIVE 70/220/EEC
AS AMENDED BY DIRECTIVE ...

List of Annexes

1. The list of Annexes is amended as follows:

- The indication to Annex VI reads as follows:

'Annex VI: Type IV test (Determination of evaporative emissions from vehicles with spark-ignition engines)

Appendix 1: Calibration frequency and methods

Appendix 2: Diurnal ambient temperature profile for the diurnal emission test'

- Annex VIII:

The title reads as follows: 'Specifications of reference fuels'

- The following items are added:

'Annex X: Control of compliance of vehicles in service

Annex XI: On-board diagnostics (OBD) for motor vehicles

Appendix 1: Functional aspects of OBD systems

Appendix 2: Diagnostic services (Test Modes)

Appendix 3: OBD tools

Appendix 4: Numeric codes

Appendix 5: Addendum to the Information Document

Appendix 6: Essential characteristics of the vehicle family

Appendix 7: Addendum to the EC type-approval certificate'

Annex I

2. The heading reads as follows:

'SCOPE, DEFINITIONS, APPLICATION FOR EC-TYPE APPROVAL, EC TYPE APPROVAL, REQUIREMENTS AND TESTS, EXTENSION OF EC TYPE-APPROVAL, CONFORMITY OF PRODUCTION, COMPLIANCE IN SERVICE, ON-BOARD DIAGNOSTIC (OBD) SYSTEMS'

3. Section 1:

The first sentence reads as follows:

'This Directive applies to

- the tailpipe emissions, evaporative emissions, emissions of crankcase gases, the durability of anti-pollution devices and on-board diagnostic (OBD) systems for all motor vehicles equipped with positive-ignition engines

and

- the tailpipe emissions, the durability of anti-pollution devices and on-board diagnostic (OBD) systems from vehicles of category M_1 and N_1[(1)], equipped with compression-ignition engines

covered by Article 1 of Directive 70/220/EEC in the version of Directive 83/351/EEC[(2)], with the exception of those vehicles of categories N_1 for which type-approval has been granted pursuant to Directive 88/77/EEC[(3)].'

4. A new Section 2.13 is added to read as follows:

'2.13. 'OBD' means an on-board diagnostics system for emission control which shall have the capability of identifying the likely area of malfunction by means of fault codes stored in computer memory.'

5. Sections 3 to 3.2.1 read as follows:

'3. APPLICATION FOR EC TYPE-APPROVAL

3.1. The application for EC type-approval pursuant to Article 3(4) of Directive 70/156/EEC of a vehicle type with regard to its tailpipe emissions, evaporative emissions, durability of antipollution devices as well as to its on-board diagnostic (OBD) system shall be submitted by the vehicle manufacturer.

As far as the application concerns an on-board diagnostic (OBD) system the procedure described in Annex XI, Section 3 has to be followed.

3.2. A model for the information document relating to tailpipe emissions, evaporative emissions and durability is given in Annex II; concerning an on-board diagnostic (ODB) system a model is given in Annex XI, Appendix 5.

3.2.1. Where appropriate, copies of other type-approvals with the relevant data to enable extension of approvals and establishment of deterioration factors shall be submitted.'

6. Sections 4 to 4.2 read as follows:

'4. GRANTING OF EC TYPE-APPROVAL

4.1. If the relevant requirements are satisfied, EC type-approval shall be granted to Article 4 (3) of Directive 70/156/EEC.

4.2. A model for the EC type-approval certificate relating to tailpipe emissions, evaporative emissions and durability is given in Annex IX, concerning an on-board diagnostic (OBD) system a model is given in Annex XI, Appendix 7.'

7. Section 5:

The note is deleted.

8. Section 5.1.1:

The second paragraph reads as follows:

' The technical measures taken by the manufacturer must be such as to ensure that the tailpipe and evaporative emissions are effectively limited, pursuant to this Directive, throughout the normal life of the vehicle and under normal conditions of use. This will include the security of those hoses, their joints and connections; used within the emission control systems, which must be so constructed as to conform with the original design intent.

For tailpipe emissions, these provisions are deemed to be met if the provisions of Section 5.3.1.4 (type-approval), Section 7 (conformity of production) and Section 8 (compliance of vehicles in service) are respectively complied with.

For evaporative emissions, these provisions are deemed to be met if the provisions of Section 5.3.4 (type-approval), Section 7 of Annex VI (conformity of production) and Section 8 (compliance of vehicles in service) are respectively complied with. '

9. A new Section 5.1.3 is added to read as follows:

'5.1.3. Provision must be made to prevent excess evaporative emissions caused by a missing fuel filler cap. This may be achieved by using:

- an automatically opening and closing, non-removable fuel filler cap;

- design features which avoid excess evaporative emissions in the case of a missing fuel filler cap;

- a malfunction indicator different from the OBD malfunction indicator to signal a missing fuel filler cap;

or any other provision which has the same effect.'

10. Figure I.5.2 is replaced by the following new figure:

'Figure I.5.2

Different routes for type-approval and extensions

Type approval test	**Positive-ignition engined vehicles of categories M and N**	**Compression ignition engined vehicles of categories M_1 and N_1**
Type I	Yes (mass ≤ 3,5 t)	Yes (mass ≤ 3,5 t)
Type II	Yes (mass ≤ 3,5 t)	-
Type III	Yes	-
Type IV	Yes (mass ≤ 3,5 t)	-
Type V	Yes (mass ≤ 3,5 t)	Yes (mass ≤ 3,5 t)
In Service Compliance (Section 8)	Yes (mass ≤ 3,5 t)	Yes (mass ≤ 3,5 t)
On Board Diagnostics (Section 9)	Yes (Capacity ≤ 6 occupants) (mass ≤ 2,5 t)	Optional
Extension conditions	Section 6	- Section 6 - M_2 and N_2 with reference mass not more than 2 840 kg'

11. Section 5.3.1.4:

- After the first paragraph a new Table is inserted to read as follows:

Category of vehicle			Reference mass	Limit values								
				Mass of carbon monoxide (CO)		Mass of hydrocarbons (HC)		Mass of oxides of nitrogen (NO_x)		Combined mass of hydrocarbons and oxides of nitrogen (HC + NO_x)		Mass of particulates (PM)
			RW (kg)	L_1 (g/km)		L_2 (g/km)		L_3 (g/km)		$L_2 + L_3$ (g/km)		L_4 (g/km)
	Category	Class		Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Diesel
A (2000)	M (2)	-	all	2,3	0,64	0,20	-	0,15	0,50	-	0,56	0,05
B (2005)*	M (2)	-	all	1,00	0,50	0,10	-	0,08	0,25	-	0,30	0,025

(*) Indicative limit values to be applied to new types of vehicles from 1 January 2005 which are subject to confirmation by the Council and the European Parliament. These limit values can be the subject of tax incentives referred to in Article 3 of Directive [number of current amending directive].

- The first line of the present Table relating to vehicles of category M is deleted.

12. A new Section 7.1.4 is added to read as follows:

'7.1.4. If a verification of the performance of the OBD system is to be carried out, it must be conducted in accordance with Section 7 of Annex XI.'

13. Section 8 is deleted.

14. A new Section 8 and 9 are added to read as follows:

'8. CONTROL OF COMPLIANCE OF VEHICLES IN SERVICE

8.1 In order to satisfy the provisions of Section 5.1.1, vehicles in service properly used and maintained shall comply with the provisions of Sections 5.3.1.4 (tailpipe emissions) and 5.3.4 (evaporative emissions) for up to 5 years of age or 80 000 km, which occurs first. Compliance with these provisions will be verified in accordance with the provisions of Article 11 of Directive 70/156/EEC by the authorities which have approved the vehicle type concerned with the help of surveys on vehicles in service belonging to this vehicle type. The procedure to be followed for such in service survey is laid down in Annex X.

Any vehicle being accompanied by a valid certificate of conformity in accordance with Directive 70/156/EEC may be subject of an in-service survey.

Where non-compliance is established in accordance with the provisions of Annex X, the manufacturers of the vehicle type concerned shall carry out the measures notified to him by the authorities of the Member States in accordance with the provisions of Article 11(2) and 12(2) of Directive 70/156/EEC.

9. ON-BOARD DIAGNOSTIC (OBD) SYSTEM FOR MOTOR VEHICLES

9.1. Vehicles of category M[1] equipped with positive-ignition engines, except

- vehicles designed to carry more than six occupants including the driver,

- vehicles whose maximum mass exceeds 2 500 kg,

shall be fitted with an on-board diagnostic (OBD) system for the emission control in accordance with Annex XI. If other vehicles of category M are fitted with an on-board diagnostic (OBD) system, the OBD system must meet the requirements of Annex XI.'

(1) As defined in Annex II Section A to Directive 70/156/EEC.

Annex III

15. Section 2.3.1:

- Paragraph 2 and 3 are deleted.
- Paragraph 2 (former paragraph 4) reads as follows:

'Vehicles which do not attain the acceleration ...' (rest unchanged).

16. Section 6.1.3:

The first sentence reads as follows:

'A current of air of variable speed shall be blown over the vehicle.'

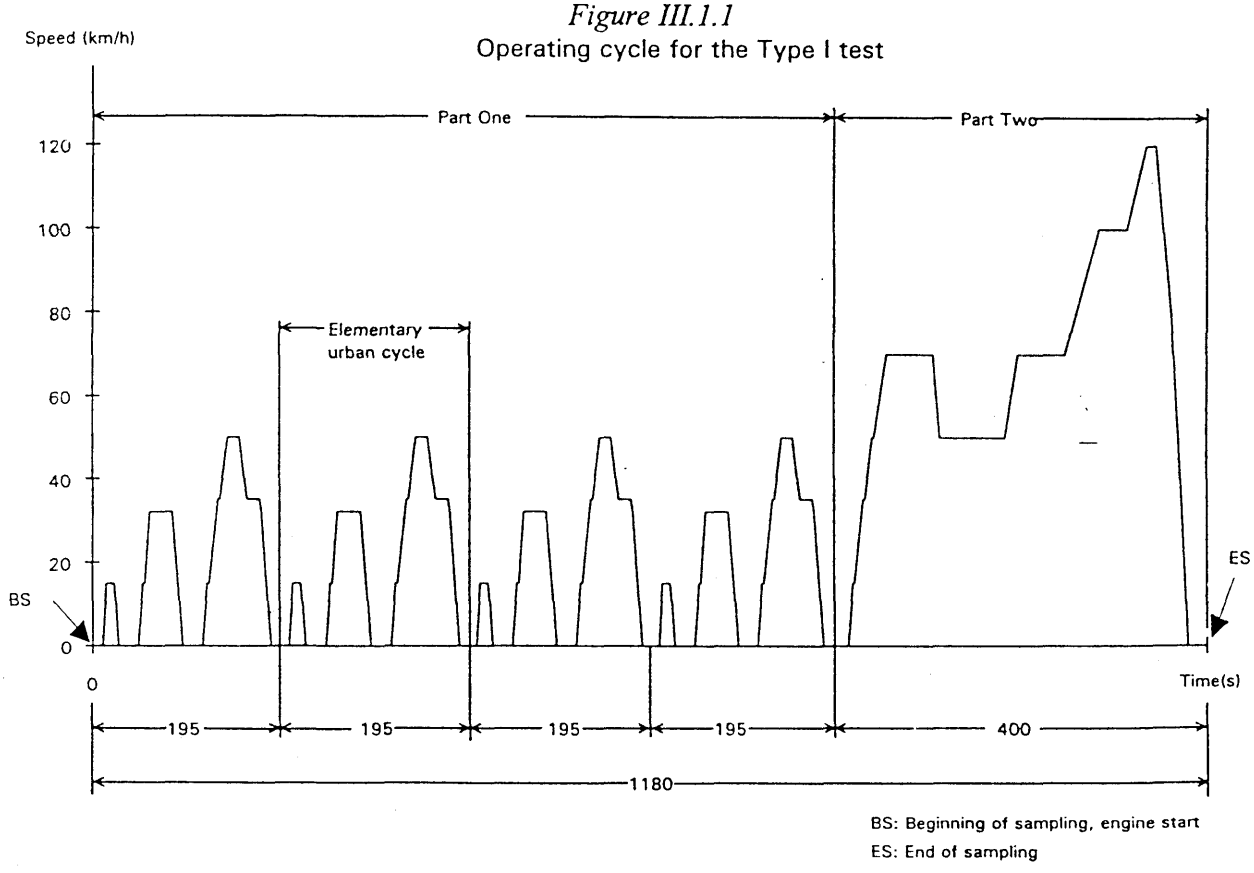
17. Section 6.2.2 is deleted.

Appendix 1

18. Section 1.1:

- Figure III.1.1 is replaced by the following new figure:

Figure III.1.1
Operating cycle for the Type I test



- In the English version in column 5 of Table III.1.2 (entitled: 'Speed (km/h)'); operation 23 reads as follows:

  '35 - 10'

19. Sections 4 to 4.3 including Table III.1.4 and Figure III.1.4 are deleted.

Appendix 3

20. Section 5.1.1.2.7:

  In the English version, the formula reads as follows:

  $$'P = \frac{M\,V\,\Delta V}{500T}'$$

Annex VI

21. Sections 1 to 6 read as follows:

'1. INTRODUCTION

This Annex describes the procedure of the Type IV test according to Section 5.3.4 of Annex 1.

This procedure describes a method for the determination of the loss of hydrocarbons by evaporation from the fuel systems of vehicles with spark ignition engines.

2. DESCRIPTION OF TEST

The evaporative emission test (Figure VI.1) is designed to determine HC evaporative emissions as a consequence of diurnal temperatures fluctuation, hot soaks during parking, and urban driving. The test consists of these phases:

- test preparation including an urban (Part One) and extra-urban (Part Two) driving cycle,
- hot soak loss determination,
- diurnal loss determination.

Mass emissions of hydrocarbons from the hot soak and the diurnal loss phases are summed up to provide an overall result for the test.

3. VEHICLE AND FUEL

3.1. **Vehicle**

3.1.1. The vehicle must be in good mechanical condition and have been ran in and driven at least 3 000 km before the test. The evaporative emission control system must be connected and have been functioning correctly over this period and the carbon canister(s) shall have been subject to normal use, neither undergoing abnormal purging nor abnormal loading.

3.2. **Fuel**

3.2.1. The appropriate reference fuel must be used, as defined in Annex VIII to this Directive.

4. TEST EQUIPMENT FOR EVAPORATIVE TEST

4.1. **Chassis dynamometer**

The chassis dynamometer must meet the requirements of Annex III.

4.2. **Evaporative emission measurement enclosure**

The evaporative emission measurement enclosure must be a gas-tight rectangular measuring chamber able to contain the vehicle under test. The vehicle must be accessible from all sides and the enclosure when sealed must be gas tight in accordance with Appendix 1. The inner surface of the enclosure must be impermeable and non-reactive to hydrocarbons. The temperature conditioning system shall be capable of controlling the internal enclosure air temperature to follow the prescribed temperature versus time profile throughout the test, and an average tolerance of ± 1 K over the duration of the test.

The control system shall be tuned to provide a smooth temperature pattern that has a minimum of overshoot, hunting, and instability about the desired long-term ambient temperature profile. Interior surface temperatures shall not be less than 278 K (5 °C) nor more than 328 K (55 °C) at any time during the diurnal emission test. Wall design must be such as to promote good dissipation of heat. Interior surface temperatures shall not be below 293 K (20 °C), nor above 325 K (52 °C) for the duration of the hot soak test.

To accommodate the volume changes due to enclosure temperature changes, either a variable-volume or fixed-volume enclosure may be used.

4.2.1. *Variable-volume enclosure*

The variable-volume enclosure expands and contracts in response to the temperature change of the air mass in the enclosure. Two potential means of accommodating the internal volume changes are movable panel(s), or a bellows design, in which impermeable bag(s) inside the enclosure expand and contract in response to internal pressure changes by exchanging air from outside the enclosure. Any design for volume accommodation must maintain the integrity of the enclosure as specified in Appendix 1 over the specified temperature range.

Any method of volume accommodation shall limit the differential between the enclosure internal pressure and the barometric pressure to a maximum value of ± 5 hPa.

The enclosure shall be capable of latching to a fixed volume. A variable volume enclosure must be capable of accommodating a ± 7 percent change from its "nominal volume" (see Appendix 1 Section 2.1.1), accounting for temperature and barometric pressure variation during testing.

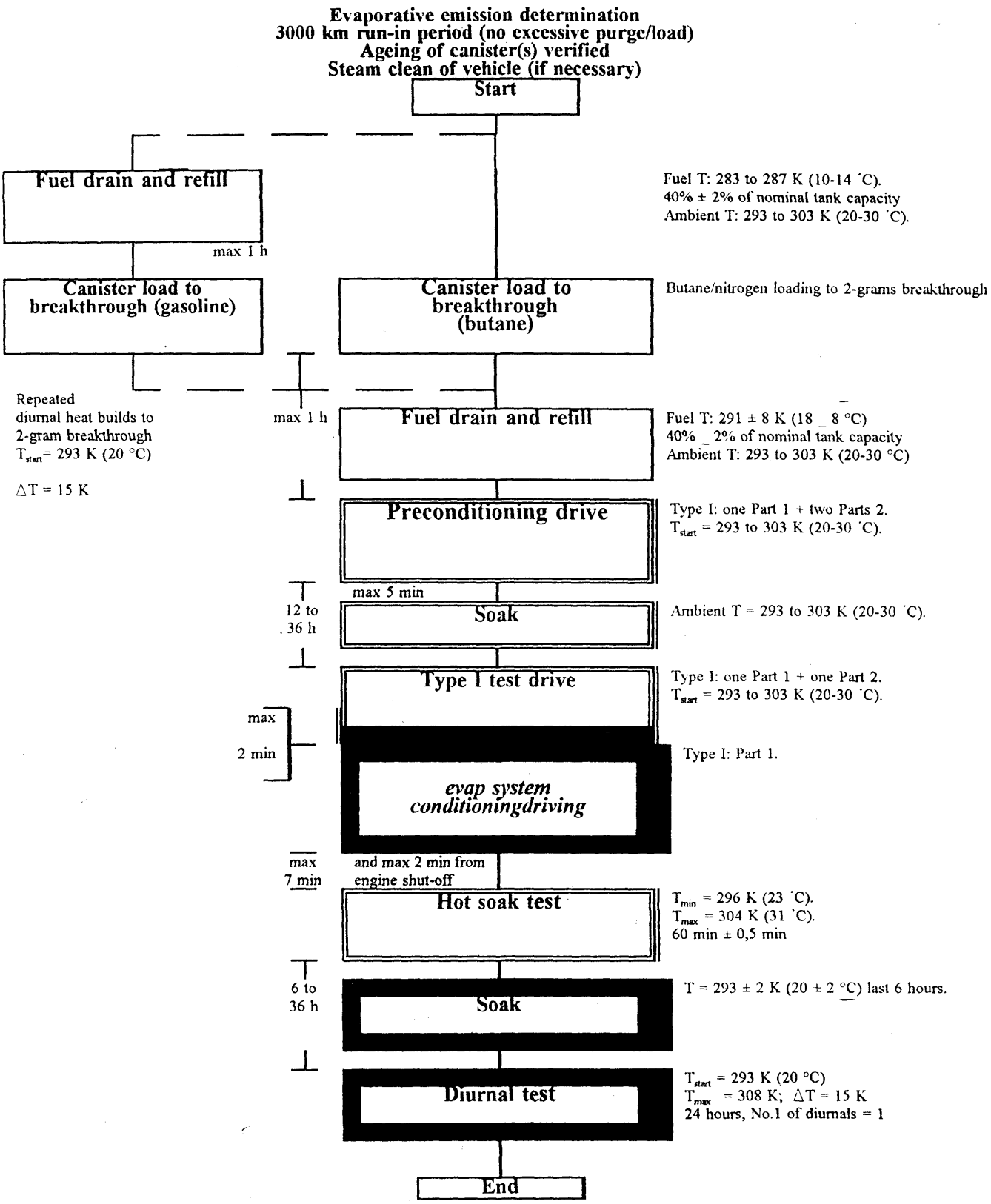
4.2.2. *Fixed-volume enclosure*

The fixed-volume enclosure shall be constructed with rigid panels that maintain a fixed enclosure volume, and meet the following requirements.

4.2.2.1. The enclosure shall be equipped with an outlet flow stream that withdraws air at a low, constant rate from the enclosure throughout the test. An inlet flow stream may provide make-up air to balance the outgoing flow with incoming ambient air. Inlet air must be filtered with activated carbon to provide a relatively constant hydrocarbon level. Any method of volume accommodation shall maintain the differential between the enclosure internal pressure and the barometric pressure between 0 and -5 hPa.

4.2.2.2. The equipment shall be capable of measuring the mass of hydrocarbon in the inlet and outlet flow streams with a resolution of 0,01 gram. A bag sampling system may be used to collect a proportional sample of the air withdrawn from and admitted to the enclosure. Alternatively, the inlet and outlet flow streams may be continuously analyzed using an on-line FID analyzer and integrated with the flow measurements to provide a continuous record of the mass hydrocarbon removal.

Figure VI.1



Note: 1. Evaporative emission control families - details clarified.
2. Tailpipe emissions may be measured during type I test drive, but these are not used for legislative purposes. Exhaust emission legislative test remains separate.

4.3. **Analytical systems**

4.3.1. *Hydrocarbon analyzer*

4.3.1.1. The atmosphere within the chamber is monitored using a hydrocarbon detector of the flame ionization detector (FID) type. Sample gas must be drawn from the mid-point of one side wall or roof of the chamber and any bypass flow must be returned to the enclosure, preferably to a point immediately downstream of the mixing fan.

4.3.1.2. The hydrocarbon analyzer must have a response time to 90% of final reading of less than 1,5 seconds. Its stability shall be better than 2% of full scale at zero and at 80 ± 20% of full scale over a 15-minute period for all operational ranges.

4.3.1.3. The repeatability of the analyzer expressed as one standard deviation shall be better than 1% of full scale deflection at zero and at 80 ± 20% of full scale on all ranges used.

4.3.1.4. The operational ranges of the analyzer must be chosen to give best resolution over the measurement, calibration and leak checking procedures.

4.3.2. *Hydrocarbon analyzer data recording system*

4.3.2.1. The hydrocarbon analyzer must be fitted with a device to record electrical signal output either by strip chart recorder or other data processing system at a frequency of at least once per minute The recording system must have operating characteristics at least equivalent to the signal being recorded and must provide a permanent record of results. The record shall show a positive indication of the beginning and end of the hot soak or diurnal emission test (including beginning and end of sampling periods along with the time elapsed between start and completion of each test).

4.4. **Fuel tank heating** (only applicable for gasoline canister load option)

4.4.1. The fuel in the vehicle tank(s) must be heated by a controllable source of heat, for example a heating pad of 2 000 W capacity is suitable. The heating system must apply heat evenly to the tank walls beneath the level of the fuel so as not to cause local overheating of the fuel. Heat must not be applied to the vapour in the tank above the fuel.

4.4.2. The tank heating device must make it possible to evenly heat the fuel in the tank by 14 K from 289 K (16 °C) within 60 minutes, with the temperature sensor position as in Section 5.1.1. The heating system must be capable of controlling the fuel temperature to ± 1,5 K of the required temperature during the tank heating process.

4.5. **Temperature recording**

4.5.1. The temperature in the chamber is recorded at two points by temperature sensors which are connected so as to show a mean value. The measuring points are extended approximately 0,1 m into the enclosure from the vertical centre line of each side wall at a height of 0,9 ± 0,2 m.

4.5.2. The temperatures of the fuel tank(s) shall be recorded by means of the sensor positioned in the fuel tank as in Section 5.1.1 in the case of use of the gasoline canister load option (Section 5.1.5).

4.5.3. Temperatures must, throughout the evaporative emission measurements, be recorded or entered into a data processing system at a frequency of at least once per minute.

4.5.4. The accuracy of the temperature recording system must be within ± 1,0 K and the temperature must be capable of being resolved to 0,4 K.

4.5.5. The recording or data processing system must be capable of resolving time to ± 15 seconds.

4.6. **Pressure recording**

4.6.1. The difference Δ_p between barometric pressure within the test area and the enclosure internal pressure must, throughout the evaporative emission measurements, be recorded or entered into a data processing system at a frequency of at least once per minute.

4.6.2. The accuracy of the pressure recording system must be within ± 2 hPa and the pressure must be capable of being resolved to 0,2 ± hPa.

4.6.3. The recording or data processing system must be capable of resolving time to ± 15 seconds.

4.7. **Fans**

4.7.1. By the use of one or more fans or blowers with the SHED door(s) open it must be possible to reduce the hydrocarbons concentration in the chamber to the ambient hydrocarbon level.

4.7.2. The chamber must have one or more fans or blowers of likely capacity 0,1 to 0,5 m^3s^{-1} with which to thoroughly mix the atmosphere in the enclosure. It must be possible to attain an even temperature and hydrocarbon concentration in the chamber during measurements. The vehicle in the enclosure must not be subjected to a direct stream of air from the fans or blowers.

4.8. **Gases**

4.8.1. The following pure gases must be available for calibration and operation:

- purified synthetic air (purity: < 1 ppm C_1 equivalent ≤ 1 ppm CO, ≤ 400 ppm CO_2, ≤ 0,1 ppm NO); oxygen content between 18 and 21% by volume.
- hydrocarbon analyzer fuel gas (40 ± 2% hydrogen, and balance helium with less than 1 ppm C_1 equivalent hydrocarbon, less than 400 ppm CO_2),
- propane (C_3H_8), 99,5% minimum purity;
- butane (C_4H_{10}), 98% minimum purity;
- nitrogen (N_2), 98% minimum purity.

4.8.2. Calibration and span gases shall be available containing mixtures of propane (C_3H_8) and purified synthetic air. The true concentrations of a calibration gas must be within ± 2% of stated figures. The accuracy of the diluted gases obtained when using a gas divider must be to within ± 2% of the true value. The concentrations specified in Appendix 1 may also be obtained by the use of a gas divider using synthetic air as the diluent gas.

4.9. **Additional equipment**

4.9.1. The absolute humidity in the tests area must be measurable to within ± 5%.

5. TEST PROCEDURE

5.1. **Test preparation**

5.1.1. The vehicle is mechanically prepared before the test as follows:

- the exhaust system of the vehicle must not exhibit any leaks,
- the vehicle may be steam cleaned before the test,
- in the case of use of the gasoline canister load option (Section 5.1.5) the fuel tank of the vehicle must be equipped with a temperature sensor to enable the temperature to be measured at the mid-point of the fuel in the fuel tank when filled to 40% of its capacity,
- additional fittings, adapters of devices must be fitted to the fuel system in order to allow a complete draining of the fuel tank. For this purpose it is not necessary to modify the shell of the tank.

5.1.2. The vehicle is taken into the test area where the ambient temperature is between 293 and 303 K (20 and 30 °C).

5.1.3. The ageing of the canister(s) has to be verified. This may be done by demonstrating that it has accumulated a minimum of 3 000 km. If this demonstration is not given, the following procedure is used. In the case of a multiple canister system each canister shall undergo the procedure separately.

5.1.3.1. The canister shall be removed from the vehicle. Special care shall be taken during this step to avoid damage to components and the integrity of the fuel system.

5.1.3.2. Check the weight of the canister.

5.1.3.3. Connect the canister to a fuel tank, possibly an external one, filled with reference fuel, to 40% volume of the fuel tank(s).

5.1.3.4. The fuel temperature in the fuel tank should be between 283 K (10 °C) and 287 K (14 °C).

5.1.3.5. Heat the (external) fuel tank from 288 to 318 K (15 to 45 °C) (1 °C increase every 9 minutes).

5.1.3.6. If the canister reaches breakthrough before the temperature reaches 318 K (45 °C), the heat source shall be turned off. Then weigh the canister. If the canister did not reach breakthrough during the heating to 318 K (45 °C), the procedure shall be repeated from Section 5.1.3.3 until breakthrough occurs.

5.1.3.7. Breakthrough may be checked as is described in Sections 5.1.6.1 and 5.1.6.2 of this Annex, or with the use of another sampling and analytical arrangement capable of detecting the emission of hydrocarbons from the canister at breakthrough.

5.1.3.8. Purge the canister with 25 _ 5 liters per liter of charcoal and per minute using the emission laboratory air until 300 bed volume exchanges are reached.

5.1.3.9. Check the weight of the canister.

5.1.3.10 Repeat nine times the steps of the procedure in Sections 5.1.3.4 to 5.1.3.9. The test may be terminated prior to that, after not less than three ageing cycles, if the weight of the canister after the last cycles has stabilized.

5.1.3.11 Reconnect the evaporative emission canister and restore the vehicle to its normal operation condition.

5.1.4. One of the methods specified in Sections 5.1.5 and 5.1.6 shall be used to precondition the evaporative canister. For vehicles with multiple canisters, each canister shall be preconditioned separately.

5.1.4.1. Canister emissions are measured to determine breakthrough.

Breakthrough is here defined as the point at which the cumulative quantity of hydrocarbons emitted is equal to 2 grams.

5.1.4.2. Breakthrough may be verified using the evaporative emission enclosure as described in Sections 5.1.5 and 5.1.6 respectively. Alternatively, breakthrough may be determined using an auxiliary evaporative canister connected downstream of the vehicle's canister. The auxiliary canister shall be well purged with dry air prior to loading.

5.1.4.3. The measuring camber shall be purged for several minutes immediately before the test until a stable background is obtained. The chamber air mixing fan(s) must be switched on at this time.

The hydrocarbon analyzer must be zeroed and spanned immediately before the test.

5.1.5. *Canister loading with repeated heat builds to breakthrough*

5.1.5.1. The fuel tank(s) of the vehicle(s) is (are) emptied using the fuel tank drain(s). This must be done so as not to either abnormally purge nor abnormally load the evaporative control devices fitted to the vehicle. Removal of the fuel cap will normally be sufficient to achieve this.

5.1.5.2. The fuel tank(s) is (are) refilled with test fuel at a temperature of between 283 and 287 K (10 and 14 °C) to 40 ± 2% of the tank's normal volumetric capacity. The fuel cap(s) of the vehicle must be fitted at this point.

5.1.5.3. Within one hour of being refuelled the vehicle shall be placed, with the engine shut off, in the evaporative emission enclosure. The fuel tank temperature sensor shall be connected to the temperature recording system. A heat source shall be properly positioned with respect to the fuel tank(s) and connected to the temperature controller. The heat source is specified in Section 4.4. In the case of vehicles fitted with more than one fuel tank, all the tanks must be heated in the same way as described below. The temperatures of the tanks must be identical to within ± 1,5 K.

5.1.5.4. The fuel may be artificially heated to the starting diurnal temperature of 293 K (20 °C) ± 1 K.

5.1.5.5. When the fuel temperature reaches at least 292 K (19 °C), immediately: turn off the purge blower; close and seal enclosure doors; and initiate measurement of the hydrocarbon level in the enclosure.

5.1.5.6. When the fuel temperature of the fuel tank reaches 293 K (20 °C) a linear heat build of 15 K (15 °C) begins. The fuel shall be heated in such a way that the temperature of the fuel during the heating shall conform to the function below to within ± 1,5 K. The elapsed time of the heat build and temperature rise is recorded.

$$T_r = T_o + 0{,}2333 \cdot t$$

where:

T_r = required temperature (K);
T_o = initial temperature (K);
t = time from start of the tank heat build in minutes.

5.1.5.7. As soon as breakthrough occurs or when the fuel temperature reaches 308 K (35 °C), whichever occurs first, the heat source shall be turned off, the enclosure doors shall be unsealed and opened, and the vehicle fuel tank cap(s) shall be removed. If breakthrough has not occurred by the time the fuel temperature reaches 308 K (35 °C), the heat source shall be removed from the vehicle, the vehicle shall be removed from the evaporative emission enclosure and the entire procedure outlined in Section 5.1.7. shall be repeated until breakthrough occurs.

5.1.6. *Butane loading to breakthrough*

5.1.6.1. If the enclosure is used for the determination of the breakthrough (see Section 5.1.4.2) the vehicle shall be placed, with the engine shut off, in the evaporative emission enclosure.

5.1.6.2 Prepare the evaporative emission canister for the canister loading operation. The canister shall not be removed from the vehicle, unless access to the canister in its normal location is so restricted that loading can only reasonably be accomplished by removing the canister from the vehicle. Special care shall be taken during this step to avoid damage to the components and the integrity of the fuel system.

5.1.6.3. Load the canister with a mixture composed of 50 percent butane and 50 percent nitrogen by volume at a rate of 40 grams butane per hour.

5.1.6.4. As soon as the canister reaches breakthrough, the vapour source shall be shut off.

5.1.6.5. Reconnect the evaporative emission canister and restore the vehicle to its normal operation condition.

5.1.7. *Fuel drain and refill*

5.1.7.1. The fuel tank(s) of the vehicle(s) is (are) emptied using the fuel tank drain(s). This must be done so as not to either abnormally purge nor abnormally load the evaporative control devices fitted to the vehicle. Removal of the fuel cap will normally be sufficient to achieve this.

5.1.7.2. The fuel tank(s) is (are) refilled with test fuel at a temperature of between 291 ± 8 K (18 ± 8 °C) to 40 ± 2% of the tank's normal volumetric capacity. The fuel cap(s) of the vehicle must be fitted at this point.

5.2. **Preconditioning drive**

5.2.1. Within **one hour** from the completing of canister loading in Section 5.1.5. or 5.1.6 the vehicle is placed on the chassis dynamometer and is driven through one Part One and two Part Two driving cycles of Type I test as specified in Annex III. Exhaust emissions are not sampled during this operation.

5.3. **Soak**

5.3.1. Within five minutes of completing the preconditioning operation specified in Section 5.2.1 the engine bonnet must be completely closed and the vehicle driven off the chassis dynamometer and parked in the soak area. The vehicle is parked for a minimum of 12 hours and a maximum of 36 hours. The engine oil and coolant temperatures must have reached the temperature of the area of within ± 3 K at the end of the period.

5.4. **Dynamometer test**

5.4.1. After conclusion of the soak period the vehicle is driven through a complete Type I test drive as described in Annex III (cold start urban and extra urban test). Then the engine is shut off. Exhaust emissions may be sampled during this operation and the results are not used for the purpose of exhaust emission type approval.

5.4.2. Within two minutes of completing the Type I test drive specified in Section 5.4.1 the vehicle is driven a further conditioning drive consisting of one urban test cycle (hot start) of a Type I test. Then the engine is shut off again. Exhaust emissions need not to be sampled during this operation.

5.5. **Hot soak evaporative emissions test**

5.5.1. Before the completion of the conditioning drive the measuring chamber must be purged for several minutes until a stable hydrocarbon background is obtained. The enclosure mixing fan(s) must also be turned on at this time.

5.5.2. The hydrocarbon analyzer must be zeroed and spanned immediately prior to the test.

5.5.3. At the end of the conditioning drive the engine bonnet must be completely closed and all connections between the vehicle and the test stand disconnected. The vehicle is then driven to the measuring chamber with a minimum use of the accelerator pedal. The engine must be turned off before any part of the vehicle enters the measuring chamber. The time at which the engine is switched off is recorded on the evaporative emission measurement data recording system and temperature recording begins. The vehicle's windows and luggage compartments must be opened at this stage, if not already opened.

5.5.4. The vehicle must be pushed or otherwise moved into the measuring chamber with the engines switched off.

5.5.5. The enclosure doors are closed and sealed gas-tight within two minutes of the engine being switched off and within seven minutes of the end of the conditioning drive.

5.5.6. The start of a 60 ± 0,5 minute hot soak period begins when the chamber is sealed. The hydrocarbon concentration, temperature and barometric pressure are measured to give the initial readings $C_{HC,i}$, P_i and T_i for the hot soak test. These figures are used in the evaporative emission calculation, Section 6. The ambient SHED temperature T must not be less than 296 K and no more than 304 K during the 60-minute hot soak period.

5.5.7. The hydrocarbon analyzer must be zeroed and spanned immediately before the end of the 60 ± 0,5 minute test period.

5.5.8. At the end of the 60 ± 0,5 minute test period measure the hydrocarbon concentration in the chamber. The temperature and the barometric pressure are also measured. These are the final readings $C_{HC,f}$, P_f and T_f for the hot soak test used for the calculation in Section 6.

5.6. **Soak**

5.6.1. The test vehicle shall be pushed or otherwise moved to the soak area without use of the engine and shall be soaked for not less than 6 hours and not more than 36 hours between the end of the hot soak test and the start of the diurnal emission test. For at least 6 hours of this period; the vehicle shall be soaked at 293 K ± 2 K (20 °C ± 2 °C).

5.7. **Diurnal test**

5.7.1. The test vehicle shall be exposed to one cycle of ambient temperature according to the profile specified in Appendix 2 with a maximum deviation of ± 2 K at any time. The average temperature deviation from the profile, calculated using the absolute value of each measured deviation, shall not exceed 1 K. Ambient temperatures shall be measured at least every minute. Temperature cycling shall begin when time t_{start} = 0, as specified in Section 5.7.6.

5.7.2. The measuring chamber shall be purged for several minutes immediately before the test until a stable background is obtainable. The chamber mixing fan(s) must also be switched on at this time.

5.7.3. The test vehicle, with the engine shut off and the test vehicle windows and luggage compartment(s) opened shall be moved into the measuring chamber. The mixing fan(s) shall be adjusted in such a way that it (they) maintain a minimum air circulation of 8 km/h under the fuel tank of the test vehicle.

5.7.4. The hydrocarbon analyser must be zeroed and spanned immediately before the test.

5.7.5. The enclosure doors are closed and gas-tight sealed.

5.7.6. Within 10 minutes of closing and sealing the doors, the hydrocarbon concentration, temperature and barometric pressure are measured to give the initial readings $C_{HC,i}$, P_i and T_i for the diurnal test. This is the point where time t_{start} = 0.

5.7.7. The hydrocarbon analyser must be zeroed and spanned immediately before the end of the test.

5.7.8. The end of the emission sampling period shall occur 24 hours ± 6 minutes after the beginning of the initial sampling, as specified in Section 5.7.6. The time elapsed is recorded. The hydrocarbon concentration, temperature and barometric pressure are measured to give the final readings $C_{HC,f}$, P_f and T_f for the diurnal test used for the calculation in Section 6. This completes the evaporative emission test procedure.

6. CALCULATION

The evaporative emission tests described in Section 5 allow the hydrocarbon emissions from the diurnal and hot soak phases to be calculated. Evaporative losses from each of theses phases is calculated using the initial and final hydrocarbon concentrations, temperatures and pressures in the enclosure, together with the net enclosure volume.

The formula below is used:

$$M_{HC} = k \; V \; 10^{-4} \left(\frac{C_{HC,f} \; P_f}{T_f} - \frac{C_{HC,i} \; P_i}{T_i} \right) + M_{HC,out} - M_{HC,i}$$

where:

M_{HC} = mass of hydrocarbon exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing (grams).

$M_{HC,i}$ = mass of hydrocarbon entering the enclosure, in the case of fixed-volume enclosures for diurnal emission testing (grams).

C_{HC} = measured hydrocarbon concentration in the enclosure (ppm (volume) C_1 equivalent),

V = net enclosure volume in cubic metres corrected for the volume of the vehicle, with the windows and the luggage compartment open. If the volume of the vehicle is not determined a volume of 1,42 m^3 is subtracted.

T = ambient chamber temperature, K,

P = barometric pressure in kPA,

H/C = hydrogen to carbon ration,

k = $1{,}2 \cdot (12 + H/C)$;

when:

i is the initial reading

f is the final reading

H/C is taken to be 2,33 for diurnal test losses,

H/C is taken to be 2,20 for hot soak losses.

6.2. **Overall results of test**

The overall hydrocarbon mass emission for the vehicle is taken to be:

$$M_{total} = M_{DI} + M_{HS}$$

where:

M_{total} = overall mass emissions of the vehicle (grams),
M_{DI} = hydrocarbon mass emission for diurnal test (grams).
M_{HS} = hydrocarbon mass emission for the hot soak (grams).'

Appendix 1

22. Sections 1 and 2 read as follows:

'1. CALIBRATION FREQUENCY AND METHODS

1.1. All equipment must be calibrated before its initial use and then calibrated as often as necessary and in any case in the month before type-approval testing. The calibration methods to be used are described in this Appendix.

1.2. Normally the series of temperatures which are mentioned firstly should be used. The series of temperatures within square brackets can alternatively be used.

2. CALIBRATION OF THE ENCLOSURE

2.1. **Initial determination of enclosure internal volume**

2.1.1. Before its initial use, the internal volume of the chamber must be determined as follows. The internal dimensions of the chamber are carefully measured, allowing for any irregularities such as bracing struts. The internal volume of the chamber is determined from these measurements.

For variable-volume enclosures, latch the enclosure to a fixed volume when the enclosure is held at an ambient temperature of 303 K (30 °C) [302 K (29 °C)]. This nominal volume shall be repeatable within ± 0,5 percent of the reported value.

2.1.2. The net internal volume is determined by subtracting 1,42 m^3 from the internal volume of the chamber. Alternatively the volume of the test vehicle with the luggage compartment and windows open may be used instead of the 1,42 m^3.

2.1.3. The chamber must be checked as in Section 2.3. If the propane mass does not agree with the injected mass to within ± 2% then corrective action is required.

2.2. **Determination of chamber background emissions**

This operation determines that the chamber does not contain any materials that emit significant amounts of hydrocarbons. The check must be carried out at the enclosure's introduction to service, after any operations in the enclosure which may affect background emissions and at a frequency of a least once per year.

2.2.1. Variable-volume enclosures may be operated in either latched or unlatched volume configuration, as described in Section 2.1.1. Ambient temperatures shall be maintained at 308 ±2 K (35 ± 2 °C) [309 ± 2 K (36 ±2 °C)], throughout the 4-hour period mentioned below.

2.2.2. Fixed volume enclosures shall be operated with inlet and outlet flow streams closed. Ambient temperatures shall be maintained at 308 ± 2 K (35 ± 2 °C) [309 ± 2 K (36 ± 2 °C)] throughout the 4-hour period mentioned below.

2.2.3. The enclosure may be sealed and the mixing fan operated for a period of up to 12 hours before the 4-hour background sampling period begins.

2.2.4. Calibrate the analyzer (if required), then zero and span.

2.2.5. Purge the enclosure until a stable hydrocarbon reading is obtained. The mixing fan is turned on if not already on.

2.2.6. Seal the chamber and measure the background hydrocarbon concentration, temperature and barometric pressure. These are the initial readings $C_{HC,i}$, P_i and T_i used in the enclosure background calculation.

2.2.7. The enclosure is allowed to stand undisturbed with the mixing fan on for a period of four hours.

2.2.8. At the end of this time use the same analyzer to measure the hydrocarbon concentration in the chamber. The temperature and the barometric pressure are also measured. These are the final readings $C_{HC,f}$, P_f and T_f.

2.2.9. Calculate the change in mass of hydrocarbons in the enclosure over the time of the test according to Section 2.4. The background emission of the enclosure must not exceed 0,05 g.

2.3. **Calibration and hydrocarbon retention test of the chamber**

The calibration and hydrocarbon retention test in the chamber provides a check on the calculated volume in Section 2.1 and also measures any leak rate. The enclosure leak rate shall be determined at the enclosure's introduction to service, after any operations in the enclosure which may effect the integrity of the enclosure, and at least monthly thereafter. If six consecutive monthly retention checks are successfully completed without corrective action, the enclosure leak rate may be determined quarterly thereafter as long as no corrective action is required.

2.3.1. Purge the enclosure until a stable hydrocarbon concentration is reached. Turn on the mixing fan, if not already switched on. The hydrocarbon analyzer is zeroed, calibrated if required, and spanned.

2.3.2. On variable-volume enclosures latch the enclosure to the nominal volume position. On fixed-volume enclosures close the outlet and inlet flow streams.

2.3.3. Turn on the ambient temperature control system (if not already on) and adjust it for an initial temperature of 308 K (35 °C) [309 K (36 °C)].

2.3.4. When the enclosure stabilizes at 308 ± 2 K (35 ± 2 °C) [309 ± 2 K (36 ± 2 °C)], seal the enclosure and measure the background concentration, temperature and barometric pressure. These are the initial readings $C_{HC,i}$, P_i and T_i used in the enclosure calibration.

2.3.5. Inject a quantity of approximately 4 grams of propane into the enclosure. The mass of propane must be measured to an accuracy and precision of ± 0,2% of the measured value.

2.3.6. Allow the contents of the chamber to mix for five minutes and then measure the hydrocarbon concentration, temperature and barometric pressure. These are the final readings $C_{HC,f}$, T_f and P_f for the calibration of the enclosure as well as the initial readings $C_{HC,i}$, T_i and P_i for the retention check.

2.3.7. Using the readings taken in Sections 2.3.4 and 2.3.6 and the formula in Section 2.4, calculate the mass of propane in the enclosure. This must be within ± 2% of the mass of propane measured in Section 2.3.5.

2.3.8. For variable-volume enclosures unlatch the enclosure from the nominal volume configuration. For fixed-volume enclosures, open the outlet and inlet flow streams.

2.3.9. Start cycling the ambient temperature from 308 K (35 °C) to 293 K (20 °C) and back to 308 K (35 °C) [308,6 K (35,6 °C) to 295,2 K (22,2 °C) and back to 308,6 K (35,6 °C)] over a 24-hour period according to the profile [alternative profile] specified in Appendix 2 within 15 minutes of sealing the enclosure. (Tolerances as specified in Section 5.7.1 of Annex VI)

2.3.10. At the completion of the 24-hour cycling period, measure and record the final hydrocarbon concentration, temperature and barometric pressure. These are the final readings $C_{HC,f}$, T_f and P_f for the hydrocarbon retention check.

2.3.11. Calculate using the formula in Section 2.4, the hydrocarbon mass from the readings taken in Sections 2.3.10 and 2.3.6. The mass may not differ by more than 3% from the hydrocarbon mass given by Section 2.3.7.

2.4. Calculations

The calculation of net hydrocarbon mass change within the enclosure is used to determine the chamber's hydrocarbon background and leak rate. Initial and final readings of hydrocarbon concentration, temperature and barometric pressure are used in the following formula to calculate the mass change.

$$M_{HC} = k\ V\ 10^{-4}\ \left(\frac{C_{HC,f}\ P}{T_f} - \frac{C_{HC,i}\ P}{T_i}\right) + M_{HC,out} - M_{HC,i}$$

where:

M_{HC} = hydrocarbon mass in grams

$M_{HC,out}$ = mass of hydrocarbon exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing (grams)

$M_{HC,i}$ = mass of hydrocarbon entering the enclosure, in the case of fixed volume enclosures for diurnal emission testing (grams)

C_{HC} = hydrocarbon concentration in the enclosure (ppm carbon (NB: ppm carbon = ppm propane x 3))

V = enclosure volume in cubic metres as measured in Section 2.1.1.

T = ambient temperature in the enclosure, K,

P = barometric pressure, kPa,

k = 17,6;

when:

i is the initial reading.

f is the final reading'

Appendix 2

23. The following new Appendix 2 is added:

'Appendix 2

Diurnal Ambient Temperature Profile for the Calibration of the Enclosure and the Diurnal Emission Test

Time (hours)		Temperature ($°C_i$)
calibration	test	
16	0	20
17	1	20,2
18	2	20,5
19	3	21,2
20	4	23,1
21	5	25,1
22	6	27,2
23	7	29,8
24	8	31,8
0	9	33,3
1	10	34,4
2	11	35
3	12	34,7
4	13	33,8
5	14	32
6	15	30
7	16	28,4
8	17	26,9
9	18	25,2
10	19	24
11	20	23
12	21	22
13	22	20,8
14	23	20,2
15	24	20

Alternative Diurnal Ambient Temperature Profile for the Calibration of the Enclosure in Accordance with Annex I Section 1.2

Time (hours)	Temperature ($°C_i$)
0	35,6
1	35,3
2	34,5
3	33,2
4	31,4
5	29,7
6	28,2
7	27,2
8	26,1
9	25,1
10	24,3
11	23,7
12	23,3
13	22,9
14	22,6
15	22,2
16	22,5
17	24,2
18	26,8
19	29,6
20	31,9
21	33,9
22	35,1
23	35,4
24	35,6

Annex VIII

24. Annex VIII reads as follows:

'ANNEX VIII

SPECIFICATIONS OF REFERENCE FUELS

1. TECHNICAL DATA OF THE REFERENCE FUEL TO BE USED FOR TESTING VEHICLES EQUIPPED WITH POSITIVE-IGNITION ENGINES

Type: petrol, unleaded (regular, premium, super)

Parameter	Unit	Limits[1]		Test Method[2]
		Minimum	Maximum	
Research octane number, RON		95,0	--	ISO 5164
Motor octane number, MON		85,0	--	ISO 5163
Density at 15 °C	kg/l	0,748	0,762	ASTM D 1298
Reid vapour pressure, - summer period[3]	kPa	56,0	60,0	EN 12
Distillation[4]:	°C			
- initial boiling point	% v/v	24	40	ASTM D 86
- evaporated at 100 °C	% v/v	49,0	57,0	ISO 3405
- evaporated at 150 °C	°C	81,0	87,0	ISO 3405
- final boiling point	%	190	215	ASTM D 86
Residue		--	2	ASTM D 86
Hydrocarbon analysis:	% v/v			
- olefins	% v/v	8	14	ASTM D1319
- aromatics	% v/v	29,0	41,0	ASTM D1319
- benzene		--	2,0	EN 238
- saturates		balance		ASTM D 1319
Carbon/hydrogen ratio	min	r a t i o		
Oxidation stability[5]	% m/m	480	--	ASTM D 525
Oxygen content	mg/ml	--	2,3	pr EN 1601
Existent gum	% ppm	--	0,04	ASTM D 381
Sulphur content		--	150	ISO 8754
Copper corrosion at 50 °C	g/l	--	1	ASTM D 130
Lead content	g/l	--	0,005	EN 237
Phosphorous content		--	0,0013	ASTM D 3231

(1) The values quoted in the specification are 'true values'. In establishment of their limit values the terms of ISO 4259 'Petroleum products - Determination and application of precision data in relation to methods of test' have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility).
Notwithstanding this measure, which is necessary for statistical reasons, the manufacturer of fuels should nevertheless aim at a zero value where the stipulated maximum value is 2R and at the mean value in the case of quotations of maximum and minimum limits. Should it be necessary to clarify the question as to whether a fuel meets the requirements of the specifications, the terms of ISO 4259 should be applied.

(2) Equivalent ISO methods will be adopted when issued for all properties listed above.

(3) The summer period extends from 1 April to 30 September of each year.

(4) The figures quoted shows the evaporated quantities (percentage recovered + percentage loss).

(5) The fuel may contain exidation inhibitors and metal deactivators normally used to stabilize refinery gasoline streams, but detergent/dispersant additives and solvent oils must not be added.

2. TECHNICAL DATA OF THE REFERENCE FUEL TO BE USED FOR TESTING VEHICLES EQUIPPED WITH A DIESEL ENGINE

Type: Diesel fuel

Parameter	Unit	Limits[1]		Test Method [2]
		Minimum	Maximum	
Cetane number[3]		52,0	54	ISO 5163
Density at 15 °C	kg/m^3	833	837	ISO 3675
Distillation[4]:				
- 50% point	°C	245	--	ISO 3405
- 95% point	°C	345	350	ISO 3405
- final boiling point	°C	--	370	ISO 3405
Flash point	°C	55	--	ASTM D 93
CFPP	°C	--	-5	EN 116
Viscosity at 40 °C	mm^2/s	2,5	3,5	ASTM D 445
Polycyclic aromatic hydrocarbons	% m/m	3	6,0	pr IP 391
Sulphur content	% m/m	--	0,03	ISO 8754
Copper corrosion		--	1	ASTM D 130
Conradson carbon residue (10% DR)	% mass	--	0,2	ASTM D 189
Ash content	% mass	--	0,01	ASTM D 482
Water content	% mass	--	0,05	ASTM D95/D
Neutralization (strong acid) number	mg KOH/g	--	0,02	1744
Oxidation stability[6]	mg/ml	--	2,5	ASTM 2274

(1) The values quoted in the specification are 'true values'. In establishment of their limit values the terms of ISO 4259 'Petroleum products - Determination and application of precision data in relation to methods of test' have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility).
Notwithstanding this measure, which is necessary for statistical reasons, the manufacturer of fuels should nevertheless aim at a zero value where the stipulated maximum value is 2R and at the mean value in the case of quotations of maximum and minimum limits. Should it be necessary to clarify the question as to whether a fuel meets the requirements of the specifications, the terms of ISO 4259 should be applied.

(2) Equivalent ISO methods will be adopted when issued for all properties listed above.

(3) The range for cetane number is not in accordance with the requirement of a minimum range of 4R. However, in the case of dispute between fuel supplier and fuel user, the terms in ISO 4259 can be used to resolve such disputes provided replicate measurements of sufficient number to archive the necessary precision, are made in preference to single determinations.

(4) The figures quoted shows the evaporated quantities (percentage recovered + percentage loss).

(5) As from 1 January 2005.

(6) Even though oxidation stability is controlled, it is likely that self life will be limited. Advice should be sought from the supplier as to storage conditions and life.

Annex X

25. A new Annex X is added to read as follows:

'*Annex X*

CONTROL OF COMPLIANCE OF VEHICLES IN SERVICE

1. INTRODUCTION

1.1. This Annex describes the procedure referred to in Section 8 of Annex I for the control of compliance of vehicles in service. The procedure describes the selection and handling of test vehicles, in service survey testing and evaluation, the plan of remedial measures and its implementation .

2. IN SERVICE SURVEY

2.1. The in service survey will be performed by the approval authority which granted the original type-approval according to this Directive, according to procedures laid down in Section 5.

2.2. The manufacturer shall be notified whenever the approval authority in a Member State, which granted the original type-approval in accordance with this directive, has determined that a vehicle type produced by that manufacturer, although properly maintained and used, does not conform to these provisions.

2.3. When a manufacturer is notified that a vehicle type is in non-compliance with applicable requirements (including emission limit values) of this Directive, the manufacturer shall submit a plan of measures to the approval authority to remedy such non-compliance.

2.4. Any vehicle approved according to the requirements of this Directive is subject to the provisions in this Annex.

3. DEFINITIONS

For the purpose of this Annex the following definitions apply.

3.1. The terms used in this Annex X and not specifically defined shall have the meaning assigned to such terms in Annex I to this Directive, or if not defined in Annex I to this Directive, the meaning assigned to such terms in Directive 70/156/EEC.

3.2. 'In Service Survey' means tests and evaluations of compliance conducted according to this Annex.

3.3. 'Properly maintained and used' means for the purpose of a test vehicle that such a vehicle satisfies the criteria for acceptance of a selected vehicle of Section 5.

4. SURVEY SCHEDULE

4.1. The manufacturer will be notified 45 working days before the initiation of the in service survey of a vehicle type.

4.2. The manufacturer may submit a voluntary plan of remedial measures, drafted according to Section 6 at any time prior to completion of an in service survey.

5. SELECTION CRITERIA, MAINTENANCE, AND SURVEY TEST

5.1. Emission tests and evaluations to determine whether a vehicle type conforms to the requirements shall be performed in accordance with the procedures of Section 5. The manufacturer shall have an opportunity to observe all the selection and testing and to inspect all vehicles tested under Section 5. In service survey testing of the on-board diagnostic system shall be performed in accordance with Section 5.5. Sections 5.2, 5.3 and 5.4 do not apply under OBD survey.

5.2 The approval authority shall select vehicles for in service survey on a random base chosen in accordance with Appendix 1 to this Annex from vehicles within the selected vehicle type. The approval authority determines the vehicle selection. The vehicles for testing shall be representative of the vehicle type which they belong to and available for sale or sold in the EU.

Selection criteria

5.3. The criteria for acceptance of a selected vehicle follows from Sections 5.3.1 - 5.3.8. Information will be gathered through vehicle examination and a interview with the owner which may include a written survey by the manufacturer.

5.3.1. The vehicle belongs to a vehicle type that is type-approved under this Directive and is accompanied with a Certificate of Conformity according to Directive 70/156/EEC. It shall be registered and privately used in the EU.

5.3.2. The vehicle has been in service for less than 80 000 km or 5 years which ever occurs first.

5.3.3. There is a maintenance record to show that the vehicle has been properly maintained, e.g. has been serviced in accordance with the manufacturer's recommendations.

5.3.4. There is no indication of abuse (e.g., racing, overloading, misfuelling, or other misuse), or other factors (e.g., tampering) that would affect emissions performance. In the case of vehicles fitted with an OBD system, the information stored in its memory shall be taken into account.

5.3.5 There has been no unauthorized major repair to the engine or major repair of the vehicle.

5.3.6. Lead content and sulphur content of fuel sample from the vehicle tank meets applicable standards and there is no other evidence of misfuelling. Checks may be done in the exhaust pipe, etc.

5.3.7. There is no indication of any problem that might jeopardize the safety of laboratory personnel.

5.3.8. All emission control system components on the vehicle shall be in conformity with applicable type approval.

Diagnosis and restorative maintenance

5.4. Diagnosis and restorative maintenance will be performed on vehicles accepted for testing, prior to in service survey testing, according to Sections 5.4.1 - 5.4.8.

5.4.1. Check air filter, all drive belts, all fluid levels, radiator cap, all vacuum hoses and electrical wiring related to emissions control for integrity; check ignition, fuel metering and emission control system components for maladjustments and/or tampering. Record all discrepancies.

5.4.2. Check the integrity of the OBD system; record all malfunction information stored in the OBD memory; make all repairs necessary for extinguishing all malfunction indications.

5.4.3. If the OBD malfunction indicator registers a malfunction during a preconditioning cycle or emission test cycle, the fault may be identified and repaired. The test may be rerun, and the results from that repaired vehicle may be used.

5.4.4. Check ignition system and replace defective components; i.e., spark plugs, wires, etc.

5.4.5. Check compression.

5.4.6. Check and adjust engine parameters to manufacturer's specifications.

5.4.7. If the vehicle is [before]within 800 km of a scheduled maintenance service, that maintenance will be performed according to the manufacturer's service instructions. Regardless of odometer reading, change of oil and air filter may be performed at the request of the manufacturer.

5.4.8. Upon acceptance of the vehicle the fuel shall be replaced with appropriate emission test reference fuel, unless the manufacturer accepts the use of market fuel.

In service survey testing and evaluation of results

5.5. Applicable emission tests in accordance with this Directive will be performed on vehicles selected in accordance with the requirements of Sections 5.3 and 5.4 and after being pre-conditioned.

5.6. Vehicles equipped with an OBD system will be checked for proper durability of the malfunction indication, etc., in relation to levels of emissions (e.g. malfunction indication limits defined in Annex XI) for the type-approved specification.

5.6.1. The OBD system may be tested for, e.g., levels of emissions above applicable limit values with no malfunction indication, systematic erroneous activation of the malfunction indication, and identified faulty or deteriorated components in the OBD system.

5.6.2. If a component or system that operates outside of the particulars in the type-approval certificate and/or information package for such vehicle type and such deviation has not been authorized under Article 5 (3) or 5 (4) of Directive 70/156/EEC with no malfunction indication by the OBD, the component or system shall not be replaced prior to emission testing, unless it is determined that the component or system has been tampered with or abused in such a manner that the OBD does not detect the resulting malfunction.

5.7. The test results are submitted to the evaluation procedure in accordance with Appendix 1 of this Directive.

5.8. Within 10 working days after concluding the test, the results of the test and of the evaluation referred to in Section 5.7 shall be submitted to the manufacturer.

5.9. The manufacturer shall have, as far as possible, the opportunity to make such inspections and investigations of vehicles whose test results do not comply with the limit value for any pollutant applicable under this Directive to determine the existence of any improper maintenance, misuse, misfuelling, tampering or abuse that was not reasonably discoverable prior to the commencement of testing.

5.10. Within 25 working days from receiving the test results, the manufacturer may submit a statement based on additional investigation on sample vehicles to the authority concerning the performance of the testing or the determination of a non-compliance. The statement, if any, will be enclosed in the test report. The authority shall give due regard to the manufacturer's statement in determing whether a non-compliance exists.

5.11. Within 10 working days after the time limit of Section 5.10 has elapsed, the authority shall finalize the test report and take a decision on compliance and non-compliance. Non-compliance shall be declared when for any single pollutant the result of the evaluation referred in Section 5.7 exceed the limit values given in Section 5.3.1.4 of Annex I to this Directive. Test results shall not be multiplied by deterioration factors.

6. PLAN OF REMEDIAL MEASURES

6.1. When the manufacturer is notified that a vehicle type is in non-compliance according to the requirements of these provisions, the manufacturer shall submit to the approval authority a plan of remedial measures to remedy the non-compliance. These plan of remedial measures can address vehicles in service, vehicles under production as well as amendements to the type-approval, if appropriate.

6.2. The plan of remedial measures shall be filed with the approval authority not later than 45 working days from the date of the notification issued according to Section 5.10. The approval authority shall within 20 working days declare the approval or disapproval of the plan of remedial measures.

6.2.1. The accaptence of the plan of remedial measures may be subject to conditions required by the approval authority.

6.2.2. The approval authority may specify an extended time limit for submitting a plan of remedial measures by up to 60 working days if the manufacturer in writing showed good cause for such extension.

6.2.3. When the approval authority cannot approve the plan of remedial measures it may take other measures in accordance with Article 11 (2) (a) to Directive 70/156/EEC.

6.3. The approval authority shall notify all Member States of its decision concerning the plan of remedial measures and supply all Member States with the plan of remedial measures.

The plan of remedial measures

6.4. The plan of remedial measures shall have the content specified in Sections 6.4.1 - 6.4.11. The manufacturer shall give the plan of remedial measures a unique identifying name or number.

6.4.1. A description of each vehicle type included in the plan of remedial measures.

6.4.2. A description of the specific modifications, alterations, repairs, corrections, adjustments, or other changes to be made to bring the vehicles into conformity including a brief summary of the data and technical studies which support the manufacturer's decision as to the particular remedial changes to be used in correcting the non-compliance.

6.4.3. A description of the method by which the manufacturer will inform the vehicle owners.

6.4.4. A description of the proper maintenance or use, if any, upon which the manufacturer conditions eligibility for repair under the plan of remedial measures, and an explanation of the manufacturer's reasons for imposing any such condition. No maintenance or use conditions may be imposed unless it is demonstrably related to the non-compliance and the remedial measures.

6.4.5. A description of the procedure to be followed by vehicle owner to obtain correction of the non-compliance. This shall include a date after which when the non-compliance may be remedied, the estimated time for the workshop to perform the remedy, and where the remedy can be done. The repair shall be done expediently, within a reasonable time after delivery of the vehicle.

6.4.6. A copy of the information transmitted to the vehicle owner.

6.4.7. A brief description of the system which the manufacturer will use to assure an adequate supply of component or system, for fulfilling the remedial action. It shall be indicated when there will be an adequate supply of component or system to initiate the campaign.

6.4.8. A copy of all instructions to be sent to those persons who are to perform the repair.

6.4.9. A description of the impact of the proposed remedy on the emissions, fuel consumption, driveability, and safety of each vehicle type, included the plan of remedial measures with data, technical studies etc. which supports these conclusions.

6.4.10. Any other information, reports or data the approval authority reasonably may determine is necessary to evaluate the plan of remedial measures.

6.4.11. In the case the plan of remedial measures includes a recall, a description of the methode for recording the repair shall be submitted to the type approval authority. In the case a label is used an exemple of it shall be submitted.

6.5. The manufacturer may be required to conduct tests on components and vehicles incorporating a proposed change, repair, or modification reasonably designed and necessary to demonstrate the effectiveness of the change, repair, or modification.

6.6. The manufacturer is responsible for keeping a record of every vehicle recalled and repaired and the workshop which performed the repair. The approval authority shall have access to the record after request for a period of 5 years from the implementation of the plan of remedial measures.

7. IMPLEMENTATION OF THE PLAN OF REMEDIAL MEASURES

7.1. A recall campaign is commencing after decision by the Member State, based on the approved plan of remedial measures. The manufacturer, or his/her representative, is responsible for conducting the campaign according to the approved plan of remedial measures.

7.1.1. If the plan of remedial measures is not carried in the approved time limits fixed in the remedial plan and the manifacturer cannot justify the exceed of the time limits, the approval authority can take measures in accordance with Article 11(2)(a) to Directive 70/156/EEC.

7.2. The notification of the vehicle owner shall be done expeditiously. This notification shall include all relevant information relating the necessary repair of the vehicle.

7.3. The manufacturer shall provide a copy of all communication related to the plan of remedial measures. He/she shall also maintain a record on the recall campaign, and supply regularly status reports to the approval authority.

Annex XI

26. A new Annex XI is added to read as follows:

'*Annex XI*

ON-BOARD DIAGNOSTICS (OBD) FOR MOTOR VEHICLES

1. SCOPE

This Annex applies to the functional aspects of on-board diagnostic (OBD) systems for the emission control of all motor vehicles of category M_1[(1)]) equipped with positive-ignition engines and all motor vehicles of categories M_1 equipped with compression-ignition engines covered by Article 1 of this Directive.

2. DEFINITIONS

For the purposes of this Annex:

2.1. 'OBD' means an on-board diagnostics system for emission control which shall have the capability of identifying the likely area of malfunction by means of fault codes stored in computer memory.

2.2. 'Vehicle type' means a category of power driven vehicles which do not differ in such essential engine and OBD system characteristics as defined in Appendix 5.

2.3. 'Vehicle family' means a manufacturer's grouping of vehicles which, through their design, are expected to have similar exhaust emission and OBD system characteristics. Each engine of this family must have complied with the requirements of this Directive.

2.4. 'Emission control system' means the electronic engine management controller and any emission related component in the exhaust or evaporative system which supplies an input to or receives an output from this controller.

2.5. 'Malfunction indicator (MI)' means a visible or audible indicator that clearly informs the driver of the vehicle in the event of a malfunction of any emission related component connected to the OBD system, or the OBD system itself.

2.6. 'Malfunction' means the failure of an emission related component or system that would result in emissions exceeding the limits in Section 5.3.2 of this Annex.

2.7. 'Secondary air' refers to air introduced into the exhaust system by means of a pump or aspirator valve or other means that is intended to aid in the oxidation of HC and CO contained in the exhaust gas stream.

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(1) As defined in Annex II Section A of Directive 70/156/EEC.

2.8. 'Engine misfire' means lack of combustion in the cylinder of a positive ignition engine due to absence of spark, poor fuel metering, poor compression or any other cause. In terms of OBD monitoring it is that percentage of misfires out of a total number of firing events (as declared by the manufacturer) that would result in emissions exceeding the limits given in Section 5.3.2 or that percentage that could lead to an exhaust catalyst, or catalysts, overheating causing irreversible damage.

2.9. 'Type I test' means the driving cycle (Parts One and Two) used for emission approvals, as detailed in Annex III, Appendix 1.

2.10. 'A driving cycle' consists of engine start-up, a driving mode where a malfunction would be detected if present, and engine shut-off.

2.11. 'A warm-up cycle' means sufficient vehicle operation such that the coolant temperature has risen by at least 22 K from engine starting and reaches a minimum temperature of 343 K (70 °C).

2.12. 'Fuel trim' refers to feedback adjustments to the base fuel schedule. Short-term fuel trim refers to dynamic or instantaneous adjustments. Long-term fuel trim refers to much more gradual adjustments to the fuel calibration schedule than short-term trim adjustments. These long-term adjustments compensate for vehicle differences and gradual changes that occur over time.

2.13. 'Calculated load value' refers to an indication of the current airflow divided by peak airflow, where peak airflow is corrected for altitude, if available. This definition provides a dimensionless number that is not engine specific and provides the service technician with an indication of the percent engine capacity that is being used (with wide open throttle as 100%);

$$CLV = \frac{\text{Current airflow}}{\text{Peak airflow (at sea level)}} \cdot \frac{\text{Atm. pressure (at sea level)}}{\text{Barometric pressure}}$$

2.14. 'Permanent emission default mode' refers to a case where the engine management controller permanently switches to a setting that does not require an input from a failed component or system where such a failed component or system would result in an increase in emissions from the vehicle to a level above the limits given in Section 5.3.2 of this Annex.

2.15. 'Power Take-Off unit' means an engine driven output provision for the purposes of powering auxiliary, vehicle mounted, equipment.

3. APPLICATION FOR EC TYPE-APPROVAL

3.1. The application conforming to Annex I, Section 3 is accompanied by the additional information required in Appendix 5 together with:

3.1.1. a declaration by the manufacturer of:

3.1.1.1. in the case of vehicles equipped with positive-ignition engines, the percentage of misfires out of a total number of firing events that would result in emissions exceeding the limits given in Section 5.3.2 of this Annex if that percentage of misfire had been present from the start of a Type I test as described in Section 5.3.1 of Annex III;

3.1.1.2. in the case of vehicles equipped with positive-ignition engines, the percentage of misfires out of a total number of firing events that could lead to an exhaust catalyst, or catalysts, overheating prior to causing irreversible damage;

3.1.2. detailed written information fully describing the functional operation characteristics of the OBD system, including a listing of all relevant parts of the vehicle's emission control system, i.e. sensors, actuators and components, that are monitored by the OBD system;

3.1.3. a description of the MI used by the OBD system to signal the presence of a fault to the driver of the vehicle;

3.1.4. the manufacturer shall describe provisions taken to prevent tampering and modification of the emission control computer;

3.1.5. when appropriate, copies of other type-approvals with the relevant data to enable extensions of approvals;

3.1.5.1. if applicable, the particulars of the vehicle family as referred to in Appendix 6.

3.2. For the tests described in Section 5 of this Annex, a vehicle representative of the vehicle types or vehicle family fitted with the OBD system to be approved must be submitted to the technical service responsible for the type-approval test. If the technical service determines that the submitted vehicle does not fully represent the vehicle type or vehicle family described in Appendix 6, an alternative, and if necessary, an additional vehicle shall be submitted for test according to Section 5 of this Annex.

4. GRANTING OF EC TYPE-APPROVAL

4.1. The certificate conforming to Annex I, Section 4, is accompanied by the Addendum for which a model is given in Appendix 7.

5. REQUIREMENTS AND TESTS

5.1. All vehicles shall be equipped with an OBD system so designed, constructed and installed in a vehicle to enable it to identify types of deterioration or malfunction over the entire life of the vehicle. In achieving this objective the approval authority shall accept that vehicles which have travelled distances in excess of the Type V durability distance, referred to in Section 5.3.1, may show some deterioration in OBD system performance such that the emission limits given in Section 5.3.2 may be exceeded before the OBD system signals a failure to the driver of the vehicle.

5.2. The OBD system must be so designed, constructed and installed in a vehicle to enable it to comply with the requirements of this Annex during conditions of normal use.

5.2.1. Temporary disablement of the OBD system.

5.2.1.1. A manufacturer may disable the OBD system if its ability to monitor is affected by low fuel levels. Disablement shall not occur when the fuel tank level is above 15 percent of the nominal capacity of the fuel tank.

5.2.1.2. A manufacturer may disable the OBD system at ambient engine starting temperatures below 266 K (-7 °C) or at elevations over 2 500 metres above sea level provided the manufacturer submits data and/or an engineering evaluation which adequately demonstrate that monitoring would be unreliable when such conditions exist. A manufacturer may also request disablement of the OBD system at other ambient engine starting temperatures if he demonstrates to the authority with data and/or an engineering evaluation that mis-diagnosis would occur under such conditions.

5.2.1.3. For vehicles designed to accommodate the installation of Power Take-Off units, disablement of affected monitoring systems is permitted provided disablement occurs only when the Power Take-Off unit is active.

5.2.2. Engine Misfire - vehicles equipped with positive-ignition engines.

5.2.2.1. Manufacturers may adopt higher misfire percentage malfunction criteria, than that declared to the authority, under specific engine speed and load conditions where it can be demonstrated to the authority that the detection of lower levels of misfire would be unreliable.

5.2.2.2. Manufacturers who can demonstrate to the authority that the adoption of higher misfire percentages would still lead to unreliable detection may disable the monitoring system when such conditions exist.

5.3. Description of tests.

5.3.1. The tests are carried out on the vehicle used for the Type V durability test, given in Annex VII, and using the test procedure in Appendix I to this Annex. Tests are carried out at the conclusion of the Type V durability testing. When no Type V durability testing is carried out, or at the request of the manufacturer, a suitably aged and representative vehicle may be used for these OBD demonstration tests.

5.3.2. The OBD system shall indicate the failure of an emissions related component or system when that failure results in an increase in emissions above the limits given below:

Engine Type	CO (g/km)	HC (g/km)	NOx (g/km)	PM[1] (g/km)
Positive-ignition	3,2	0,4	0,6	-
Compression-ignition	3,2	0,4	1,2	0,18

[1] for compression-ignition engines only

5.3.3. Monitoring requirements for vehicles equipped with positive-ignition engines

In satisfying the requirements of Section 5.3.2 the OBD system shall, at a minimum, monitor for:

5.3.3.1. Reduction in the efficiency of the catalytic converter with respect to the emissions of HC only;

5.3.3.2. The presence of engine misfire in the engine operating region bounded by the following lines:

(a) A maximum speed of 4 500 min^{-1} or 1 000 min^{-1} greater than the highest speed occurring during a Type I test cycle, whichever is the lower;

(b) The positive torque line (i.e. engine load with the transmission in neutral);

(c) A line joining the following engine operating points: the positive torque line at 3 000 min^{-1} and a point on the maximum speed line defined in (a) above with the engine's manifold vacuum at 13,33 kPa lower than that at the positive torque line.

5.3.3.3. Oxygen sensor deterioration

5.3.3.4. Other emission control system components or systems, or emission-related powertrain components or systems which are connected to a computer, the failure of which may result in tailpipe emissions exceeding the limits given in Section 5.3.2;

5.3.3.5. Any other emission-related powertrain component connected to a computer shall be monitored for circuit continuity;

5.3.3.6. The electronic evaporative emission purge control shall, at a minimum, be monitored for circuit continuity.

5.3.4. Monitoring requirements for vehicles equipped with compression-ignition engines.

In satisfying the requirements of Section 5.3.2 the OBD system shall monitor:

5.3.4.1. Where fitted, reduction in the efficiency of the catalytic converter;

5.3.4.2. Where fitted, the functionality and integrity of the particulate trap;

5.3.4.3. The fuel injection system electronic fuel quantity and timing actuator(s) will be monitored for circuit continuity and total functional failure;

5.3.4.4. Other emission control system components or systems, or emission-related powertrain components or systems, which are connected to a computer, the failure of which may result in tailpipe emissions exceeding the limits given in Section 5.3.2. Examples of such systems or components are those for monitoring and control of air mass-flow, air volumetric flow (and temperature), boost pressure and inlet manifold pressure (and relevant sensors to enable these functions to be carried out).

5.3.4.5. Any other emission-related powertrain component connected to a computer shall be monitored for circuit continuity.

5.3.5. Manufacturers may demonstrate to the approval authority that certain components or systems need not be monitored if, in the event of their total failure or removal, emissions do not exceed the emission limits given in Section 5.3.2 of this Annex.

5.4. A sequence of diagnostic checks will be initiated at each engine start and completed at least once provided that the correct test conditions are met. The test conditions shall be selected in such a way that they all occur under normal driving as represented by the Type I test.

5.5. Activation of malfunction indicator.

5.5.1. The OBD system shall incorporate a malfunction indicator (MI) readily perceivable to the vehicle operator. The MI shall not be used for any other purpose except to indicate emergency start-up or limp-home routines to the driver. The MI shall be in all reasonable lighting conditions. When activated, it shall display a symbol in conformance with ISO 2575[(2)]. A vehicle shall not be equipped with more than one general purpose MI for emission-elated problems. Separate specific purpose warning lights (e.g. brake system, fasten seat belt, oil pressure, etc.) are permitted. The use of red for a MI is prohibited.

5.5.2. For strategies requiring on average between three and ten driving cycles for MI activation, the manufacturer shall provide data and/or an engineering evaluation which adequately demonstrates that the monitoring system is equally effective and timely in detecting component deterioration. Strategies requiring on average more than ten driving cycles for MI activation shall not be accepted. The MI shall also activate whenever the engine control enters a permanent emission default mode of operation if the emission limits given in Section 5.3.2 are exceeded. The MI shall operate in a distinct warning mode, e.g. a flashing light, under any period during which engine misfire occurs at a level likely to cause catalyst damage, as specified by the manufacturer. The MI shall also activate when the vehicle's ignition is in the "key-on" position before engine starting or cranking and de-activate after engine starting if no malfunction has previously been detected.

5.6. Fault code storage.

The OBD system shall record code(s) indicating the status of the emission control system. Separate status codes shall be used to identify correctly functioning emission control systems and those emission control systems which need further vehicle operation to be fully evaluated. Fault codes that cause MI activation due to deterioration or malfunction or permanent emission default modes of operation shall be stored and that fault code shall identify the type of malfunction.

5.6.1. In the case of vehicles equipped with positive-ignition engines, misfiring cylinders need not be uniquely identified if a distinct single or multiple cylinder misfire fault code is stored.

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(2) International Standard ISO 2575-1982 (E), entitled "Road vehicles - Symbols for controls, indicators and tell-tales", Symbol Number 4.36.

5.7. Extinguishing the MI.

5.7.1. For misfire malfunctions at levels likely to cause catalyst damage (as specified by the manufacturer), the MI may be switched to the normal mode of activation if the misfire is not present any more, or if the engine is operated after changes to speed and load conditions where the level of misfire will not cause catalyst damage.

5.7.2. For all other malfunctions, the MI may be de-activated after three subsequent sequential driving cycles during which the monitoring system responsible for activating the MI ceases to detect the malfunction and if no other malfunction has been identified that would independently activate the MI.

5.8. Erasing a fault code.

5.8.1. The OBD system may erase a fault code and freeze-frame information if the same fault is not re-registered in at least 40 engine warm-up cycles.

5.9. Provisions for system security.

5.9.1. Any vehicle with an emission control computer shall include features to deter modification, except as authorized by the manufacturer. Any reprogrammable computer codes or operating parameters must be resistant to tampering and the computer and any related maintenance instructions must conform to the provisions in SAE J2186 "E/E Data Link Security" (ISO XXX-8). Any removable calibration memory chips shall be potted, encased in a sealed container or protected by electronic algorithms and shall not be changeable without the use of specialised tools and procedures.

5.9.2. Computer-coded engine operating parameters shall not be changeable without the use of specialised tools and procedures (e.g. soldered or potted computer components or sealed (or soldered) computer enclosures).

5.9.3. In the case of mechanical fuel injection pumps fitted to compression-ignition engines, manufacturers shall take adequate steps to protect the maximum fuel delivery setting from tampering while the vehicle is in service.

5.9.4. Manufacturers may apply to the approval authority for an exemption to this requirement for those vehicles which are unlikely to require protection. The criteria that the approval authority will evaluate in considering an exemption will include, but are not limited to, the current availability of performance chips, the high performance capability of the vehicle and the probable sales volume of the vehicle.

5.9.5. Manufacturers using programmable computer code systems (e.g. Electrical Erasable Programmable Read-Only Memory, EEPROM) shall employ proven methods to deter unauthorized reprogramming. Manufacturers shall include enhanced tamper protection strategies including data encryption using methods to secure the encryption algorithm and write protect features requiring electronic access to an off-site computer maintained by the manufacturer. Equivalent methods may be considered by the authority.

5.9.6. Anti-tampering features should not preclude the use of replacement parts which give the equivalent level of emission control.

6. EXTENSION OF EC TYPE-APPROVAL

6.1. Approval granted to a vehicle type with respect to the OBD system may be extended to different vehicle types belonging to the same vehicle-OBD family as described in Appendix 6. The engine emission control system must be identical to that of the vehicle already approved and comply with the description of the OBD engine family given in Appendix 6, regardless of the following vehicle characteristics:

- combustion process
- engine accessories
- method of engine fuelling
- tyres
- equivalent inertia
- cooling system
- overall gear ratio
- transmission type
- type of bodywork

7. CONFORMITY OF PRODUCTION OF A VEHICLE EQUIPPED WITH AN OBD SYSTEM

7.1. When the approval authority determines that the quality of production seems unsatisfactory a vehicle is randomly taken from the series and subjected to the tests described in Appendix 1.

7.2. If the vehicle taken from the series does not satisfy the requirements of Section 7.1.5.2 a further random sample of three vehicles shall be taken from the series and subjected to the tests described in Appendix 1. The tests may be carried out on vehicles which have been run-in a minimum of 3 000 km.

7.3. The production is deemed to conform if at least 3 vehicles meet the requirements of the tests described in Appendix 1.

8. ALTERNATIVE REQUIREMENTS

8.1. Manufacturers may obtain type-approval on the basis of the alternative technical requirements given in Section 8.1.1 and 8.1.2, subject to the additional requirements of Sections 8.1.3, 8.1.4 and 8.1.5:

8.1.1. Federal Register 40 CFR Part 86 Subpart A, entitled "Control of Air Pollution From New Motor Vehicles and New Motor Vehicle Engines; Regulations Requiring On-Board Diagnostic Systems on 1994 and Later Model Year Light-Duty Vehicles and Light-Duty Trucks", published by the US Government Printing Office, Washington, DC 20402.

8.1.2. Section 1968.1 of Title 13, California Code of Regulations (CCR), entitled "Malfunction and Diagnostic Systems Requirements - 1994 and Subsequent Model Year Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles and Engines".

8.1.3. The application for approval shall include a written statement that the vehicle family conforms to this Annex. The application for approval to this Annex shall include the complete documentation to meet the requirements of either Section 8.1.1 or 8.1.2 and the documentation required in Appendix 5 of this Annex.

8.1.4. The MI shall comply with the requirements of Section 5.5 of this Annex.

8.1.5. If type-approval is granted according to the requirements of this Section, Section 7 of this Annex shall continue to apply for conformity of production checking.

Appendix 1

FUNCTIONAL ASPECTS OF ON-BOARD DIAGNOSTIC (OBD) SYSTEMS

1. INTRODUCTION

This Appendix describes the procedure of the test according to Section 5 of this Annex. The procedure describes a method for checking the function of the on-board diagnostic (OBD) system installed on the vehicle by failure simulation of relevant systems in the engine management or emission control system. It also sets procedures for determining the durability of OBD systems.

The manufacturer shall make available the defective components and/or electrical devices which would be used to simulate failures. Having simulated a failure the OBD system is approved if the MI is activated when the vehicle emissions exceed the limits of Section 5.3.2 by less than [20%].

2. DESCRIPTION OF TEST

2.1. The testing of OBD systems consists of the following phases:

- simulation of malfunction of a component of the engine management or emission control system;
- preconditioning of the vehicle with a simulated malfunction over at least one Type I test or specific preconditioning cycle specified by the manufacturer;
- driving the vehicle with a simulated malfunction over the Type I test cycle and measuring the emissions of the vehicle;
- determining whether the OBD system reacts to the simulated malfunction and indicates malfunction in an appropriate manner to the vehicle driver.

2.2. Alternatively, at the request of the manufacturer, malfunction of one or more components may be electronically simulated according to the requirements of Section 6 of this Appendix.

2.3. Manufacturers may request that monitoring take place outside the Type I test cycle if it can be demonstrated to the authority that monitoring during conditions encountered during the Type I test cycle would impose restrictive monitoring conditions when the vehicle is used in service.

3. TEST VEHICLE AND FUEL

3.1. Vehicle

The test vehicle must meet the requirements of Section 3.1 of Annex III.

3.2. Fuel

The appropriate reference fuel as described in Annex IX must be used for testing.

4. TEST TEMPERATURE AND PRESSURE

4.1. The test temperature and pressure must meet the requirements of the Type I test as described in Annex III.

5. TEST EQUIPMENT

5.1. Chassis dynamometer

The chassis dynamometer must meet the requirements of Annex III.

6. OBD TEST PROCEDURE

6.1. The operating cycle on the chassis dynamometer shall meet the requirements of Annex III.

6.2. Vehicle preconditioning

6.2.1. According to the engine type and after introduction of one of the failure modes given in Section 6.3, the vehicle shall be preconditioned by driving at least two consecutive Type I tests (Parts One and Two). For compression ignition engined vehicles an additional preconditioning of two Part Two cycles is permitted. At the request of the manufacturer, alternative preconditioning methods may be used.

6.3. Failure modes to be tested.

6.3.1. Positive-ignition engined vehicles.

6.3.1.1. Replacement of the catalyst with a deteriorated or defective catalyst or electronic simulation of such a failure.

6.3.1.2. Engine misfire conditions according to the conditions for misfire monitoring given in Section 5.3.3.2 of this Annex.

6.3.1.3. Replacement of the oxygen sensor with a deteriorated or defective oxygen sensor or electronic simulation of such a failure.

6.3.1.4. Electrical disconnection of any other emission-related powertrain component connected to a computer.

6.3.1.5. Electrical disconnection of the electronic evaporative purge control device (if equipped).

6.3.2. Compression-ignition engined vehicles.

6.3.2.1. Where fitted, replacement of the catalyst with a deteriorated or defective catalyst or electronic simulation of such a failure.

6.3.2.2. Where fitted, total removal of the particulate trap or, where sensors are an integral part of the trap, a defective trap assembly.

6.3.2.3. Electrical disconnection of any fuelling system electronic fuel quantity and timing actuator.

6.3.2.4. Electrical disconnection of any other emission-related powertrain component connected to a computer.

6.3.2.5. In meeting the requirements of Sections 6.3.2.3 and 6.3.2.4, and with the agreement of the approval authority, the manufacturer shall take appropriate steps to demonstrate that the OBD system will indicate a fault when disconnection occurs.

6.4. OBD system test.

6.4.1. Vehicles fitted with positive-ignition engines.

6.4.1.1. After vehicle preconditioning according to Section 6.2 above, the test vehicle shall be driven over a Type I test (Parts One and Two). The MI must activate before the end of this test under any of the conditions given in Sections 6.4.1.2 to 6.4.1.5 of this Appendix. The technical service may substitute those conditions by others in accordance with Section 6.4.1.6. However, the total number of failures simulated shall not exceed 4 for the purpose of type-approval.

6.4.1.2. Replacement of a catalyst with a deteriorated or defective catalyst or electronic simulation of a deteriorated or defective catalyst that results in emissions exceeding the HC limit given in Section 5.3.2 of this Annex.

6.4.1.3. An induced misfire condition according to the conditions for misfire monitoring given in Section 5.3.3.2 of this Annex that results in emissions exceeding any of the limits given in Section 5.3.2 of this Annex.

6.4.1.4. Replacement of an oxygen sensor with a deteriorated or defective oxygen sensor or electronic simulation of a deteriorated or defective oxygen sensor that results in emissions exceeding any of the limits given in Section 5.3.2 of this Annex.

6.4.1.5. Electrical disconnection of the electronic evaporative purge control device (if equipped).

6.4.1.6. Electrical disconnection of any other emission-related powertrain component connected to a computer that results in emissions exceeding any of the limits given in Section 5.3.2 of this Annex.

6.4.2. Vehicles fitted with compression-ignition engines.

6.4.2.1. After vehicle preconditioning according to Section 6.2 above, the test vehicle shall be driven over a Type I test (Parts One and Two). The MI must activate before the end of this test under any of the conditions given in Sections 6.4.2.2 to 6.4.2.5 of this Appendix.

6.4.2.2. Where fitted, replacement of a catalyst with a deteriorated or defective catalyst or electronic simulation of a deteriorated or defective catalyst that results in emissions exceeding limits given in Section 5.3.2 of this Annex.

6.4.2.3. Where fitted, total removal of the particulate trap or replacement of the particulate trap with a defective particulate trap meeting the conditions of Section 6.3.2.2 of this Appendix that results in emissions exceeding the limits given in Section 5.3.2 of this Annex.

6.4.2.4. With reference to Section 6.3.2.5 of this Appendix, disconnection of any fuelling system electronic fuel quantity and timing actuator that results in emissions exceeding any of the limits given in Section 5.3.2 of this Annex.

6.4.2.5. With reference to Section 6.3.2.5 of this Appendix, disconnection of any other emission-related powertrain component connected to a computer that results in emissions exceeding any of the limits given in Section 5.3.2 of this Annex.

6.5. Diagnostic Signals

6.5.1.1. Upon determination of the first malfunction of any component or system, "freeze frame" engine conditions present at the time shall be stored in computer memory. Should a subsequent fuel system or misfire malfunction occur, any previously stored freeze frame conditions shall be replaced by the fuel system or misfire conditions (whichever occurs first). Stored engine conditions shall include, but are not limited to calculated load value, engine speed, fuel trim value(s) (if available), fuel pressure (if available), vehicle speed (if available), coolant temperature, intake manifold pressure (if available), closed- or open-loop operation (if available) and the fault code which caused the data to be stored. The manufacturer shall choose the most appropriate set of conditions facilitating effective repairs for freeze frame storage. Only one frame of data is required. Manufacturers may choose to store additional frames provided that at least the required frame can be read by a generic scan tool meeting the specifications of Sections 6.5.3.2 and 6.5.3.3. If the fault code causing the conditions to be stored is erased in accordance with Section 5.7 of this Annex, the stored engine conditions may also be erased.

6.5.1.2. If available, the following signals in addition to the required freeze frame information shall be made available on demand through the serial port on the standardised data link connector, if the information is available to the on-board computer or can be determined using information available to the on-board computer: diagnostic trouble codes, engine coolant temperature, fuel control system status (closed loop, open loop, other), fuel trim, ignition timing advance, intake air temperature, manifold air pressure, air flow rate, engine speed, throttle position sensor output value, secondary air status (upstream, downstream or atmosphere), calculated load value, vehicle speed and fuel pressure.

The signals shall be provided in standard units based on the specifications given in Section 6.5.3 of this Appendix. Actual signals shall be clearly identified separately from default value or limp home signals. In addition, the capability to perform bi-directional diagnostic control based on the specifications given in Section 6.5.3 of this Appendix shall be made available on demand through the serial port on the standardised data link connector according to the specifications given in Section 6.5.3 of this Appendix.

6.5.1.3. For all emission control systems for which specific on-board evaluation tests are conducted (catalyst, oxygen sensor, etc.), except misfire detection, fuel system monitoring and comprehensive component monitoring, the results of the most recent test performed by the vehicle and the limits to which the system is compared shall be made available through the serial data port on the standardised data link connector according to the specifications given in Section 6.5.3 of this Appendix. For the monitored components and systems excepted above, a pass/fail indication for the most recent test results shall be available through the data link connector.

6.5.1.4. The OBD requirements to which the vehicle is certified (i.e. this Annex or the alternative requirements specified in Section 8 of this Annex) and the major emission control systems monitored by the OBD system consistent with Section 6.5.3.3 of this Appendix shall be available through the serial data port on the standardised data link connector according to the specifications given in Section 6.5.3 of this Annex.

6.5.2. The emission control diagnostic system is not required to evaluate components during malfunction if such evaluation would result in a risk to safety or component failure.

6.5.3. The emission control diagnostic system shall provide for standardised access and conform with the following ISO and/or SAE standards. Some of the ISO standards have been derived from Society of Automotive Engineers standards and Recommended Practices. Where this is the case the appropriate SAE reference appears in parenthesis.

6.5.3.1. One of the following standards with the restrictions as described shall be used as the on-board to off-board communications link:

ISO 9141 - 2 "Road Vehicles - Diagnostic Systems - CARB Requirements for the Interchange of Digital Information";

ISO 11519 - 4 "Road Vehicles - Low Speed Serial Data Communication - Part 4: Class B Data Communication Interface (SAE J1850)". Emission related messages shall use the cyclic redundancy check and the three byte header and shall not use inter-byte separation or checksums.

ISO DIS 14230 - Parts 1, 2 and 3 "Road Vehicles - Diagnostic Systems - Keyword Protocol 2000". Either the CARB mode shall be used (directly equivalent to ISO 9141-2) or with fast initialisation at the address specified in Appendix 2 and with the format specified by using keybytes with the decimal value of 2025 (three byte header with normal timing).

6.5.3.2. Test equipment and diagnostic tools needed to communicate with OBD systems shall meet or exceed the functional specification given in Appendix 3.

6.5.3.3. Basic diagnostic data, (as specified in Section 6.5.1 of this Appendix) and bi-directional control information shall be provided using the format and units described in Appendix 2 and shall be available using a diagnostic tool meeting the requirements of Appendix 3.

6.5.3.4. Fault codes selected by the manufacturer shall be consistent with those given in Appendix 4.

6.5.3.5. The connection interface between the vehicle and the diagnostic tester shall meet the all requirements of SAE J1962 "Diagnostic Connector, June 1992" (ISO XXX-A "Road vehicles - Diagnostic systems - On-board connector"). The installation position shall be subject to agreement of the approval authority such that it is readily accessible by service personnel but protected from tampering by non-qualified personnel.

Appendix 2

1. Scope

This Apppendix defines diagnostic services and functionally addressed request-response messages required to be supported by vehicles and test tools for diagnostic purposes which pertain to vehicle emission-related data. These messages are intended to be used by any service tool meeting the requirements of Appendix 3. Seven Diagnostic Services (Test Modes) are defined and these are detailed in Section four.

This Appendix is based on draft ISO CD XXX1 and SAE J1979, "E/E Diagnostic Test Modes".

2. References

2.1. Applicable Documents

The following publications form a part of this specification to the extent specified herein.

2.1.1. Normative References

ISO Documents:

ISO 9141-2	Road vehicles - Diagnostic systems - CARB requirements for interchange of digital information
ISO CD 14230	Keyword Protocol 2000, Parts 1/2/3
ISO 11519 - 4	Road Vehicles Low speed Serial Data Communication Class B - Data Communications Interface (SAE J1850)
ISO CD 14229	Diagnostic Services

2.1.2. Informative References

J1850	FEB94	Class B Data Communication Network Interface
J1930	JUN93	E/E Systems Diagnostic Terms, Definitions, Abbreviations and Acronyms
J1962	JUN93	Diagnostic Connector
J1978	MAR92	OBD II Scan Tool
J2012	MAR92	Recommended Format and Messages for Diagnostic Trouble Codes
J2186	SEP91	Diagnostic Data Link Security
J2190	JUN93	Enhanced E/E Diagnostic Test Modes

3. Definitions

Most terms for components and systems contained in this document are included in ISO CD XXX3 (SAE J1930) - Terms, Definitions, and Acronyms. This section includes additional definitions of terms used in this document, not included in ISO CD XXX3.

3.1. # = number

3.2. "Service" in ISO diagnostic communication documents is the equivalent of "Test Mode" or "Mode" in the SAE documents.

3.3. No further definitions.

4. Technical Requirements

4.1. Diagnostic Service General Conditions

These guidelines are necessary to ensure proper operation of both the test equipment and the vehicle during diagnostic procedures. Test equipment, when using messages defined in this document, should not affect normal operation of the emission control system.

4.1.1. Multiple Responses to a Single Data Request

The messages contained in this Appendix are functional messages, which means the off-board test equipment will request data without knowledge of which module on the vehicle will respond. In some vehicles, multiple modules may respond with the information requested. In addition, a single module may send multiple responses to a single request. Any test device requesting information must, therefore, have provisions for receiving multiple responses.

4.1.2. Response Time

For ISO 9141-2 and ISO 14230-2 interfaces, response time requirements are specified in these documents.

For ISO CD 11519-4(SAE J1850) network interfaces, the on-board systems should respond to a request within 100 milliseconds of a request or a previous response. With multiple responses possible from a single request, this allows as much time as is necessary for all modules to access the data link and transmit their response(s). If there is no response within this time period, the tool can either assume no response will be received, or if a response has already been received, that no more responses will be received.

4.1.3. Minimum Time Between Requests from Scan Tool

For ISO 9141-2 interfaces, the required times between requests are specified in the ISO 9141-2 document.

For SAE J1850 network interfaces, a tool should always wait for a response from the previous request, or "no response" timeout before sending another request. In no case should a request be sent less than 100 msec. after the previous request.

4.1.4. Data not Available

There are two conditions for which data is not available. One condition is that the Service is not supported, and the other is that the Service is supported but data is not currently available.

There will be no reject message to a functional request if the request is not supported by the module. This prevents responses from all modules that do not support a Service or a specific data value.

Some Services are supported by a vehicle, but data may not always be available when requested. For Services $05 and $06, if the test has not been run since test results were cleared, or for Service $02 if freeze frame data has not been stored, valid data will not be available. For these conditions, the manufacturer has the option either to not respond or to respond with data that is invalid. The functional description for these Services discuss the method to determine if the data is valid.

4.1.5 Maximum Values

If the data value exceeds the maximum value possible to be sent, the on-board system should send the maximum value possible ($FF or $FFFF). The tool should display the maximum value or an indication of data too high. This is not normally critical for real time diagnostics, but in the case of a misfire at 260 km/h with resulting freeze frame data stored, this will be very valuable diagnostic information.

4.2. Diagnostic Message Format

4.2.1. Addressing method

Functional addressing will be used for all generic Diagnostic Service messages because the test tool does not know which system on the vehicle has the information that is needed.

4.2.2. Maximum message length

Is defined in Figure 1 below.

4.2.3. Diagnostic Message Format

Is defined in Figure 1 below.

Header Bytes			Data Bytes								
Priority - Type	Target Address	Source Address	#1	#2	#3	#4	#5	#6	#7	ERR	RSP
Diagnostic Request at 10.4 Kbps (ISO 11519-4 [J1850] and ISO 9141-2)											
68	6A	Tester Address Fx	Maximum 7 data bytes							Yes	No
Diagnostic Response at 10.4 Kbps (ISO 11519-4 [J1850] and ISO 9141-2)											
48	6B	ECU Addr	Maximum 7 data bytes							Yes	No
Diagnostic Response at 41.6 Kbps (ISO 11519-4 [J1850])											
61	6A	Fx	Maximum 7 data bytes							Yes	No
Diagnostic Response at 41.6 Kbps (ISO 11519-4 [J1850])											
41	6B	ECU Addr	Maximum 7 data bytes							Yes	No
Diagnostic Request at 41.6 Kbps (ISO 14230)											
61	6A	Fx	Maximum 7 data bytes								
Diagnostic Request at 41.6 Kbps (ISO 14230)											
41	6B	ECU Addr	Maximum 7 data bytes								

Figure 1 - Diagnostic Message Format

4.2.4. Header bytes

The first three bytes of all diagnostic messages are the header bytes. The value of the first header byte is dependent on the bit rate of the data link and the type of message. The second byte has a value that depends on the type of message, either a request or a response. The third header byte is the physical address of the device sending the message.

OBD Scan Tools have the address $F1. Other service tools should use addresses in the range from $F0 to $FD. The response to all request messages in this document will be independent of the address of the test equipment requesting the information.

Vehicle manufacturers should not use the ISO CD XXX1(J1979) header bytes for any purpose other than diagnostic messages. When they are used, they must conform to this specification.

4.2.5. Data bytes

The maximum number of data bytes available to be specified in this Appendix is 7. The first data byte following the header is the Diagnostic Service Type, and the remaining 6 bytes vary depending on the specific Diagnostic Service . For services $01 and $02, message length is determined by Parameter Identification (PID). For Service $05, message length is determined by Test ID. For other services, the message length is determined by the service. This enables the tools to check for proper message length, and to recognize the end of the message without waiting for possible additional data bytes.

4.2.6. Non-data bytes included in diagnostic messages with ISO 11519-4 (J1850)

All diagnostic messages will use a Cyclic Redundancy Check (CRC), as defined in ISO 11519-4 (J1850), as the error detection (ERR) byte.

In-frame response (RSP) is defined as optional in ISO 11519-4 (J1850). For messages defined in this document, the RSP byte is required in all request and response messages at 41.6Kbps, and is not allowed for messages at 10.4 Kbps.

ISO 11519-4 (SAE J1850) defines additional message elements that may be included in Diagnostic Messages. Use of these message elements is beyond the scope of this specification, but needs to be considered when defining total diagnostic messages.

4.2.7. Non-data bytes included in diagnostic messages with ISO 9141-2 and ISO 14230 (Keyword Protocol 2000)

Messages will include a checksum, defined in those documents, after the data bytes as the Error Detection Byte (ERR).

There is no provision for an in-frame response.

4.2.8. Bit position convention

Some data byte values in this document include descriptions that are based on bit positions within the byte. The convention used in this document is that the Most Significant Bit (MSB) is referred to as "bit 7", and the Least Significant Bit (LSB) is referred to as "bit 0," as shown below:

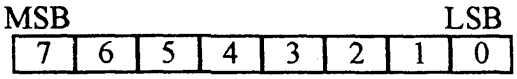

Figure 2 - Bit position within a data byte

4.3. Allowance for Expansion and Enhanced Diagnostic Services

This Appendix allows for the addition of Diagnostic Services both as industry standards and manufacturer specific services. The Diagnostic Services $00 through $0F are reserved to be defined in ISO CD XXX1 (J1979).

4.4. Format of Data to be Displayed

The format of data to be displayed to the user of the data obtained with these test needs to be standardised so that vehicle manufacturers can write generic service information. Data is transmitted from the vehicle in metric units. The following Table indicates the type of data and minimum requirements for format of the data. See Figure 3.

Data	Services	Display Format
Device ID - source address of response	all	Hexadecimal (00 to FF)
Parameter ID (PID)	$01 & $02	Hexadecimal (00 to FF) description (see Table in Section 5.3)
Frame number	$02	Decimal (0 to 255)
Data values	$01 & $02	see Table in Section 5.3
Diagnostic Trouble Codes	$03 & $07	"P", "B", "C" or "U", plus 4 digits and/or DTC definition - see *ISO CD XXX2* (SAE J2012)
Test ID	$05, $06 & $08	Hexadecimal (00 to FF)
Test value and test limits	$05	Engineering units for Test IDs less than $80 (see Section 5.6.2) - Decimal (0 to 255) for Test IDs greater than $80
Test value and test limits	$06	Decimal (0 to 65535)
Component ID	$06 (part of data byte #3)	Hexadecimal (00 to 7F)
Optional Data Bytes	$08	4 bytes, each decimal (0 to 255)

Figure 3 - Format of Data to be Displayed

5. Services

5.0. Diagnostic Services included in this document are:

Service $01 - Request Current Powertrain Diagnostic Data

Analogue inputs and outputs

Digital inputs and outputs

System status information

Calculated values

Service $02 - Request Powertrain Freeze Frame Data

Analogue inputs and outputs

Digital inputs and outputs

System status information

Calculated values

Service $03 - Request Emission-Related Powertrain Diagnostic Trouble Codes

Service $04 - Clear/Reset Emission-Related Diagnostic Information

Service $05 - Request Oxygen Sensor Monitoring Test Results

Service $06 - Request On-Board Monitoring Test Results for Non-continuously Monitored Systems

Service $07 - Request On-Board Monitoring Test Results for Continuously Monitored Systems

Service $08 - Request Control of on-board system, test or component

For each Service this definition includes:

Functional descriptions of service

Request and response message formats

For some of the more complex services, an example of messages and an explanation of the interpretation of those messages is included.

5.1 . Service $01 - Request Current Powertrain Diagnostic Data

5.1.1. Functional Description

The purpose of this service is to allow access to current emission related data values, including analogue inputs and outputs, digital inputs and outputs, and system status information. The request for information includes a Parameter Identification (PID) value that indicates to the on-board system the specific information requested. PID definitions, scaling information, and display formats are included in this document.

The on-board module will respond to this message by transmitting the requested data value last determined by the system. All data values returned for sensor readings will be actual readings, not default or substitute values used by the system because of a fault with that sensor.

Not all PIDs are applicable or supported by all systems. PID $00 is a bit-encoded PID that indicates, for each module, which PIDs that module supports. PID $00 must be supported by all modules that respond to a service $01 request as defined in this document, because diagnostic tools that conform to Appendix 3 use the presence of a response by the vehicle to this request to determine which protocol is supported for diagnostic communications.

5.1.2. Message Data Bytes

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6	#7
Request Current Powertrain Diagnostic Data							
Request Powertrain Diagnostic Data	01	PID					
Report Current Powertrain Diagnostic Data							
Report Powertrain Diagnostic Data	41	PID	data A	data B (*)	data C (*)	data D (*)	

Figure 4 - Message data Bytes

(*) conditional - number of bytes depends on PID - see Figure 6

5.2. Service $02 - Request Powertrain Freeze Frame Data

5.2.1. Functional Description

The purpose of this service is to allow access to emission related data values in a freeze frame. This allows expansion to meet manufacturer specific requirements not necessarily related to the required freeze frame, and not necessarily containing the same data values as the required freeze frame. The request for information includes a Parameter Identification (PID) value that indicates to the on-board system the specific information requested. PID definitions, scaling information, and display formats for the freeze frame are included in this document.

The on-board module will respond to this message by transmitting the requested data value stored by the system. All data values returned for sensor readings will be actual stored readings, not default or substitute values used by the system because of a fault with that sensor.

Not all PIDs are applicable or supported by all systems. PID $00 is a bit-encoded PID that indicates, for each module, which PIDs that module supports. Therefore, PID $00 must be supported by all modules that respond to a Service $02 request as defined in this document.

PID $02 indicates the DTC that caused the freeze frame data to be stored. If freeze frame data is not stored in the module, the system should report $00 00 as the DTC. Any data reported when the stored DTC is $00 00 may not be valid.

The frame number byte will indicate $00 for the freeze frame data. Manufacturers may optionally save additional freeze frames and use this service to obtain that data by specifying the freeze frame number in the request. If a manufacturer uses these additional freeze frames, they will be stored under conditions defined by the manufacturer, and contain data specified by the manufacturer.

5.2.2. Message Data Bytes

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6	#7
Request Powertrain Freeze Frame Data							
Request Powertrain Freeze Frame Data	02	PID	frame no.				—
Report Powertrain Freeze Frame Data (only valid if Service $02 PID $02 DTC is not $00 00)							
Report Powertrain Freeze Frame Data	42	PID	frame no.	data A	data B (*)	data C (*)	data D (*)

Figure 5 - Message Data Bytes
(*) conditional - number of bytes depends on PID - see Figure 6

5.3. PIDs for Services $01 and $02 - see Figure 6

Service ID (see note 1)		PID (Hex)	Description	Min ($00) or ($0000)	Max ($FF) or ($FFFF)	SI (Metric) Scaling/bit and display	English display
$01	$02						
A	A	00	PIDs supported ($01 - $20): Module responds with a message that contains 4 bytes of bit-encoded information, each bit indicating support or non-support of a PID where: 0 = PID not supported by this module 1 = PID supported by this module			Byte bit PID Data A 7 $01 Data A 6 $02 . . . Data B 7 $09 . . . Data D 0 $20	
A		01	Data A - Number of emission-related powertrain trouble codes and MI status: bits 0-6: Number of codes stored in this module bit 7: 0 = MI not commanded ON by this module 1 = MI commanded ON by this module Data B (bits 0 to 3) and Data C - Each bit indicates support or non-support of an on-board diagnostic evaluation: Data B: covers continuous monitoring tests Data C: covers tests run at least once per trip where: 0 = test not supported by this module 1 = test supported by this module Data B (bits 4 to 7) and Data D - Each bit indicates status of on-board diagnostic evaluation for this module, corresponding to tests included in Data B (bits 0 to 3) and Data C: 0 = test complete, or not applicable 1 = test not complete Note: Data B, bits 4 to 7, are required only for vehicles that do not support any non-continuous tests.		Data B: bit Evaluation supported / status 0 Misfire monitoring supported 1 Fuel system monitoring supported 2 Comprehensive component monitoring supported 3 reserved (report as 0) 4 misfire monitoring status 5 fuel system monitoring status 6 Comprehensive component monitoring status 7 reserved (report as 0) Data C and Data D: bit Evaluation supported / status 0 Catalyst monitoring 1 Heated catalyst monitoring 2 Evaporative system monitoring 3 Secondary air system monitoring 4 A/C system refrigerant monitoring 5 Oxygen sensor monitoring 6 Oxygen sensor heater monitoring 7 EGR system monitoring		

Figure 6 PIDs for Services $01and $02

Service ID (see note 1)		PID (Hex)	Description	Min ($00) or ($0000)		Max ($FF) or ($FFFF)		SI (Metric) Scaling/bit and display	English display
$01	$02								
	A	02	DTC that caused required freeze frame data storage (2 byte value - $0000 indicates no freeze frame data)	00	00	09	99	Pxxxx, Cxxx, Bxxx or Uxxx	Pxxxx, Cxxx, Bxxx or Uxxx
A	A	03	Data A: Fuel system 1 status Data B: Fuel system 2 status ($00 if not used) For each data byte, no more than one bit at a time can be set to a 1 to indicate the status of that bank, where: bit 0 = Open loop - has not yet satisfied conditions to go closed loop bit 1 = Closed loop - using oxygen sensor(s) as feedback for fuel control bit 2 = Open loop due to driving conditions (e.g. power enrichment, deceleration enleanment) bit 3 = Open loop due to detected system fault bit 4 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control bits 5-7 = reserved (report as 0)						
A	A	04	Calculated load value	0%		100%		100/255% xxx.x%	100/255% xxx.x%
A	A	05	Engine coolant temperature	-40°C		+215°C		1°C with -40°C offset xxx°C	xxx°F
A	A	06	Short term fuel trim - Bank 1 (use if only 1 fuel trim value)	-100.00% (lean)		+99.22% (rich)		100/128% (0% at 128) xxx.x%	100/128% (0% at 128) xxx.x%
A	A	07	Long term fuel trim - Bank 1	"		"		"	
A	A	08	Short term fuel trim - Bank 2	"		"		"	
A	A	09	Long term fuel trim - Bank 2	"		"		"	
A	A	0A	Fuel pressure gauge	0 kPaG(gauge)		765 kPaG (gauge)		3 kPaG(gauge) xxx kPaG(gauge)	xx.x psig(gauge)
A	A	0B	Intake manifold absolute pressure	0 kPaA		255 kPaA		1 kPaA xxx kPaA	xx.x in. Hg
A	A	0C	Engine RPM (2 byte value - high byte/low byte)	0 rpm		16,383.75 rpm		1/4 rpm xxxxx rpm	

Figure 6 PIDs for Services $01and $02 (continued)

Service ID (see note 1)		PID (Hex)	Description	Min ($00) or ($0000)	Max ($FF) or ($FFFF)	SI (Metric) Scaling / bit and display	English display
$01	$02						
A	A	0D	Vehicle speed	0 km/h	255 km/h	1 km/h xxx km/h	xxx mph
A		0E	Ignition timing advance for #1 cylinder (not including mechanical advance)	-64°	+63,5°	1/2°with 0° at 128 xx.x°	
A		0F	Intake air temperature	-40°C	+215°C	1°C with -40°C offset xxx°C	xxx°F
A		10	Air flow rate from MAF sensor (2 byte value - high byte/low byte)	0 gm/sec	655.35 gm/sec	.01 gm/sec xxx.xx gm/sec	xxxx.x lb/min
A		11	Absolute throttle position	0%	100%	100/255% xxx.x%	
A		12	Commanded secondary air status (if supported, one, and only one bit at a time can be set to a 1) bit 0 1 = upstream of first catalytic converter bit 1 1 = downstream of first catalytic converter inlet bit 2 1 = atmosphere / off bits 3 - 7 = reserved (report as 0)				
A X or PID $1D		13	Location of oxygen sensors, where sensor 1 is closest to the engine. Each bit indicates the presence or absence of an oxygen sensor at the following location: bit Sensor location 0 Bank 1 - Sensor 1 1 Bank 1 - Sensor 2 2 Bank 1 - Sensor 3 3 Bank 1 - Sensor 4 4 Bank 2 - Sensor 1 5 Bank 2 - Sensor 2 6 Bank 2 - Sensor 3 7 Bank 2 - Sensor 4 where: 1 = sensor present at that location 0 = sensor not present at that location				

Figure 6 PIDs for Services $01and $02 (continued)

Service ID (see note 1)		PID (Hex)	Description	Min ($00) or ($0000)	Max ($FF) or ($FFFF)	SI (Metric) Scaling/bit and display	English display
$01	$02						
A		14 15 16 17 18 19 1A 1B	Bank 1 - Sensor 1 Bank 1 - Sensor 2 Bank 1 - Sensor 3 Bank 1 - Sensor 4 Bank 2 - Sensor 1 Bank 2 - Sensor 2 Bank 2 - Sensor 3 Bank 2 - Sensor 4			This scaling assumes a nominal 1 volt full scale oxygen sensor; any sensor with a different full scale value should be normalised to provide nominal full scale at $C8 (200 decimal).	
			for each sensor: Data A - Oxygen sensor output voltage	0 volt	1.275 volt	.005 volt x.xxx volt	
			Data B - short term fuel trim associated with this sensor ($FF if this sensor is not used in the calculation)	-100.00% (lean)	99.22% (rich)	100/128% (0% at 128) xxx.x%	
B		1C	OBD requirements to which vehicle is designed, where: $ 01 - OBD II (California ARB) $ 02 - OBD (Federal EPA) $ 03 - OBD and OBD II $ 04 - OBD I $ 05 - Not intended to meet any OBD requirements				

Figure 6 PIDs for Services $01and $02 (continued)

Service ID (see note 1)		PID (Hex)	Description	Min ($00) or ($0000)	Max ($FF) or ($FFFF)	SI (Metric) Scaling/bit and display	English display
$01	$02						
A or PID $13		1D	Location of oxygen sensors, where 1 is closest to the engine. Each bit indicates the presence or absence of an oxygen sensor at the following location: bit Alternate sensor location 0 Bank 1 - Sensor 1 1 Bank 1 - Sensor 2 2 Bank 2 - Sensor 1 3 Bank 2 - Sensor 2 4 Bank 3 - Sensor 1 5 Bank 3 - Sensor 2 6 Bank 4 - Sensor 1 7 Bank 4 - Sensor 2 Where 1 = sensor present at that location 0 = sensor not present at that location				
A		1E	Auxiliary Input Status bit 0:Power Take Off (PTO) Status where 0 =PTO not active 1 = PTO active bits 1 to 7 reserved for future expansion report as 0 Waive continuous monitoring tests during PTO				
		1F	Unused - reserved for future expansion.				

Figure 6 PIDs for Services $01and $02 (continued)

Service ID (see note 1)		PID (Hex)	Description	Min ($00) or ($0000)	Max ($FF) or ($FFFF)	SI (Metric) Scaling / bit and display	English display
$01	$02						
A		20	PIDs supported ($21 - $40):			Byte bit PID Data A 7 $21 Data A 6 $22 . . . Data B 7 $29 . . . Data D 0 $40	
		21-3F	Reserved - to be specified in ISO 14230 - 3 (*SAE* J2190), if needed				
A		40	PIDs supported ($41 - $60):				
A		41-FF	Reserved for future expansion				

Figure 6 PIDs for Services $01and $02 (continued)

NOTE 1: Letters in the column under Service $01 or $02 indicate that this value is included in OBD legislation as indicated below. This information is for guidance only and may be out of date. Refer to the latest appropriate regulations to determine if each value is required to be supported on a given vehicle, or only required if available.

5.4. Service $03 - Request Emission-Related Powertrain Diagnostic Trouble Codes

5.4.1. Service $03 Functional Description

The purpose of this service is to enable the off-board test device to obtain stored emission-related powertrain trouble codes. This shall be a two step process for the test equipment but a module may respond to a Service $03 request without a Service PID $01 request. If a tester establishes that the Service $01, PID $01 is not supported by all of the modules on the vehicle it may send only Service $03 requests on all subsequent DTC requests.

Step 1 - Send a Service $01, PID $01 request to get the number of stored emission-related powertrain trouble codes from all modules that have this available. Each on-board module that has codes stored will respond with a message that includes the number of stored codes to be reported. If a module capable of storing powertrain codes does not have stored codes, then that module shall respond with a message indicating zero codes are stored.

Step 2 - Send a Service $03 request for all stored emission-related powertrain codes. Each module that has codes stored will respond with one or more messages, each containing up to 3 codes. If no codes are stored in the module, then the module may not respond to this request.

If additional trouble codes are set between the time that the number of codes are reported by a module, and the stored codes are reported by a module, then the number of codes reported could exceed the number expected by the tool. In this case, the tool should repeat this cycle until the number of codes reported equals the number expected based on the Service 1 response.

Diagnostic trouble codes are transmitted in two bytes of information for each code. The first two bits (high order) of the first byte for each code will be zeros to indicate a powertrain code (refer to Appendix 3 for additional interpretation of this structure). The second two bits will indicate the first digit of the diagnostic code (0 through 3). The second nibble of the first byte and the entire second byte are the next three digits of the actual code reported as Binary Coded Decimal (BCD). A powertrain trouble code transmitted as $0143 should be displayed as P0143. See Figure 7

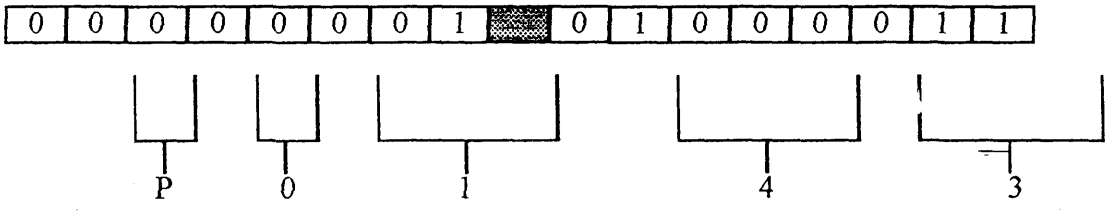

Figure 7 - Diagnostic Trouble Code Encoding Example

If less than 3 trouble codes are reported, the response messages used to report diagnostic trouble codes should have their unused bits set to zero to maintain the required fixed message length for all messages.

If there are no diagnostic trouble codes to report, no response is required.

5.4.2. Message Data Bytes

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6	#7
Request number of codes from all modules							
Request number of Powertrain DTC	01	01					
Report number of codes (each module)							
Report number of stored powertrain DTC	41	01	# DTC & MI	Eval. Supp. #1	Eval. Supp. #2	Eval. Status	
Request codes from all modules							
Request powertrain DTC	03						
Report codes (each module)							
Report powertrain DTC	43	Code #1 or 00 00		Code #2 or 00 00		Code #3 or 00 00	

Figure 8 - Message Data Bytes

NOTE: Refer to Appendix 2 (ISO CD XXX2 - SAE J2012, Recommended Format and Messages for Diagnostic Trouble Codes), the encoding method for trouble codes.

5.4.3. Powertrain Diagnostic Trouble Code Example (assume 10.4 Kbps)

	Header Bytes (Hex)			Data Bytes (Hex)						
	Pty/ Type	Tgt Addr	Src Addr	#1	#2	#3	#4	#5	#6	#7
Request Powertrain DTC										
Request number of Powertrain DTC	68	6A	F1	01	01					
Report Number of Powertrain DTC										
Module 06 has 6 stored DTC	48	6B	06	41	01	06	00	00	00	
Module C3 has 1 stored DTC	48	6B	C3	41	01	01	00	00	00	
Module 2B has 0 stored DTC	48	6B	2B	41	01	00	00	00	00	
Module 3E has 2 stored DTC and MI ON	48	6B	3E	41	01	82	00	00	00	
Request All Stored Powertrain DTC										
Request powertrain DTC	68	6A	F1	03						
Report All Stored Powertrain DTC										
Module 06 send codes P0143,P0196, & P0234	48	6B	06	43	Code #1		Code #2		Code #3	
					01	43	01	96	02	34
Module C3 send code P0443	48	6B	C3	43	Code #1		00	00	00	00
					04	43				
Module 06 send codes P0357,P0531, & P0661	48	6B	06	43	Code #4		Code #5		Code #6	
					03	57	05	31	06	61
Module 3E send codes P0112 & P0445	48	6B	3E	43	Code #1		Code #2		00	00
					01	12	04	45		

Figure 9 Powertrain Diagnostic Trouble Code Example

5.5. Service $04 - Clear/Reset Emission-Related Diagnostic Information

5.5.1. Functional Description

The purpose of this service is to provide a means for the external test device to command on-board modules to clear all emission-related diagnostic information.

This includes:

- Clear number of diagnostic trouble codes (Service $01, PID $01)
- Clear diagnostic trouble codes (Service $03)
- Clear trouble code for freeze frame data (Service $01, PID $02)
- Clear freeze frame data (Service $02)
- Clear oxygen sensor test data (Service $05)
- Reset status of system monitoring tests (Service $01, PID $01)
- Clear on-board monitoring test results (Services $06 and $07)

Other manufacturer specific "clearing/resetting" actions may also occur in response to this request.

For safety and/or technical design reasons, some modules may not respond to this test service under all conditions. All modules must respond to this test service request with the ignition ON and with the engine not running. Modules that cannot perform this operation under other conditions, such as with the engine running, will ignore the request.

5.5.2. Message Data Bytes

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6	#7
Request to Clear/Reset Emission-Related Diagnostic Information							
Clear Powertrain DTC	04						
Report when Emission-Related Diagnostic Information is Reset							
Powertrain -DTC-cleared	44						

Figure 10 Message Data Bytes

5.6. Service $05 - Request Oxygen Sensor Monitoring Test Results

5.6.1. Functional Description

The purpose of this service is to allow access to the on-board oxygen sensor monitoring test results. The same information may be obtained by the use of Service $06

The request for test results includes a Test ID value that indicates the information requested. Test value definitions, scaling information, and display formats are included in this document.

Many methods may be used by different manufacturers to comply with this requirement. If data values are to be reported using these messages that are different from those predefined in this document, ranges of test values have been assigned that can be used which have standard units of measure. The tool can convert these values and display them in the standard units.

The on-board module will respond to this message by transmitting the requested test data last determined by the system.

The operation of this diagnostic service in the on-board module is different from Service $01. Service $01 reports data value(s) that are stored internally at a single, or multiple contiguous, locations in memory. Service $05 can report data values that are stored in non-contiguous memory locations. As an example, test results may be stored in RAM, and test limits, (if the value is a calculated value), would normally be stored in ROM. Therefore, the on-board software has additional requirements to respond to this request than it does for Service $01 requests.

Not all test values are applicable or supported by all vehicles. An optional feature of this test service is for the on-board module to indicate which test IDs are supported. Test ID $00 is a bit-encoded value that indicates support for test IDs from $01 to $20. Test ID $20 indicates support for test IDs $21 through $40, etc. This is the same concept as used for PID support in test services $01 and $02. If Test ID $00 is not supported, then the module does not use this feature to indicate test ID support.

5.6.2. Message Data Bytes

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6	#7
Request Oxygen Sensor Test Results							
Request Oxygen Sensor Test Results	05	Test ID	O2S Sens #				
Report Oxygen Sensor Test ID Support - Optional (Test IDs $00, $20, $40, $60, $80, $A0, $C0, $E0)							
Report Oxygen Sensor Test ID Support	45	Test ID	O2S Sens #	Support for the next 32 test IDs following the requested ID is indicated in data bytes #4 through #7			
Report Oxygen Sensor Test Results (All Test IDs That Do Not Indicate Test ID Support) Data is only valid if Service $01 PID $01 indicates Oxygen Sensor monitoring is supported and the test is complete.							
Report Oxygen Sensor Test Results	45	Test ID	O2S #	test value	min limit *	max limit *	–

Figure 11 - Message data Bytes

* NOTE: report limits if value is a test result - not required for test constants, such as ID $01 to $04

Results of latest mandated on-board oxygen sensor monitoring test

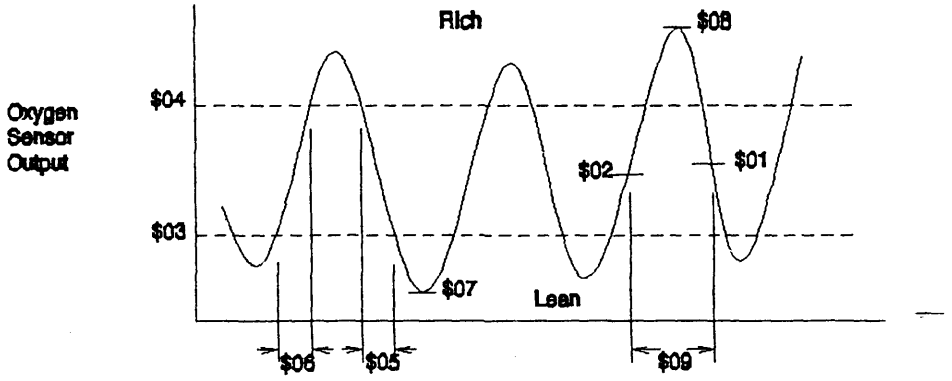

Figure 12 - Test ID Value Example - Note: Numbers refer to Test ID

Data Byte	Description
2	Which Test ID: $00 - Test ID's supported - optional ($01 to $20) $01 - Rich to lean sensor threshold voltage (constant) $02 - Lean to rich sensor threshold voltage (constant) $03 - Low sensor voltage for switch time calculation (constant) $04 - High sensor voltage for switch time calculation (constant) $05 - Rich to lean sensor switch time (calculated) $06 - Lean to rich sensor switch time (calculated) $07 - Minimum sensor voltage for test cycle (calculated) $08 - Maximum sensor voltage for test cycle (calculated) $09 - Time between sensor transitions (calculated) $0A-$1F - reserved $20 - Test ID's supported - optional ($21 to $40) $21-$2F - values with units of time less than 1.02 seconds $30-$3F - values with units of time less than 10.2 seconds $40 - Test ID's supported - optional ($41 to $60) $41-$4F - values with units of voltage less than 1.275 volts $50-$5F - values with units of voltage less than 12.75 volts $60 - Test ID's supported - optional ($61 to $80) $61-$6F - values with units of Frequency less than 25.5 Hz $70-$7F - values with units of counts less than 255 counts $80 - Test ID's supported - optional ($81 to $A0) $81-$9F - manufacturer specific values / units $A0 - Test ID's supported - optional ($A1 to $C0) $A1-$BF - manufacturer specific values / units $C0 - Test ID's supported - optional ($C1 to $E0) $C1-$DF - manufacturer specific values / units $E0 - Test ID's supported - optional ($E1 to $FF) $E1-$FF - manufacturer specific values / units
3	Oxygen sensor location (one, and only one bit can be set to a 1): bit Sensor location * Alternative sensor location + 0 Bank 1 - Sensor 1 Bank 1 - Sensor 1 1 Bank 1 - Sensor 2 Bank 1 - Sensor 2 2 Bank 1 - Sensor 3 Bank 2 - Sensor 1 3 Bank 1 - Sensor 4 Bank 2 - Sensor 2 4 Bank 2 - Sensor 1 Bank 3 - Sensor 1 5 Bank 2 - Sensor 2 Bank 3 - Sensor 2 6 Bank 2 - Sensor 3 Bank 4 - Sensor 1 7 Bank 2 - Sensor 4 Bank 4 - Sensor 2 * If Service $01 PID $13 supported +If Service $01 PID $1D supported
The following 4 bytes define data bytes for Test IDs that indicate support of other Test IDs - optional ($00, $20, $40, $60, $80, $A0, $C0, and $E0)	
4	Support for Test ID, where 1=support, 0=non-support: bit 7 - support for Test ID request + $01 bit 6 - support for Test ID request + $02 . . bit 0 - support for Test ID request + $08

5	Support for Test ID, where 1=support, 0=non-support: bit 7 - support for Test ID request + $09 bit 6 - support for Test ID request + $0A . . bit 0 - support for Test ID request + $10
6	Support for Test ID, where 1=support, 0=non-support: bit 7 - support for Test ID request + $11 bit 6 - support for Test ID request + $12 . . bit 0 - support for Test ID request + $18
7	Support for Test ID, where 1=support, 0=non-support: bit 7 - support for Test ID request + $19 bit 6 - support for Test ID request + $1A . . bit 0 - support for Test ID request + $20

The following 3 bytes define data bytes for Test IDs that report data values				
4	Test ID:	Min ($00):	Max ($FF):	Scaling/bit
	Test ID $01	0 volt	1.275 v.	.005 v.
	Test ID $02	0 volt	1.275 v.	.005 v.
	Test ID $03	0 volt	1.275 v.	.005 v.
	Test ID $04	0 volt	1.275 v.	.005 v.
	Test ID $05	0 sec.	1.02 sec.	.004 sec.
	Test ID $06	0 sec.	1.02 sec.	.004 sec.
	Test ID $07	0 volt	1.275 v.	.005 v.
	Test ID $08	0 volt	1.275 v.	.005 v.
	Test ID $09	0 sec.	10.2 sec.	.04 sec.
	Test ID $21-$2F	0 sec.	1.02 sec.	.004 sec.
	Test ID $30-$3F	0 sec.	10.2 sec.	.04 sec.
	Test ID $41-$4F	0 volt	1.275 v.	.005 volt
	Test ID $50-$5F	0 volt	12.75 v.	.05 volt
	Test ID $61-$6F	0 Hz	25.5 Hz	.1 Hz
	Test ID $70-$7F	0 counts	255 counts	1 count
5	Minimum test limit (only for calculated test result) see Data Byte #4 for minimum value, maximum value, and scaling			
6	Maximum test limit (only for calculated test result) see Data Byte #4 for minimum value, maximum value, and scaling			

*NOTE: Current oxygen sensors are nominally 1 volt full scale. If an oxygen sensor is used with a different nominal output, the output voltage should be normalised to 1 volt. Full scale should be reported as $C8 (decimal 200), which allows for reporting an overvoltage condition.

Figure 13 - Message Data Byte Description

5.7. Service $06 - Request On-Board Monitoring Test Results for Non-continuously Monitored Systems

5.7.1. Functional Description

The purpose of this test service is to allow access to the results for on-board diagnostic monitoring tests of specific components/systems that are not continuously monitored. Examples are catalyst monitoring and the evaporative system monitoring.

The vehicle manufacturer is responsible for assigning test IDs and component IDs for tests of different systems and components. Test results are requested by test ID. Only one test limit is included in a response message, but that limit could be either a minimum or a maximum limit. If both a minimum and maximum test limit are to be reported, then two response messages will be transmitted, in any order. The most significant bit of the "test limit type / component ID" byte will be used to indicate the test limit type.

This test service can be used as an alternative to Service $05 to report oxygen sensor test results.

5.7.2. Message Data Bytes

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6	#7
Request Test Results							
Request Test Results	06	Test ID					
Report Test ID Support (Test IDs $00, $20, $40, $60, $80, $A0, $C0, $E0)							
Report Test ID Support	46	Test ID	FF	Support for the next 32 test IDs following the requested ID for any component is indicated in data bytes #4 through #7			
Report Test Results Multiple Responses may be Transmitted (Test IDs other than $00, $20, $40, $60, $80, $A0, $C0, $E0) Data is only valid if Service $01 PID $01 indicates the monitoring test is supported and the test is complete.							
Report Test Results	46	Test ID	Test Limit Type & Component ID	test value		test limit	
				MSB	LSB	MSB	LSB

Data Byte	Description
2	Test ID: $00 - Test ID's supported ($01 to $20) $01-$1F - values defined by manufacturer $20 - Test ID's supported ($21 to $40) $21-$3F - values defined by manufacturer $40 - Test ID's supported ($41 to $60) $41-$5F - values defined by manufacturer $60 - Test ID's supported ($61 to $80) $61-$7F - values defined by manufacturer $80 - Test ID's supported ($81 to $A0) $81-$9F - values defined by manufacturer $A0 - Test ID's supported ($A1 to $C0) $A1-$BF - values defined by manufacturer $C0 - Test ID's supported ($C1 to $E0) $C1-$DF - values defined by manufacturer $E0 - Test ID's supported ($E1 to $FF) $E1-$FF - values defined by manufacturer
3	bit 7: Most significant bit indicates type of test limit, where: 0 - test limit is maximum value - test fails if test value is greater than this value 1 - test limit is minimum value - test fails if test value is less than this value If the test result should be within a range of values, two messages will be returned, one with the maximum value and one with the minimum value bit 6 - bit 0: Component ID - manufacturer defined - necessary when multiple components or systems are present on the vehicle and have the same definition of test ID

The following 4 bytes define data bytes for Test IDs that indicate support of other Test IDs (Services $00, $20, $40, $60, $80, $A0, $C0, and $E0)	
4	Support for Test ID, where 1=support, 0=non-support: bit 7 - support for Test ID request + $01 bit 6 - support for Test ID request + $02 . . bit 0 - support for Test ID request + $08
5	Support for Test ID, where 1=support, 0=non-support: bit 7 - support for Test ID request + $09 bit 6 - support for Test ID request + $0A . . bit 0 - support for Test ID request + $10
6	Support for Test ID, where 1=support, 0=non-support: bit 7 - support for Test ID request + $11 bit 6 - support for Test ID request + $12 . . bit 0 - support for Test ID request + $18
7	Support for Test ID, where 1=support, 0=non-support: bit 7 - support for Test ID request + $19 bit 6 - support for Test ID request + $1A . . bit 0 - support for Test ID request + $20
The following 4 bytes define data bytes for Test IDs that report data values (multiple response messages will be received if there are multiple components that support the same test ID and $FF is included as data byte #3 in the request message)	
4-5	Test result (two byte value) - this value should be less than or equal to the test limit if most significant bit of data byte #3 is '0', and should be greater than or equal to the test limit if most significant bit of data byte #3 is '1' [Integer values]
6-7	Test limit (two byte value) [Integer values]

Figure 14 - Message Data Bytes

5.7.3. Message Example

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6	#7
Determine Test ID Support							
Request Test ID Support - ID in Hex	06	00					
Report Support for Test IDs 06, 10, 1E and 20	46	00	FF	00000100 =04	00000001 =01	0000000 0 =00	0000010 1 =05
Request Test ID Support	06	20					
Report Support for Test ID 40	46	20	FF	00000000 =00	00000000 =00	0000000 0 =00	0000000 1 =01
Request Test ID Support	06	40					
Report Support for Test ID 60	46	40	FF	00000000 =00	00000000 =00	0000000 0 =00	0000000 1 =01
Request Test ID Support	06	60					
Report Support for Test ID 80	46	60	FF	00000000 =00	00000000 =00	0000000 0 =00	0000000 1 =01
Request Test ID Support	06	80					
Report Support for Test ID A0	46	80	FF	00000000 =00	00000000 =00	0000000 0 =00	0000000 1 =01
Request Test ID Support	06	A0					
Report Support for Test ID A1 - no additional test IDs supported	46	A0	FF	10000000 =10	00000000 =00	0000000 0 =00	0000000 0 =00
Following messages indicate test results for component 01 greater than the minimum							
Request Results for Test ID 06	06	06					
Report Results for component 01 - test value exceeds minimum - passed	46	06	81	test value		minimum test limit	
				32	C4	16	00
Following messages indicate test results greater than the maximum for component ID 01 and less than the maximum for component 02							
Request Results for Test ID 10	06	10					
Report Results for component 01 - test value greater than maximum - failed	46	10	01	test value		maximum test limit	
				92	36	7F	FF
Report Results for component 02 - test value less than maximum - passed	46	10	02	test value		maximum test limit	
				06	61	58	43

Following messages indicate test results for component 31 between the minimum and maximum limits							
Request Results for Test ID A1	06	A1					
Report Results for component 31 - test value greater than minimum - passed	46	A1	B1	test value		minimum test limit	
				35	95	14	00
Report Results for component 31 - test value less than maximum - passed	46	A1	31	test value		maximum test limit	
				35	95	66	53

Figure 15 - Message Example

5.8. Service $07 - Request On-Board Monitoring Test Results for Continuously Monitored Systems

5.8.1. Functional Description

The purpose of this service is to enable the off-board test device to obtain test results for emission-related powertrain components/systems that are continuously monitored during normal driving conditions. The intended use of this data is to assist the service technician after a vehicle repair, and after clearing diagnostic information, by reporting test results after a single driving cycle. If the test failed during the driving cycle, the DTC associated with that test will be reported. Test results reported by this service do not necessarily indicate a faulty component/system. If test results indicate a failure after additional driving, then the MI will be illuminated and a DTC will be set and reported with Service $03, indicating a faulty component/system.

Test results for these components/systems are reported in the same format as the diagnostic trouble codes in Test Service $03 - refer to the functional description for Service $03.

If less than 3 DTC values are reported for failed tests, the response messages used to report the test results should be padded with $00 to fill 7 data bytes. This maintains the required fixed message length for all messages.

If there are no test failures to report, no response is required.

5.8.2. Message Data Bytes

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6	#7
Request test results for continuously monitored systems							
Request test results	07						
Report test results for continuously monitored systems							
Report test results	47	Code #1 or 00 00		Code #2 or 00 00		Code #3 or 00 00	

Figure 16 - Message Data Bytes

5.9. Service $08 - Request Control of on-board system, test or component

5.9.1. Functional Description

The purpose of this service is to enable the off-board test device to control the operation of an on-board system, test or component.

The data bytes will be defined, if necessary, for each Test ID, and will be unique for each Test ID. If any data bytes are unused for any test, they should be filled with $00 to maintain a fixed message length.

Possible uses for these data bytes in the request message are:

- Turn device ON
- Turn device OFF
- Cycle device for nn seconds.

Possible uses for these data bytes in the response message are:

- Report system status
- Report test results

5.9.2. Message Data Bytes

	Data Bytes (Hex)						
	#1	#2	#3	#4	#5	#6	#7
Request control of on-board device							
Request control of on-board device	08	Test ID	Data A or $00	Data B or $00	Data C or $00	Data D or $00	Data E or $00
Report control of on-board device							
Report control of on-board device	48	Test ID	Data A or $00	Data B or $00	Data C or $00	Data D or $00	Data E or $00

Figure 17 - Message Data Bytes

5.9.3. Test ID and Data Byte Description

Test ID (Hex)	Test ID and Data Byte Description
00	Test IDs supported ($01 to $20) Request: Data bytes A to E should be set to $00 Response: Data A - $00 Data B - Same as Data Byte #4 in Service $06 Data C - Same as Data Byte #4 in Service $06 Data D - Same as Data Byte #4 in Service $06 Data E - Same as Data Byte #4 in Service $06
01	Evaporative system leak test Data bytes A to E should be set to $00 for request and response. If the conditions are not proper to run the test, the vehicle may either not respond to the request, or may respond with a manufacturer defined value as Data A which corresponds to the reason the test cannot be run. This test mode enables the conditions required to conduct an evaporative system leak test, but does not actually run the test. An example is to close a purge solenoid, preventing leakage if the system is pressurised. The vehicle manufacturer is responsible to determine the criteria to automatically stop the test (open the solenoid in the example), such as engine running, vehicle speed greater than zero, or exceeding a specified time period.
02-FF	Reserved - to be defined by ISO / SAE

Figure 18 - Test ID and Data Byte Description

Appendix 3

1. Scope

This Appendix defines the requirements of OBD tools, i.e. test equipment that will interface with vehicle modules in support of the OBD diagnostic requirements. It covers the required capabilities of and conformance criteria for OBD Scan Tools.

This Appendix is based on ISO CD XXX4 and SAE J1978, "OBD II Scan Tool".

2. References

2.1. Applicable Documents:

The following publications form a part of this Appendix to the extent specified herein.

2.1.1. Normative References

ISO Documents:

ISO 9141-2: 1994 (E)	"Road Vehicles - Diagnostic Systems - CARB Requirements for Interchange of Digital Information"

2.1.2. Informative References

SAE Documents:

SAE J1850	Class B Data Communication Network Interface
SAE J1930	Electrical / Electronic Systems Diagnostic Terms, Acronyms, and Definitions
SAE J1962	Diagnostic Connector
SAE J1979	E/E Diagnostic Test Modes
SAE J2012	Recommended Format and Messages for Diagnostic Trouble Codes
SAE J2201	Universal Interface for OBD II Scan Tools
SAE J2205	DRAFT - Expanded Diagnostic Protocol

3. California Code of Regulations, Section 1968.1 Title 13 - "Malfunction and Diagnostic System Requirements 1994 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles With Feedback Control Systems"

Environmental Protection Agency 40 CFR Part 86 Control of Air Pollution From New Motor Vehicles and New Motor Vehicle engines; Regulations Requiring On-Board Diagnostic Systems on 1994 and later Model Year Light-Duty Vehicles and Light-Duty trucks

4. Most terms for components and systems contained in this document are included in ISO CD XXX3 (SAE J1930) - Terms, Definitions, and Acronyms. This Section includes additional definitions of terms used in this document, not included in ISO CD XXX3.

4.1. Service = Test Mode

4.2. No further definitions

5. Required Functions

The following are the basic functions that the OBD Scan Tool is required to support or provide:

- Automatic hands-off determination of the communication interface used,
- Obtaining and displaying the status and results of vehicle on-board emission related diagnostic evaluations,
- Obtaining and displaying OBD emissions related diagnostic trouble codes (DTCs),
- Obtaining and displaying OBD emissions related current data,
- Obtaining and displaying OBD emissions related freeze frame data,
- Clearing the storage of OBD emissions related diagnostic trouble codes, OBD emissions related freeze frame data storage and OBD emissions related diagnostic tests status,
- Ability to perform Expanded Diagnostic Protocol functions as described in ISO CD XXX6 (SAE J2205),
- Obtaining and displaying OBD II emissions related test parameters and results as described in Appendix 2,
- Provide a user manual and/or help facility.

6. Vehicle Interface

The following specifies the minimum vehicle interfaces to be supported by an OBD Scan Tool.

6.1. Communication Data Link and Physical Layers

The OBD Scan Tool must be able to communicate with vehicle control modules using the communication interfaces described as follows. ISO CD *XXX6*(SAE J2205) describes a set of functions and communication criteria.

6.1.1. ISO 11519-4 *Recommended Practice Class B Data Communication Network Interface*

ISO 11519-4 describes two sets of data link and physical layers for class B vehicle serial multiplex bus networks. The OBD Scan Tool must support both ISO 11519-4 protocols in a manner that is transparent to the user.

6.1.2. ISO 9141-2: 1994 (E) Road Vehicles - Diagnostic Systems - CARB Requirements for Interchange of Digital Information

ISO 9141-2 describes the physical and data link layers of a vehicle serial diagnostic bus. Refer to ISO CD XXX9 for further clarification regarding the use of ISO 9141-2.

6.1.3. ISO CD 14230-1,2 Road Vehicles - Diagnostic Sytems - Keyword Protocol 200 - Physical and Data Link Layers

Refer to ISO 14230 for further clarification regarding the use of KWP2000.

6.2. Connector

The OBD Scan Tool must be compliant with SAE J1962 Diagnostic Connector. The OBD Scan Tool must support the Standard Pin Assignments defined in SAE J1962.

6.3. Messages

Appendix 2 or ISO 14230-1,2 describes the request messages to be sent by the OBD Scan Tool to the vehicle and the response messages to be sent by the vehicle to the OBD II Scan Tool in order to perform the required services.

6.4. Expanded Diagnostic Protocol

The OBD Scan Tool must allow the user to enter and send vehicle specific messages defined and supplied in motor vehicle manufacturer documents and display the related response messages, as defined in ISO CD *XXX6*(SAE J2205).

6.5. Automatic Hands Off Determination of the Communication Interface Used in a Given Vehicle

6.5.1. General

While there are four types of communication interfaces that could be used to access the OBD functions in a given vehicle (i.e. ISO 11519-4(SAE J1850) 41.6 Kbps PWM, ISO 11519-4(SAE J1850) 10.4 Kbps VPW with CRC, ISO 9141-2, KWP2000 ISO CD 14230-1,2), only one is allowed to be used in any one vehicle to access all supported OBD functions.

When connected to a vehicle and/or when the OBD support is selected where such a selection is necessary, the OBD Scan Tool shall automatically attempt to determine which of the possible communication interfaces is being used in the vehicle to support OBD related functions. The tool will continue to try to determine which interface is being used until it is successful in doing so. No user input will be required, nor allowed, to determine the appropriate interface.

Indications or messages will be displayed during this process informing the user that initialisation is taking place and, if all interface types have been tested and none is responding properly to the request for OBD services, the OBD Scan Tool must advise the user:

- To verify that the ignition is on.
- To check the emissions label or vehicle service information to verify that the vehicle is OBD equipped.
- To check that the tool is connected to the vehicle correctly.

6.5.2. Initialisation Details

Only the following steps shall be used by an OBD Scan Tool to attempt to determine the type of communications interface used in a given vehicle to support OBD functions.

- Test for ISO 11519-4(SAE J1850) 41.6 Kbps PWM

  step 1: enable the ISO 11519-4(SAE J1850) 41.6 Kbps PWM interface

  step 2: send a service 1 PID 0 request message

  step 3: if a service 1 PID 0 response message is received then ISO 11519-4(SAE J1850) 41.6 Kbps PWM is the type of interface used in a vehicle for OBD support.

- Test for ISO 11519-4(SAE J1850) 10.4 Kbps VPW

  step 1: enable the ISO 11519-4(SAE J1850) 10.4 Kbps VPW interface

  step 2: send a service 1 PID 0 request message

  step 3: if a service 1 PID 0 response message is received then ISO 11519-4(SAE J1850) 10.4 Kbps VPW with CRC is the type of interface used in a vehicle for OBD support.

- Test for ISO 9141-2

  step 1: enable the ISO 9141-2 interface

  step 2: if the initialisation sequence defined in ISO 9141-2 is completed successfully, then ISO 9141-2 is the type of interface used in a vehicle for *OBD II* support.

- Test for KWP2000 ISO CD 14230-1,2

  step 1: enable the ISO 14230-1,2 interface

  step 2: if the initialisation sequence defined in ISO 14230-1,2 is completed successfully, then ISO 14230-1,2 is the type of interface used in a vehicle for OBD support.

The previous tests may be performed in any order and where possible may be performed in parallel.

The service 1 PID 0 request and response messages are defined in Appendix 2.

If the tester failts to establish communications using and of the initialisations and if the ignition is on and the vehicle emissions label or service information indicates the vehicle is OBD equipped, then the tester should indicate that there is a Data Link fault.

6.6. On-Board Diagnostic Evaluations

6.6.1. Completed On-Board System Readiness Tests

Immediately after initial communications are established, the OBD Scan Tool shall obtain the status of the on-board system readiness tests. If any supported tests have not been completed, the OBD Scan Tool shall indicate to the user: "Not all supported on-board system readiness tests have been completed" or equivalent. The OBD Scan Tool shall also allow the user to identify which readiness tests (if any) have not been completed.

6.6.2. Supported On-Board System Readiness Tests

The OBD Scan Tool must be capable of indicating to the user which of the tests defined by Appendix 2 service 1 PID 1 data bytes 4 and 5 are supported and which are completed.

6.6.3. Malfunction Indicator

The OBD Scan Tool must be capable of indicating if the MI has been commanded ON and if so, by which module or modules.

6.7. Use of ISO CD XXX5(SAE J2201) Universal Interface for OBD Scan Tools
The OBD Scan Tool shall use the interface described in ISO CD XXX5(SAE J2201), or an equivalent, as the interface to vehicles.

6.8. Handling of No Response from Vehicle

Vehicle modules may not respond to request messages from the OBD II Scan Tool because of incorrect communication of a request message or because the module does not support the request message. If a response is not received within the timeout period prescribed by the protocol, the scan tool shall:

- first, retransmit the request message,
- second, if still no response is received, transmit a service 1 PID 0 request message, in order to determine if communication with the vehicle is currently possible, and if the data desired is available,
- third, if a service 1 PID 0 response is received, transmit other messages, if available, to determine if the desired data is supported by the vehicle,
- lastly, if the above steps fail then as appropriate indicate to the user, that communication with the vehicle, the module or for the information the user has selected can not be performed.

6.9. Connections to the Vehicle in Addition to the SAE J1962 Diagnostic Connector

When connections are made between external equipment and the vehicle in addition to connections made between the same external equipment and the vehicle using the SAE J1962 Diagnostic Connector, any ground circuits must conform to the requirements of the Chassis Ground circuit in the SAE J1962 connector. The intent of this requirement is to maintain the isolation between the vehicle ground and the signal ground in external equipment.

7. System Interaction Capability

7.1. Obtain and Display OBD II Emissions Related Diagnostic Trouble Codes

The OBD Scan Tool must be capable of obtaining, converting and displaying OBD emissions related diagnostic trouble codes from a vehicle that can be transmitted by a response to a ISO CD XXX1(SAE J1979) request (see Appendix 2). Either the diagnostic trouble code, its descriptive text or both must be displayed. Diagnostic Trouble Codes and their descriptive text are defined in Appendix 4. When diagnostic trouble code data are selected for display, the OBD Scan Tool will continuously request of the vehicle it's DTC data and display the data received in the corresponding response messages.

7.2. Obtain and Display OBD Emissions Related Current Data, Freeze Frame Data, Test Parameters and Results

The OBD Scan Tool must be capable of obtaining, converting and displaying:

- OBD emissions related current data;
- OBD emissions related freeze frame data;
- test parameters and results data as described in Appendix 2. Appendix 2 details the available data, the messages to be used to request the data, the messages to be used to return the data, the conversion values for the data and the format to be used to display the data.

When current data items are selected for display, the OBD Scan Tool will continuously request of the vehicle the data to be displayed and display the data received in the corresponding response messages. When freeze frame or test parameters and results are selected for display, the OBD Scan Tool does not need to continuously request and display those items.

Where applicable, the OBD II Scan Tool must indicate whether a test limit is a high limit or a low limit. Where applicable, the display of test results must also show the test ID and component ID.

Data from the vehicle may indicate which items are supported, in which case this information shall be made available to the user by the OBD scan tool. The OBD Scan Tool shall also allow users to specify requests for services, parameters, test IDs, etc. irrespective of whether the vehicle has indicated support for such items.

7.3. Responses from Multiple Modules

The OBD Scan Tool must be capable of interfacing with a vehicle in which multiple modules may be used to support OBD requirements.

The OBD Scan Tool must inform the user when multiple modules respond to the same request.

The OBD Scan Tool must inform the user when multiple modules respond with different values for the same data item.

The OBD Scan Tool must provide the user with the ability to select for display, as separate items, the responses received from multiple modules for the same data item.

7.4. Code Clearing

The OBD Scan Tool must be capable of sending a request to clear OBD emissions related diagnostic trouble codes, OBD emissions related freeze frame data and OBD emissions related diagnostic tests status information. The OBD Scan Tool must require the user to confirm such a request before transmitting (e.g. are you sure?).

8. General Characteristics

8.1. Display

The OBD Scan Tool must be capable of displaying simultaneously at least 2 (two) items of OBD emissions related data.

A list of the OBD emissions related current data and freeze frame data items, their Parameter IDs, data resolution and data conversion information, units and display formats is provided in Appendix 2. The display units shall be the Standard International (SI) and English units as specified in Appendix 2. A user shall be able to select between English and SI values. The unit conversions specified in Appendix 2 shall be used.

The display of each OBD emissions related current data or freeze frame data shall include the following:

- Data value;
- Data Parameter ID or name;
- The module ID of the module that supplied the data.

The display of each OBD emissions related diagnostic trouble code shall include the module ID of the module that supplied the code.

As a minimum the data values of two data items must be displayed simultaneously. A display of the parameter IDs of the data items and the IDs of the modules that supplied the data items must be easily accessible if not displayed with the data values.

The units of measurement associated with the data items must either be:

- Displayed with the data values or;
- easily accessible on the display or;
- readily available to the user (e.g. on the tester body);
- Having this information available in a user's manual separate from the body of the tool does not satisfy this requirement.

The display must be capable of showing at least alphanumeric characters.

8.2. User Input

The OBD Scan Tool must include some form of user input that would allow the user to:

- Select between the basic functions required by OBD II, i.e:
  - display current data
  - display freeze frame data
  - display trouble codes
  - clear emissions related data
  - display test parameters and results);
- select for simultaneous display at least two items of any one of the following:
  - OBD emissions related current data
  - OBD emissions related diagnostic trouble codes
  - OBD emissions related freeze frame data
  - OBD emissions related test parameters and results.

Responses from multiple modules to requests for a current data item or a freeze frame data item are treated as separate data items for selection and display purposes

- To verify a request to clear and/or reset OBD emissions related diagnostic information as defined by Appendix 2.
- Enter and send Expanded Diagnostic Protocol messages as defined in ISO CD XXX6 (SAE J2205)

9. Power Requirements if Powered by the Vehicle Through the ISO 11519 (SAE J1962) Diagnostic Connector

Voltage

Must operate normally within a range of 8.0 to 18.0 volts D.C.

Must survive a steady state voltage of up to 24.0 volts D.C. for at least 10.0 minutes.

Must survive a steady state reverse voltage of up to 24.0 Volts D.C. for at least 10 minutes.

The tool must withstand cranking in that communications and data shall not be lost during battery voltage reductions to 5.5V for up to 0.5s. The display need not function during this period.

For Maximum current refer to ISO 11519(SAE J1962).

10. Electromagnetic Compatibility (EMC)

The tool must not interfere with the normal operation of vehicle modules.

The normal operation of the tool must be immune to conducted and radiated emissions present in a service environment and when connected to a vehicle.

The tool must be immune to reasonable levels of Electrostatic Discharge (ESD).

EMC and ESD measurements and limits will be in accordance to the standards prevailing in the country in which the tester is to be sold.

11. Conformance Testing

11.1. General

The documents relating to confromance testing are still being prepared. When they are completed the tests outlined below will need to be revised accordingly.

Conformance testing defines the tests required to be passed in order for tools to be type approved as "ISO CD XXX4 <date to be added> OBD SCAN TOOL COMPATIBLE" or "CONFORMS TO ISO CD XXX4". Tools that do not pass these tests are not to be so labelled. Validation of the conformance test is the responsibility of the Scan Tool manufacturer and the Scan Tool manufacturer may elect to self-certify.

The tests in this section must be performed successfully 5 consecutive times in order to be considered passed.

Three examples of at least production intent level tools must pass all these tests in order for a given version of tool hardware and software to be considered passed.

Any changes to the hardware or software used in a tool for the functions described in this document will require a retest of these tests or an explanation from the tool manufacturer as to why the change should not require a retest. Where an explanation is submitted in lieu of a retest due to a change, the organization originally performing these tests will determine whether the explanation is acceptable or whether a retest is required. Reasonable normal engineering criteria will be used when determining whether to accept an explanation.

The Scan Tool manufacturer shall make available to the buying public:

- The methods used to make these tests
- The results of the tests
- Clear indication of the versions of hardware and software that conform (i.e. labeled as conforming to or are compatible with the requirements of ISO CD XXX4 OBD Scan Tool or other labeling to that effect).

Both proper and improper response messages will be employed during these tests. Improper responses are those that have incorrect first, second or third bytes of the header, an incorrect mode, an incorrect PID, an incorrect length of the response message, or with an incorrect CRC or CS. The tool must ignore all improper response messages and perform as if no response was received.

Situations involving multiple modules responding to a single request, single modules responding with multiple responses to a single request and multiple modules responding with multiple responses to a single request will be tested.

The interval between the end of the request message and the beginning of the response message(s) will be varied from 0 ms up to the delay required to show a no response indication on the OBD II Scan Tool. The delay that causes the no response indication will be compared to the value defined in each protocol.

The format, content and order of messages transmitted on each of the buses will be observed and reviewed for correctness.

The ability to obtain and report the results of the on-board system readiness tests shall be verified. The ability to report which tests the vehicle supports and have been completed shall be verified.

The requirements described in 11.3 through 11.7 (inclusive) shall be verified on each protocol specified in 6.1.

When performing these tests, observation of the indications and displays provided to the user and the signals on the ISO 11519-4 (SAE J1850) (bus +) and (bus -) lines, the ISO 9141-2 K and L lines and ISO 14230-1,2 K and L lines will be the criteria for proper performance.

These tests will be executed in an environment of 25 degrees C +/-3 degrees C and between 30% and 80% relative humidity +/- 5%.

The hardware and software used in the OBD II Scan Tool version being tested must be identified.

11.2. Determine OBD II Communication Type

Item to be tested:

Automatic hands off determination of interface type

- that it is automatic when the SAE J1962 connector is plugged into its mating connector in the vehicle and/or OBD support is selected, where such a selection is necessary.

- that a test of all OBD communication interfaces is performed at least once per scan.

- that the scan of all interfaces continues until successful or until terminated by the user.

- that some indication is provided to the user that the scan of interfaces is being performed.

- that a failure to successfully find an OBD II interface during a scan of all the possible interfaces is indicated to the user at the completion of each and every scan.

- that when an OBD interface is successfully found, the tool automatically prompts the user for function selection.

- that the tool provides and uses the facilities and/or messages defined in SAE J2201 (or equivalent), Appendix 2, ISO 9141-2, ISO 11519-4 (SAE J1850), ISO 14230 and Appendix 4.

- that the tool does not exceed the polling rates specified in Appendix 2.

- that the tool provides the proper bias for the K and L lines as specified in ISO 9141-2 and ISO 14230-1.

- that the tool performs the initialisation tests according to 6.5.2, and indicates the information according to 6.5.1.

The interface determination tests will be performed:

- with no modules available,

- with an ISO 9141-2 module available,

- with a KWP2000 (ISO 14230) module available,

- with a ISO 11519 (SAE J1850) 41.6 Kbps PWM module available,

- with a ISO 11519 (SAE J1850) 10.4 Kbps VPW module available.

11.3. On-Board System Readiness Tests

Item to be tested:

- that the tool automatically requests and reports the results of the supported on-board system readiness tests.

11.4. Select Functions

Item to be tested:

- that the tool supports the functions described in Section 5.

- that the user is able to move back and forth between these functions.

The criteria for successfully passing this test is to be able to easily move back and forth between all functions and observe the results.

11.5. Select and Display Items

Item to be tested:

- that the user is able to select and display simultaneously at least two items from any one of:

  - available DTC's,

  - current data items,

  - available freeze frame data items, and

  - test parameters and results.

- that the module ID's and the PID's or parameter names associated with all the items mentioned above can also be displayed either (a) simultaneously with the displayed items, or (b) in some alternate method (printed material, etc.).

- that the units-of-measurement information associated with all the possible current data items and freeze frame data items is easily available either as a part of the data display, displayed separately, or otherwise available on or with the tool body itself.

- that the tool is able to handle multiple responses from the same module due to one request.

- that the tool is able to handle responses from multiple modules due to one request.

- that the tool is able to handle multiple responses from multiple modules due to one request.

- that the tool informs the user that responses from multiple modules due to one request were received. Responses for multiple modules to a request are to be made available to the user as separate items for display.

- that the tool informs the user that different responses from multiple modules due to one request were received.

The criteria for successfully passing this test is to easily select back and forth between all the items and observe the results.

11.6. Verify Requests to Clear Codes

Item to be tested:

- that the selection of the Clear Codes function incorporates a request to the user to verification.

- that both yes and no responses to the request to the user to verify the selection of the Clear Codes function are processed appropriately.

This test should involve situations where there are some DTC's to clear and other situations where there are no DTC's to clear. When making this test, the presence of DTC's must be verified both before and after the Clear Codes function is selected.

11.7. General Diagnostic Communication Tests

When performing tests involving diagnostic messages, tests are to be made of the tool's ability to handle an immediate response, a slow response and a response delayed longer than the maximum allowed by each of the protocols.

The tool should be able to process all responses that are received within the maximum time allowed by each protocol and indicate a no response condition to the user when the response is delayed longer than the maximum allowed by each protocol.

The tool must support the transmission of its node address as an in-frame-response during the transmission of any response messages from modules on a ISO 11519 (SAE J1850) bus and must be able to handle both the presence and the absence of an in-frame-response during the tool's transmission of request messages.

11.8. Expanded Diagnostic Protocol

Item to be tested:

- that the user is reasonably able to enter Expanded Diagnostic Protocol (EDP) input and that the OBD Scan Tool correctly executes the entered EDP input.

11.9. Capacitance and Impedance at the SAE J1962 Connector

Item to be tested:

- that the capacitance and impedance of the OBD Scan Tool, connecting cables and the male SAE J1962 connector, as seen at the connector, are within the limits defined in ISO 11519 (SAE J1850), ISO 9141-2, ISO 14230 and SAE J1962. Note that SAE J1962 details the impedance of both the used and unused pins.

Measurement of these parameters will be made by the testing agency at their discretion following generally acceptable engineering practices.

11.10. Operating Voltage and Current Draw

Item to be tested:

- that the OBD Scan Tool will correctly operate throughout the voltage range specified in the Section 9 of this Appendix and will not require more than the maximum current specified in the Section 9 of this Appendix.

- that the tool will survive the use of supply voltages of up to the maximum survival voltage and survival reverse voltage specified in the Section 9 of this Appendix.

During other conformance tests, the voltage supplied to the OBD Scan Tool is to be varied throughout the specified range and check for continuous operation. Also the current draw is to be compared with the limit specified.

11.11. Protocol Check

Item to be tested:

- that all the request and response messages defined by each of the protocols, as specified in Section 6 are properly and appropriately used by the OBD Scan Tool.

11.12. Alphanumeric Display

Item to be tested:

- that the OBD Scan Tool is able to display alphanumeric characters.

The results of the above test will be observed to determine the ability of the OBD Scan Tool to display alphanumeric characters.

11.13. User Manual and Help Facility

Item to be tested:

- that a useful user manual and/or HELP facility is available with the OBD Scan Tool.

- that the user manual and/or HELP facility at least includes:
  - Parameter definitions and Test Ids as described in Appendix 2;
  - DTC definitions as described in Appendix 4;
  - All abbreviations used by the tool;
  - how to select the functions;
  - how to select items for simultaneous display;
  - how to determine the PID, item name and module ID of data returned for display;
  - how to verify the selection of the Clear Codes function;
  - how to obtain and display OBD emissions related test parameters and results as described in related documentation for each protocol;
  - how multiple responses from one request is indicated;
  - how different responses to the same request is indicated;
  - what current and freeze frame data items are available through OBD;
  - how to enter requests for the Expanded Diagnostic Protocol and interpret the results.

The OBD Scan Tool will be tested for a HELP facility and/or the availability and coverage of a user manual.

Appendix 4

1. Scope

This Appendix provides some recommended uniformity for these numeric codes. It further provides guidance for uniform messages associated with these codes.

The document is comprised of several sections addressing format structure, messages, and a few examples applying the recommendations of the document. The actual code assignments and messages for powertrain systems are contained in one part attached to the Appendix (Part A).

The recommended Diagnostic Trouble Codes (DTC) consist of a three digit numeric code preceded by an alpha-numeric designator. The code structure itself is partially open ended. A portion of the available numeric sequences (portions of "B0", "C0", "P0, and "U0") are reserved for uniform codes assigned by this or future updates of this document. Because of continued development in OBD systems and the flexibility of the partially open assignment structure, particular attention should be paid to ensure the user has the latest version of this document.

This Appendix is based on ISO CD XXX2 and SAE J 2012, "Diagnostic Trouble Code Definitions".

2. Normative References (References)

2.1. Applicable Documents

The following publications form a part of this specification to the extent specified herein.

2.1.1. Normative References

ISO Documents:

ISO 9141-2	Road vehicles - Diagnostic systems - CARB requirements for interchange of digital information.
ISO CD 14230	Keyword Protocol 2000 Parts 1/2/3
ISO 11519 - 4	Road Vehicles Low speed Serial Data Communication Class B -Data Communications Interface (SAE J1850)
ISO CD 14229	Diagnostic Services

2.1.2. Informative References

SAE Documents:

J1850 FEB94	Class B Data Communication Network Interface
J1930 JUN93	E/E Systems Diagnostic Terms, Definitions, Abbreviations and Acronyms
J1962 JUN93	Diagnostic Connector
J1978 MAR92	OBD II Scan Tool
J2012 MAR92	Recommended Format and Messages for Diagnostic Trouble Codes

J2186 SEP91 Diagnostic Data Link Security

J2190 JUN93 Enhanced E/E Diagnostic Test Modes

3. Definitions

Most circuit, component, or system Diagnostic Trouble Codes are defined by four basic categories: General Circuit Malfunction, Range/Performance Problem, Low or High Circuit Input.

Most terms for components and systems contained in this document are included in ISO CD XXX3 (SAE Recommended Practice J1930) referenced above. This section includes additional definitions of terms not included in ISO CD XXX3.

3.1. General circuit malfunction

Fixed value or no response from the system. Manufacturers may choose to use this code in place of the dual High/Low (defined below) or use to indicate any other failure mode.

3.2. Range/performance

The circuit is functional but not in the normal operating range. May also be used to indicate stuck, erratic, intermittent, or skewed values indicating poor performance of a circuit, component, or system.

3.3. Low input

Circuit voltage, frequency, or other signal measured at the control module input terminal or pin that is at or near zero.This is measured with the external circuit, component, or system connected.The signal type (voltage, frequency, etc.) shall be included in the message in place of the word "input".

3.4. High input

Circuit voltage, frequency, or other signal measured at the control module input terminal or pin that is at or near full scale for the particular signal being measured. This is measured with the external circuit, component, or system connected. The signal type (voltage, frequency, etc.) shall be included in the message in place of the word "input".

3.5. # = number

While each manufacturer has the ability to define the specific DTC's to meet their specific controller algorithms all DTC words must meet applicable ISO CD XXX3 (SAE Recommended Practice J1930) referenced above.

4.0. Format structure

4.1. Description

The Diagnostic Trouble Code consists of an alpha-numeric designator, B0 - - B3 for Body, C0 -- C3 for Chassis, P0 -- P3 for Powertrain, and U0 -- U3 for Network Communication, followed by three digits. The assignment of the proper alpha designator should be determined by the controller into which the particular function being diagnosed is being integrated, or in the case of multiple controllers, the area most appropriate for that function. In most cases, the alpha designator will be implied since diagnostic information will be requested from a particular controller. In the cases where the source of the diagnostic information is not clear, the uppermost nibble of the two-byte code message as defined in Appendix 2 will define the source system as follows:

0000 - P0 - Powertrain codes ISO / SAE controlled

0001 - P1 - Powertrain codes Manufacturer controlled

0010 - P2 - Powertrain codes Reserved

0011 - P3 - Powertrain codes Reserved

1100 - U0 - Network Communication codes ISO / SAE controlled

1101 - U1 - Network Communication codes Manufacturer controlled

1110 - U2 - Network Communication codes Manufacturer controlled

1111 - U3 - Network Communication codes Reserved

Within each code class, the first of the three digits identifies a particular grouping of codes. These particular groupings each contain a series of 100 sequence numbers for particular code definitions.

Codes have been defined to indicate a suspected trouble or problem area and are intended to be used as a directive to the proper service procedure. To minimise service confusion, fault codes should not be used to indicate the absence of problems or the status of parts of the system (e.g. Powertrain System O.K., or MIL illuminated), but should be confined to indicated areas in need of service attention. Each alpha designator has code subdivisions which are industry controlled or which are manufacturer specific. These are shown in the above Table and described as "Core" and "Non Uniform" respectively in the following clauses. Codes in the ISO/SAE subdivisions even if not defined in this document are not to be used by manufacturers until they have been approved by SAE and ISO.

4.2. Core DTCs

Core Diagnostic Trouble Codes are those codes where industry uniformity has been achieved. These codes were felt to be common enough across most manufacturers' applications that a common number and fault message could be assigned. All undefined numbers in each grouping have been reserved for future growth. Although service procedures may differ widely amongst manufacturers, the fault being indicated is common enough to be assigned a particular fault code.

4.3. Non-Uniform DTC

Areas within each alpha designator have been made available for non-uniform DTCs. These are fault codes that will not generally be used by a majority of the manufacturers due to basic system differences, implementation differences, or diagnostic strategy differences. Each vehicle manufacturer or supplier who designs and specifies diagnostic algorithms, software, and diagnostic trouble codes are strongly encouraged to remain consistent across their product line when assigning codes in the manufacturer controlled area. For Powertrain codes, the same groupings should be used as in the ISO / SAE controlled area, i.e., 100's and 200's for Fuel and Air Metering, 300's for Ignition System or Misfire, etc.

Code groupings for non-Powertrain codes will be defined at a later date.

4.4. Powertrain System Groupings

4.4.1. P0XXX ISO / SAE Controlled

4.4.1.1. P01XX Fuel and Air Metering

4.4.1.2. P02XX Fuel and Air Metering

4.4.1.3. P03XX Ignition System or Misfire

4.4.1.4. P04XX Auxiliary Emission Controls

4.4.1.5. P05XX Vehicle Speed, Idle Control, and Auxiliary Inputs

4.4.1.6. P06XX Computer and Auxiliary Outputs

4.4.1.7. P07XX Transmission

4.4.1.8. P08XX Transmission

4.4.1.9. P09XX Reserved for ISO / SAE

4.4.1.10. P00XX Reserved for ISO / SAE

4.4.2. P1XXX Manufacturer Controlled

4.4.2.1. P11XX Fuel and Air Metering

4.4.2.2. P12XX Fuel and Air Metering

4.4.2.3. P13XX Ignition System or Misfire

4.4.2.4. P14XX Auxiliary Emission Controls

4.4.2.5. P15XX Vehicle Speed, Idle Control, and Auxiliary Inputs

4.4.2.6. P16XX Computer and Auxiliary Outputs_

4.4.2.7. P17XX Transmission

4.4.2.8. P18XX Transmission

4.4.2.9. P19XX Category to be Determined by ISO / SAE

4.4.2.10. P10XX Category to be Determined by ISO / SAE

4.4.3. P2XXX ISO / SAE Reserved

4.4.4. P3XXX ISO / SAE Reserved

4.5. Network Communication Groupings

4.5.1. U0XXX ISO / SAE Controlled

4.5.2. U1XXX Manufacturer Controlled

4.5.3. U2XXX Manufacturer Controlled

4.5.4. U3XXX Reserved

5.0. Messages

Each defined fault code has been assigned a message to indicate the circuit, component or system area that was determined to be at fault. The messages are organized such that different messages related to a particular sensor or system are grouped together. In cases where there are various fault messages for different types of faults, the group also has a "generic" message as the first Code/Message of the group. A manufacturer has a choice when implementing diagnostics, based on the specific strategy and complexity of the diagnostic, whether to use one "generic" code for any fault of that circuit, component or system or to use the more specific codes for better defining the type of fault that was detected. The manufacturer must determine what codes and messages best fit the diagnostics actually implemented. The intent is to have only one code stored for each fault detected.

Where messages are broken down into more specific fault descriptions for a circuit, component, or system, the manufacturer should choose the code most applicable to their diagnosable fault. The messages are intended to be somewhat general to allow manufacturers to use them as often as possible yet still not conflict with their specific repair procedures. The terms "LOW" and "HIGH" when used in a message, especially those related to input signals, refer to the voltage, frequency, etc. at the pin of the controller. The specific level of "LOW" and "HIGH" must be defined by each manufacturer to best meet their needs.

6.0. Examples

Manufacturers may chose the depth of diagnosis performed by on board systems and that performed by off board equipment and procedures.

In the case of a fault detected with the Throttle Position (TP) Sensor a number of fault codes may be used.

If the diagnosis is all to be completed off board then use P0120 (TP Sensor Circuit Malfunction).

However if the manufacturer chooses to perform more diagnosis on board then the following codes could be used:

- System detects that the input signal is stuck near zero use P0122 (TP Sensor Low Input)

- System detects that the input signal is stuck near full scale use P0123 (TP Sensor High Input),

- System detects that the input signal is not as expected on idle (e.g. is at 1.5v rather than 1.0v) use P0121 (TP Sensor Range / Performance).

- The generic code P0120 (TP Sensor Circuit Malfunction) could be used in place of any of the above.

Even with the more detailed information identification of the root cause of the problem remains as an off board task. For example the higher voltage on idle could be caused by corrosion of electrical contacts or by a poor setting of the throttle plate.

PART A

POWERTRAIN SYSTEM DIAGNOSTIC TROUBLE CODES

NOTE

Following are the Recommended Industry Common Trouble Codes for the Powertrain Control System. These include systems that might be integrated into an electronic control module that would be used for controlling Engine functions, such as Fuel, Spark, Idle Speed and Vehicle Speed (Cruise Control) as well as those for Transmission control. The fact that a code is recommended as a Common Industry Code does not imply that it is a Required Code (Legislated), an Emission Related Code, or that it indicates a fault that will cause the Malfunction Indicator Light to be illuminated.

P01XX Fuel and Air Metering

P0100	Mass or Volume Air Flow Circuit Malfunction	
P0101	Mass or Volume Air Flow Circuit Range/Performance Problem	
P0102	Mass or Volume Air Flow Circuit Low Input	
P0103	Mass or Volume Air Flow Circuit High Input	
P0104	Mass or Volume Air Flow Circuit Intermittent	
P0105	Manifold Absolute Pressure/Barometric Pressure Circuit Malfunction	
P0106	Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance Problem	
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input	
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input	
P0109	Manifold Absolute Pressure/Barometric Pressure Circuit Intermittent	
P0110	Intake Air Temperature Circuit Malfunction	
P0111	Intake Air Temperature Circuit Range/Performance Problem	
P0112	Intake Air Temperature Circuit Low Input	
P0113	Intake Air Temperature Circuit High Input	
P0114	Intake Air Temperature Circuit Intermittent	
P0115	Engine Coolant Temperature Circuit Malfunction	
P0116	Engine Coolant Temperature Circuit Range/Performance Problem	
P0117	Engine Coolant Temperature Circuit Low Input	
P0118	Engine Coolant Temperature Circuit High Input	
P0119	Engine Coolant Temperature Circuit Intermittent	
P0120	Throttle/Pedal Position Sensor/Switch "A" Circuit Malfunction	
P0121	Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance Problem	
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input	
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	
P0124	Throttle/Pedal Position Sensor/Switch "A" Circuit Intermittent	
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	
P0126	Insufficient Coolant Temperature for Stable Operation	
P0130	O2 Sensor Circuit Malfunction	(Bank 1* Sensor 1)
P0131	O2 Sensor Circuit Low Voltage	(Bank 1* Sensor 1)
P0132	O2 Sensor Circuit High Voltage	(Bank 1* Sensor 1)
P0133	O2 Sensor Circuit Slow Response	(Bank 1* Sensor 1)
P0134	O2 Sensor Circuit No Activity Detected	(Bank 1* Sensor 1)
P0135	O2 Sensor Heater Circuit Malfunction	(Bank 1* Sensor 1)

* For systems with single O2 sensors, use codes for Bank 1 sensor. Bank 1 contains cylinder #1. Sensor 1 is closest to the engine.

P0136	O2 Sensor Circuit Malfunction	(Bank 1* Sensor 2)
P0137	O2 Sensor Circuit Low Voltage	(Bank 1* Sensor 2)
P0138	O2 Sensor Circuit High Voltage	(Bank 1* Sensor 2)
P0139	O2 Sensor Circuit Slow Response	(Bank 1* Sensor 2)
P0140	O2 Sensor Circuit No Activity Detected	(Bank 1* Sensor 2)
P0141	O2 Sensor Heater Circuit Malfunction	(Bank 1* Sensor 2)
P0142	O2 Sensor Circuit Malfunction	(Bank 1* Sensor 3)
P0143	O2 Sensor Circuit Low Voltage	(Bank 1* Sensor 3)
P0144	O2 Sensor Circuit High Voltage	(Bank 1* Sensor 3)
P0145	O2 Sensor Circuit Slow Response	(Bank 1* Sensor 3)
P0146	O2 Sensor Circuit No Activity Detected	(Bank 1* Sensor 3)
P0147	O2 Sensor Heater Circuit Malfunction	(Bank 1* Sensor 3)
P0150	O2 Sensor Circuit Malfunction	(Bank 2 Sensor 1)
P0151	O2 Sensor Circuit Low Voltage	(Bank 2 Sensor 1)
P0152	O2 Sensor Circuit High Voltage	(Bank 2 Sensor 1)
P0153	O2 Sensor Circuit Slow Response	(Bank 2 Sensor 1)
P0154	O2 Sensor Circuit No Activity Detected	(Bank 2 Sensor 1)
P0155	O2 Sensor Heater Circuit Malfunction	(Bank 2 Sensor 1)
P0156	O2 Sensor Circuit Malfunction	(Bank 2 Sensor 2)
P0157	O2 Sensor Circuit Low Voltage	(Bank 2 Sensor 2)
P0158	O2 Sensor Circuit High Voltage	(Bank 2 Sensor 2)
P0159	O2 Sensor Circuit Slow Response	(Bank 2 Sensor 2)
P0160	O2 Sensor Circuit No Activity Detected	(Bank 2 Sensor 2)
P0161	O2 Sensor Heater Circuit Malfunction	(Bank 2 Sensor 2)
P0162	O2 Sensor Circuit Malfunction	(Bank 2 Sensor 3)
P0163	O2 Sensor Circuit Low Voltage	(Bank 2 Sensor 3)
P0164	O2 Sensor Circuit High Voltage	(Bank 2 Sensor 3)
P0165	O2 Sensor Circuit Slow Response	(Bank 2 Sensor 3)
P0166	O2 Sensor Circuit No Activity Detected	(Bank 2 Sensor 3)
P0167	O2 Sensor Heater Circuit Malfunction	(Bank 2 Sensor 3)
P0170	Fuel Trim Malfunction	(Bank 1*)
P0171	System too Lean	(Bank 1*)
P0172	System too Rich	(Bank 1*)
P0173	Fuel Trim Malfunction	(Bank 2)
P0174	System too Lean	(Bank 2)
P0175	System too Rich	(Bank 2)

* For systems with single O2 sensors, use codes for Bank 1 sensor. Bank 1 contains cylinder #1. Sensor 1 is closest to the engine.

P0176	Fuel Composition Sensor Circuit Malfunction
P0177	Fuel Composition Sensor Circuit Range/Performance
P0178	Fuel Composition Sensor Circuit Low Input
P0179	Fuel Composition Sensor Circuit High Input
P0180	Fuel Temperature Sensor "A" Circuit Malfunction
P0181	Fuel Temperature Sensor "A" Circuit Range/Performance
P0182	Fuel Temperature Sensor "A" Circuit Low Input
P0183	Fuel Temperature Sensor "A" Circuit High Input
P0184	Fuel Temperature Sensor "A" Circuit Intermittent
P0185	Fuel Temperature Sensor "B" Circuit Malfunction
P0186	Fuel Temperature Sensor "B" Circuit Range/Performance
P0187	Fuel Temperature Sensor "B" Circuit Low Input
P0188	Fuel Temperature Sensor "B" Circuit High Input
P0189	Fuel Temperature Sensor "B" Circuit Intermittent
P0190	Fuel Rail Pressure Sensor Circuit Malfunction
P0191	Fuel Rail Pressure Sensor Circuit Range/Performance
P0192	Fuel Rail Pressure Sensor Circuit Low Input
P0193	Fuel Rail Pressure Sensor Circuit High Input
P0194	Fuel Rail Pressure Sensor Circuit Intermittent
P0195	Engine Oil Temperature Sensor Malfunction

P0196 Engine Oil Temperature Sensor Range/Performance
P0197 Engine Oil Temperature Sensor Low
P0198 Engine Oil Temperature Sensor High
P0199 Engine Oil Temperature Sensor Intermittent

P02XX Fuel and Air Metering

P0200 Injector Circuit Malfunction
P0201 Cylinder 1 - Injector Circuit Malfunction
P0202 Cylinder 2 - Injector Circuit Malfunction
P0203 Cylinder 3 - Injector Circuit Malfunction
P0204 Cylinder 4 - Injector Circuit Malfunction
P0205 Cylinder 5 - Injector Circuit Malfunction
P0206 Cylinder 6 - Injector Circuit Malfunction
P0207 Cylinder 7 - Injector Circuit Malfunction
P0208 Cylinder 8 - Injector Circuit Malfunction
P0209 Cylinder 9 - Injector Circuit Malfunction
P0210 Cylinder 10 - Injector Circuit Malfunction
P0211 Cylinder 11 - Injector Circuit Malfunction
P0212 Cylinder 12 - Injector Circuit Malfunction
P0213 Cold Start Injector 1 Malfunction
P0214 Cold Start Injector 2 Malfunction
P0215 Engine Shutoff Solenoid Malfunction
P0216 Injection Timing Control Circuit Malfunction
P0217 Engine Overtemp Condition
P0218 Transmission Over Temperature Condition
P0219 Engine Overspeed Condition
P0220 Throttle/Pedal Position Sensor/Switch "B" Circuit Malfunction
P0221 Throttle/Pedal Position Sensor/Switch "B" Circuit Range/Performance Problem
P0222 Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input
P0223 Throttle/Pedal Position Sensor/Switch "B" Circuit High Input
P0224 Throttle/Pedal Position Sensor/Switch "B" Circuit Intermittent
P0225 Throttle/Pedal Position Sensor/Switch "C" Circuit Malfunction
P0226 Throttle/Pedal Position Sensor/Switch "C" Circuit Range/Performance Problem
P0227 Throttle/Pedal Position Sensor/Switch "C" Circuit Low Input
P0228 Throttle/Pedal Position Sensor/Switch "C" Circuit High Input
P0229 Throttle/Pedal Position Sensor/Switch "C" Circuit Intermittent
P0230 Fuel Pump Primary Circuit Malfunction
P0231 Fuel Pump Secondary Circuit Low
P0232 Fuel Pump Secondary Circuit High
P0233 Fuel Pump Secondary Circuit Intermittent
P0235 Turbocharger Boost Sensor "A" Circuit Malfunction
P0236 Turbocharger Boost Sensor "A" Circuit Range/Performance
P0237 Turbocharger Boost Sensor "A" Circuit Low
P0238 Turbocharger Boost Sensor "A" Circuit High
P0239 Turbocharger Boost Sensor "B" Circuit Malfunction
P0240 Turbocharger Boost Sensor "B" Circuit Range/Performance
P0241 Turbocharger Boost Sensor "B" Circuit Low
P0242 Turbocharger Boost Sensor "B" Circuit High
P0243 Turbocharger Wastegate Solenoid "A" Malfunction
P0244 Turbocharger Wastegate Solenoid "A" Range/Performance
P0245 Turbocharger Wastegate Solenoid "A" Low
P0246 Turbocharger Wastegate Solenoid "A" High
P0247 Turbocharger Wastegate Solenoid "B" Malfunction
P0248 Turbocharger Wastegate Solenoid "B" Range/Performance
P0249 Turbocharger Wastegate Solenoid "B" Low
P0250 Turbocharger Wastegate Solenoid "B" High
P0251 Injection Pump "A" Rotor/Cam Malfunction
P0252 Injection Pump "A" Rotor/Cam Range/Performance
P0253 Injection Pump "A" Rotor/Cam Low

P0254 Injection Pump "A" Rotor/Cam High
P0255 Injection Pump "A" Rotor/Cam Intermittent
P0256 Injection Pump "B" Rotor/Cam Malfunction
P0257 Injection Pump "B" Rotor/Cam Range/Performance
P0258 Injection Pump "B" Rotor/Cam Low
P0259 Injection Pump "B" Rotor/Cam High
P0260 Injection Pump "B" Rotor/Cam Intermittent
P0261 Cylinder 1 Injector Circuit Low
P0262 Cylinder 1 Injector Circuit High
P0263 Cylinder 1 Contribution/Balance Fault
P0264 Cylinder 2 Injector Circuit Low
P0265 Cylinder 2 Injector Circuit High
P0266 Cylinder 2 Contribution/Balance Fault
P0267 Cylinder 3 Injector Circuit Low
P0268 Cylinder 3 Injector Circuit High
P0269 Cylinder 3 Contribution/Balance Fault
P0270 Cylinder 4 Injector Circuit Low
P0271 Cylinder 4 Injector Circuit High
P0272 Cylinder 4 Contribution/Balance Fault
P0273 Cylinder 5 Injector Circuit Low
P0274 Cylinder 5 Injector Circuit High
P0275 Cylinder 5 Contribution/Balance Fault
P0276 Cylinder 6 Injector Circuit Low
P0277 Cylinder 6 Injector Circuit High
P0278 Cylinder 6 Contribution/Balance Fault
P0279 Cylinder 7 Injector Circuit Low
P0280 Cylinder 7 Injector Circuit High
P0281 Cylinder 7 Contribution/Balance Fault
P0282 Cylinder 8 Injector Circuit Low
P0283 Cylinder 8 Injector Circuit High
P0284 Cylinder 8 Contribution/Balance Fault
P0285 Cylinder 9 Injector Circuit Low
P0286 Cylinder 9 Injector Circuit High
P0287 Cylinder 9 Contribution/Balance Fault
P0288 Cylinder 10 Injector Circuit Low
P0289 Cylinder 10 Injector Circuit High
P0290 Cylinder 10 Contribution/Balance Fault
P0291 Cylinder 11 Injector Circuit Low
P0292 Cylinder 11 Injector Circuit High
P0293 Cylinder 11 Contribution/Balance Fault
P0294 Cylinder 12 Injector Circuit Low
P0295 Cylinder 12 Injector Circuit High
P0296 Cylinder 12 Contribution/Balance Fault

P03XX Ignition System or Misfire

P0300 Random/Multiple Cylinder Misfire Detected
P0301 Cylinder 1 Misfire Detected
P0302 Cylinder 2 Misfire Detected
P0303 Cylinder 3 Misfire Detected
P0304 Cylinder 4 Misfire Detected
P0305 Cylinder 5 Misfire Detected
P0306 Cylinder 6 Misfire Detected
P0307 Cylinder 7 Misfire Detected
P0308 Cylinder 8 Misfire Detected
P0309 Cylinder 9 Misfire Detected
P0310 Cylinder 10 Misfire Detected
P0311 Cylinder 11 Misfire Detected
P0312 Cylinder 12 Misfire Detected

P0320 Ignition/Distributor Engine Speed Input Circuit Malfunction
P0321 Ignition/Distributor Engine Speed Input Circuit Range/Performance
P0322 Ignition/Distributor Engine Speed Input Circuit No Signal
P0323 Ignition/Distributor Engine Speed Input Circuit Intermittent
P0325 Knock Sensor 1 Circuit Malfunction (Bank 1 or Single Sensor *)
P0326 Knock Sensor 1 Circuit Range/Performance (Bank 1 or Single Sensor *)
P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor *)
P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor *)
P0329 Knock Sensor 1 Circuit Input Intermittent (Bank 1 or Single Sensor *)
P0330 Knock Sensor 2 Circuit Range/Performance (Bank 2 *)
P0332 Knock Sensor 2 Circuit Low Input (Bank 2 *)
P0333 Knock Sensor 2 Circuit High Input (Bank 2 *)
P0334 Knock Sensor 2 Circuit Input Intermittent (Bank 2 *)
P0335 Crankshaft Position Sensor "A" Circuit Malfunction
P0336 Crankshaft Position Sensor "A" Circuit Range/Performance
P0337 Crankshaft Position Sensor "A" Circuit Low Input
P0338 Crankshaft Position Sensor "A" Circuit High Input
P0339 Crankshaft Position Sensor "A" Circuit Intermittent
P0340 Camshaft Position Sensor Circuit Malfunction
P0341 Camshaft Position Sensor Circuit Range/Performance
P0342 Camshaft Position Sensor Circuit Low Input
P0343 Camshaft Position Sensor Circuit High Input
P0344 Camshaft Position Sensor Circuit Intermittent
P0350 Ignition Coil Primary/Secondary Circuit Malfunction
P0351 Ignition Coil "A" Primary/Secondary Circuit Malfunction
P0352 Ignition Coil "B" Primary/Secondary Circuit Malfunction
P0353 Ignition Coil "C" Primary/Secondary Circuit Malfunction
P0354 Ignition Coil "D" Primary/Secondary Circuit Malfunction
P0355 Ignition Coil "E" Primary/Secondary Circuit Malfunction
P0356 Ignition Coil "F" Primary/Secondary Circuit Malfunction
P0357 Ignition Coil "G" Primary/Secondary Circuit Malfunction
P0358 Ignition Coil "H" Primary/Secondary Circuit Malfunction
P0359 Ignition Coil "I" Primary/Secondary Circuit Malfunction
P0360 Ignition Coil "J" Primary/Secondary Circuit Malfunction
P0361 Ignition Coil "K" Primary/Secondary Circuit Malfunction
P0362 Ignition Coil "L" Primary/Secondary Circuit Malfunction

* Bank 1 contains cylinder 1

P0370 Timing Reference High Resolution Signal "A" Malfunction
P0371 Timing Reference High Resolution Signal "A" Too Many Pulses
P0372 Timing Reference High Resolution Signal "A" Too Few Pulses
P0373 Timing Reference High Resolution Signal "A" Intermittent/Erratic Pulses
P0374 Timing Reference High Resolution Signal "A" No Pulses
P0375 Timing Reference High Resolution Signal "B" Malfunction
P0376 Timing Reference High Resolution Signal "B" Too Many Pulses
P0377 Timing Reference High Resolution Signal "B" Too Few Pulses
P0378 Timing Reference High Resolution Signal "B" Intermittent/Erratic Pulses
P0379 Timing Reference High Resolution Signal "B" No Pulses
P0380 Glow Plug /Heater Circuit Malfunction
P0381 Glow Plug /Heater Indicator Circuit Malfunction
P0385 Crankshaft Position Sensor "B" Circuit Malfunction
P0386 Crankshaft Position Sensor "B" Circuit Range/Performance
P0387 Crankshaft Position Sensor "B" Circuit Low Input
P0388 Crankshaft Position Sensor "B" Circuit High Input
P0389 Crankshaft Position Sensor "B" Circuit Intermittent

P04XX Auxiliary Emission Controls

P0400	Exhaust Gas Recirculation Flow Malfunction
P0401	Exhaust Gas Recirculation Flow Insufficient Detected
P0402	Exhaust Gas Recirculation Flow Excessive Detected
P0403	Exhaust Gas Recirculation Circuit Malfunction
P0404	Exhaust Gas Recirculation Circuit Range/Performance
P0405	Exhaust Gas Recirculation Sensor "A" Circuit Low
P0406	Exhaust Gas Recirculation Sensor "A" Circuit High
P0407	Exhaust Gas Recirculation Sensor "B" Circuit Low
P0408	Exhaust Gas Recirculation Sensor "B" Circuit High
P0410	Secondary Air Injection System Malfunction
P0411	Secondary Air Injection System Incorrect Flow Detected
P0412	Secondary Air Injection System Switching Valve "A" Circuit Malfunction
P0413	Secondary Air Injection System Switching Valve "A" Circuit Open
P0414	Secondary Air Injection System Switching Valve "A" Circuit Shorted
P0415	Secondary Air Injection System Switching Valve "B" Circuit Malfunction
P0416	Secondary Air Injection System Switching Valve "B" Circuit Open
P0417	Secondary Air Injection System Switching Valve "B" Circuit Shorted
P0420	Catalyst System Efficiency Below Threshold (Bank 1*)
P0421	Warm Up Catalyst Efficiency Below Threshold (Bank 1*)
P0422	Main Catalyst Efficiency Below Threshold (Bank 1*)
P0423	Heated Catalyst Efficiency Below Threshold (Bank 1*)
P0424	Heated Catalyst Temperature Below Threshold (Bank 1*)
P0430	Catalyst System Efficiency Below Threshold (Bank 2)
P0431	Warm Up Catalyst Efficiency Below Threshold (Bank 2)
P0432	Main Catalyst Efficiency Below Threshold (Bank 2)
P0433	Heated Catalyst Efficiency Below Threshold (Bank 2)
P0434	Heated Catalyst Temperature Below Threshold (Bank 2)

* Bank 1 contains Cylinder #1

P0440	Evaporative Emission Control System Malfunction
P0441	Evaporative Emission Control System Incorrect Purge Flow
P0442	Evaporative Emission Control System Small Leak Detected
P0443	Evaporative Emission Control System Purge Control Valve Circuit Malfunction
P0444	Evaporative Emission Control System Purge Control Valve Circuit Open
P0445	Evaporative Emission Control System Purge Control Valve Circuit Shorted
P0446	Evaporative Emission Control System Vent Control Malfunction
P0447	Evaporative Emission Control System Vent Control Open
P0448	Evaporative Emission Control System Vent Control Shorted
P0450	Evaporative Emission Control System Pressure Sensor Malfunction
P0451	Evaporative Emission Control System Pressure Sensor Range/Performance
P0452	Evaporative Emission Control System Pressure Sensor Low Input
P0453	Evaporative Emission Control System Pressure Sensor High Input
P0454	Evaporative Emission Control System Pressure Sensor Intermittent
P0455	Evaporative Emission Control System Gross Leak Detected
P0460	Fuel Level Sensor Circuit Malfunction
P0461	Fuel Level Sensor Circuit Range/Performance
P0462	Fuel Level Sensor Circuit Low Input
P0463	Fuel Level Sensor Circuit High Input
P0464	Fuel Level Sensor Circuit Intermittent
P0465	Purge Flow Sensor Circuit Malfunction
P0466	Purge Flow Sensor Circuit Range/Performance
P0467	Purge Flow Sensor Circuit Low Input
P0468	Purge Flow Sensor Circuit High Input
P0469	Purge Flow Sensor Circuit Intermittent
P0470	Exhaust Pressure Sensor Malfunction
P0471	Exhaust Pressure Sensor Range/Performance
P0472	Exhaust Pressure Sensor Low

P0473 Exhaust Pressure Sensor High
P0474 Exhaust Pressure Sensor Intermittent
P0475 Exhaust Pressure Control Valve Malfunction
P0476 Exhaust Pressure Control Valve Range/Performance
P0477 Exhaust Pressure Control Valve Low
P0478 Exhaust Pressure Control Valve High
P0479 Exhaust Pressure Control Valve Intermittent

P05XX Vehicle Speed , Idle Control , and Auxiliary Inputs

P0500 Vehicle Speed Sensor Malfunction
P0501 Vehicle Speed Sensor Range/Performance
P0502 Vehicle Speed Sensor Circuit Low Input
P0503 Vehicle Speed Sensor Intermittent / Erratic / High
P0505 Idle Control System Malfunction
P0506 Idle Control System RPM Lower Than Expected
P0507 Idle Control System RPM Higher Than Expected
P0510 Closed Throttle Position Switch Malfunction
P0530 A/C Refrigerant Pressure Sensor Circuit Malfunction
P0531 A/C Refrigerant Pressure Sensor Circuit Range/Performance
P0532 A/C Refrigerant Pressure Sensor Circuit Low Input
P0533 A/C Refrigerant Pressure Sensor Circuit High Input
P0534 Air Conditioner Refrigerant Charge Loss
P0550 Power Steering Pressure Sensor Circuit Malfunction
P0551 Power Steering Pressure Sensor Circuit Range/Performance
P0552 Power Steering Pressure Sensor Circuit Low Input
P0553 Power Steering Pressure Sensor Circuit High Input
P0554 Power Steering Pressure Sensor Circuit Intermittent
P0560 System Voltage Malfunction
P0561 System Voltage Unstable
P0562 System Voltage Low
P0563 System Voltage High
P0565 Cruise Control On Signal Malfunction
P0566 Cruise Control Off Signal Malfunction
P0567 Cruise Control Resume Signal Malfunction
P0568 Cruise Control Set Signal Malfunction
P0569 Cruise Control Coast Signal Malfunction
P0570 Cruise Control Accel Signal Malfunction
P0571 Cruise Control / Brake Switch "A" Circuit Malfunction
P0572 Cruise Control / Brake Switch "A" Circuit Low
P0573 Cruise Control / Brake Switch "A" Circuit High
P0574 to
P0580 Reserved for Cruise Codes

P06XX Computer and Auxiliary Outputs

P0600 Serial Communication Link Malfunction
P0601 Internal Control Module Memory Checksum Error
P0602 Control Module Programming Error
P0603 Internal Control Module Keep Alive Memory (KAM) Error
P0604 Internal Control Module Random Access Memory (RAM) Error
P0605 Internal Control Module Read Only Memory (ROM) Error
(Module Identification Defined by ISO Cdxxx1 / SAE J1979)
P0606 Powertrain Control Module Processor Fault

P07XX Transmission

P0700 Transmission Control System Malfunction
P0701 Transmission Control System Range/Performance
P0702 Transmission Control System Electrical
P0703 Torque Converter/Brake Switch "B" Circuit Malfunction
P0704 Clutch Switch Input Circuit Malfunction
P0705 Transmission Range Sensor Circuit Malfunction (PRNDL Input)
P0706 Transmission Range Sensor Circuit Range/Performance
P0707 Transmission Range Sensor Circuit Low Input
P0708 Transmission Range Sensor Circuit High Input
P0709 Transmission Range Sensor Circuit Intermittent
P0710 Transmission Fluid Temperature Sensor Circuit Malfunction
P0711 Transmission Fluid Temperature Sensor Circuit Range/Performance
P0712 Transmission Fluid Temperature Sensor Circuit Low Input
P0713 Transmission Fluid Temperature Sensor Circuit High Input
P0714 Transmission Fluid Temperature Sensor Circuit Intermittent
P0715 Input/Turbine Speed Sensor Circuit Malfunction
P0716 Input/Turbine Speed Sensor Circuit Range/Performance
P0717 Input/Turbine Speed Sensor Circuit No Signal
P0718 Input/Turbine Speed Sensor Circuit Intermittent
P0719 Torque Converter/Brake Switch "B" Circuit Low
P0720 Output Speed Sensor Circuit Malfunction
P0721 Output Speed Sensor Circuit Range/Performance
P0722 Output Speed Sensor Circuit No Signal
P0723 Output Speed Sensor Circuit Intermittent
P0724 Torque Converter/Brake Switch "B" Circuit High
P0725 Engine Speed Input Circuit Malfunction
P0726 Engine Speed Input Circuit Range/Performance
P0727 Engine Speed Input Circuit No Signal
P0728 Engine Speed Input Circuit Intermittent
P0730 Incorrect Gear Ratio
P0731 Gear 1 Incorrect Ratio
P0732 Gear 2 Incorrect Ratio
P0733 Gear 3 Incorrect Ratio
P0734 Gear 4 Incorrect Ratio
P0735 Gear 5 Incorrect Ratio
P0736 Reverse Incorrect Ratio
P0740 Torque Converter Clutch Circuit Malfunction
P0741 Torque Converter Clutch Circuit Performance or Stuck Off
P0742 Torque Converter Clutch Circuit Stuck On
P0743 Torque Converter Clutch Circuit Electrical
P0744 Torque Converter Clutch Circuit Intermittent
P0745 Pressure Control Solenoid Malfunction
P0746 Pressure Control Solenoid Performance or Stuck Off
P0747 Pressure Control Solenoid Stuck On
P0748 Pressure Control Solenoid Electrical
P0749 Pressure Control Solenoid Intermittent
P0750 Shift Solenoid "A" Malfunction
P0751 Shift Solenoid "A" Performance or Stuck Off
P0752 Shift Solenoid "A" Stuck On
P0753 Shift Solenoid "A" Electrical
P0754 Shift Solenoid "A" Intermittent
P0755 Shift Solenoid "B" Malfunction
P0756 Shift Solenoid "B" Performance or Stuck Off
P0757 Shift Solenoid "B" Stuck On
P0758 Shift Solenoid "B" Electrical
P0758 Shift Solenoid "B" Intermittent
P0760 Shift Solenoid "C" Malfunction
P0761 Shift Solenoid "C" Performance or Stuck Off

P0762	Shift Solenoid "C" Stuck On
P0763	Shift Solenoid "C" Electrical
P0764	Shift Solenoid "C" Intermittent
P0765	Shift Solenoid "D" Malfunction
P0766	Shift Solenoid "D" Performance or Stuck Off
P0767	Shift Solenoid "D" Stuck On
P0768	Shift Solenoid "D" Electrical
P0769	Shift Solenoid "D" Intermittent
P0770	Shift Solenoid "E" Malfunction
P0771	Shift Solenoid "E" Performance or Stuck Off
P0772	Shift Solenoid "E" Stuck On
P0773	Shift Solenoid "E" Electrical
P0774	Shift Solenoid "E" Intermittent
P0780	Shift Malfunction
P0781	1-2 Shift Malfunction
P0782	2-3 Shift Malfunction
P0783	3-4 Shift Malfunction
P0784	4-5 Shift Malfunction
P0785	Shift/Timing Solenoid Malfunction
P0786	Shift/Timing Solenoid Range/Performance
P0787	Shift/Timing Solenoid Low
P0788	Shift/Timing Solenoid High
P0789	Shift/Timing Solenoid Intermittent
P0790	Normal/Performance Switch Circuit Malfunction

Appendix 5

ADDENDUM
to the Information Document No .....
in accordance with Annex II of Council Directive 70/156/EEC(*)
relating to type approval and referring to emission control
by on-board diagnostic systems for motor vehicles

3. POWER PLANT ([9])

3.2.12.2.8. On-Board Diagnostic (OBD) System

3.2.12.2.8.1. Written description and/or drawing of the MI: .....

3.2.12.2.8.2. List and purpose of all components monitored by the OBD system:
.....

3.2.12.2.8.3. Written description (general working principles) for: .....

3.2.12.2.8.3.1. Positive-ignition engines[1]: .....

3.2.12.2.8.3.1.1. Catalyst monitoring[1]: .....

3.2.12.2.8.3.1.2. Misfire detection[1]: .....

3.2.12.2.8.3.1.3. Oxygen sensor monitoring[1]: .....

3.2.12.2.8.3.1.4. Other components monitored by the OBD system[1]: .....

3.2.12.2.8.3.2. Compression-ignition engines[1]: .....

3.2.12.2.8.3.2.1. Catalyst monitoring[1]: .....

3.2.12.2.8.3.2.2. Particulate trap monitoring[1]: .....

3.2.12.2.8.3.2.3. Electronic fuelling system monitoring[1]: .....

3.2.12.2.8.3.2.4. Other components monitored by the OBD system[1]: .....

3.2.12.2.8.4. Criteria for MI activation (fixed number of driving cycles or statistical method):.....

3.2.12.2.8.5. List of all OBD output codes and formats used (with explanation of each):
.....

3.2.12.2.8.6. Type of (off-board) interrogation tool: .....

(*) The item numbers and footnotes used in this Information Document correspond to those set out in Annex I to Directive 70/156/EEC. Items not relevant for the purpose of this Directive are omitted.

Appendix 6

ESSENTIAL CHARACTERISTICS OF THE VEHICLE FAMILY

1. Parameters defining the OBD family

The OBD family may be defined by basic design parameters which must be common to vehicles within the family. In some cases there may be interaction of parameters. These effects must also be taken into consideration to ensure that only vehicles with similar exhaust emission characteristics are included within an OBD family.

2. To this end, those vehicle types whose parameters described below are identical are considered to belong to the same engine-emission control-OBD system combination.

Engine:

- combustion process (i.e. positive-ignition, compression-ignition, two stroke, four stroke);
- method of engine fuelling (i.e. carburettor or fuel injection).

Emission control system:

- type of catalytic converter (i.e. oxidation, three-way, heated catalyst, other)
- type of particulate trap
- secondary air injection (i.e. with or without)
- exhaust gas recirculation (i.e. with or without)

OBD parts and functioning:

- the methods of OBD functional monitoring, malfunction detection and malfunction indication to the vehicle driver.

Appendix 7

ADDENDUM
to the EC type-approval certificate No ...
concerning the type-approval of an on-board diagnostic system (OBD)
Directive 70/220/EEC, as last amended by Directive ....

1.1. Written description and/or drawing of the MI: .....

1.2. List and purpose of all components monitored by the OBD system: .....

1.3. Written description (general working principles) for: .....

1.3.1. Misfire detection[1]: .....

1.3.2. Catalyst monitoring[1]: .....

1.3.3. Oxygen sensor monitoring[1]: .....

1.3.4. Other components monitored by the OBD system[1]: .....

1.3.5. Catalyst monitoring[2]: .....

1.3.6. Particulate trap monitoring[2]: .....

1.3.7. Electronic fuelling system actuator monitoring[2]: .....

1.3.8. Other components monitored by the OBD system[2]: .....

1.4. Criteria for MI activation (fixed number of driving cycles or statistical method):
.....

1.5. List of all OBD output codes and formats used (with explanation of each):.....

1.6. Specification of (off-board) interrogation tool: .....

2.4. Comments(ifany):.....

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(1) In the case of positive-ignition engines.
(2) In the case of compression-ignition engines.

FINANCIAL STATEMENT

B5-3000 Internal Market

1. TITLE OF OPERATION

Proposal for a European Parliament and the Council Directive relating to measures to be taken against air pollution by emissions from motor vehicles and amending Directives 70/220/EEC and 70/156/EEC.

2. BUDGET HEADING INVOLVED

B5-3000 Internal Market

3. LEGAL BASIS

Article 100a of the EU Treaty

4. DESCRIPTION OF OPERATION

4.1 General Objectives

Measures to be taken against air pollution by emissions from motor vehicles

4.2 Period covered and arrangements for renewal or extension

The proposed Directive requires:

From 1 January 2000, Member States may no longer grant EC type-approval for a new type of vehicle on grounds relating to air pollution by emissions if it fails to comply with the provisions of "stage 2000".

With effect from 1 January 2001, Member States shall refuse the registration, sale or entry into service of new vehicles which do not comply with the provisions of the Directive.

As regards the limit values applicable from 1 January 2005, the Commission shall submit, before 31 December 1999, a report to the Council and Parliament concernint the industrial feasibility of the application of such limits, taking account of the technological progress achieved as well as environmental needs and the availability of improved fuels.

In the light of this report, the Commission shall submit a proposal for confirming or revising, if necessary, these limit values.

5. CLASSIFICATION OF EXPENDITURE OR REVENUE

There are no receipts following this action.

6. TYPE OF EXPENDITURE

Technical work directly linked to the assessment of envisaged future vehicle technology (A)

Technical work linked to the development of new proposals, in particular those dealing with breakthrough technologies (de NOx catalyser, CNG engineered vehicles, other alternatives: fuelled/propelled vehicles), monitoring of air quality, development of Community assessment criteria for non-technical measures (B)

Technical work linked to the preparation of Commission Directives through the Committee procedure (notably improvement of OBD requirements), design of prerequisit conditions for type approving of replacement parts ensuring a control of pollution emission equivalent to the original part while not triggering the OBD (C)

Organization of a "Review Conference in 1999" (D)

7. FINANCIAL IMPACT

7.1 Method of calculating total cost of operation (relation between individual and total costs)

The expected cost would globally amount to approximately ECU 600 000 dispatched in 1997/1999, for the following actions, in the form of contract, with the following breakdown:

(A) 0.2
(B) 0.1
(C) 0.1
(D) 0.2

7.2 Itemized breakdown of costs (in ECU million)

	Budget 96	PDB 97	PDB 98	PDB 99	Total
A		0.1		0.1	0.2
B			0.1		0.1
C		0.1			0.1
D				0.2	0.2
Total		0.2	0.1	0.3	0.6

7.3 Operational expenditure of studies, experts, included in Part B of the Budget (in ECU million)

Breakdown	Budget 96	PDB 97-99	Var. in %
- Studies - Meetings of experts - Conferences and congresses - Information and publications	0	0.4 0.2	New
Total		0.6	

8. FRAUD PREVENTION MEASURES

- It will be explicitly specified in contracts that all work performed is the property of the Commission.

- Final payment of contractors will only take place after reception and examination of the reports and services requested.

9. ELEMENTS OF COST-EFFECTIVENESS ANALYSIS

9.1 Specific and quantified objectives; target population

On the basis of the data available on the costs and potential benefits of the various technical measures (engine technology, fuel quality and improved inspection and maintenance of emissions control systems), it has been possible to identify the most cost/effective packages of technical measures necessary to achieve a significant reduction of urban NOx, particulate matters in the most polluted areas and ozone precursors at European level. The present proposal corresponds to the most cost/effective strategy found in the Auto/Oil programme.

9.2 Grounds for the operation

The European Union has a longstanding history in reducing vehicle emissions. However, despite the considerable achievements with regard to the emission reduction of individual vehicles, increased traffic activity (increased number of vehicles, increased kilometers travelled) is likely to counteract these improvements thereby preventing the emission reductions necessary to achieve future air quality objectives.

The likelihood of further action to reduce vehicle emissions necessitated a reassessment of the existing policy approach; it being apparent that the emission reduction potential offered by further improvements in vehicle technology was limited and possibly very costly in comparison with other potential solutions.

Therefore a new, comprehensive and integrated approach was developed which is set out in Directive 94/12/EC, Article 4. Article 4 stipulates that technical and non-technicla measures to be assessed with regard to their cost-effectiveness shall include improved vehicle technology, the use of alternative fuels (e.g. LPG, CNG, biofuels), more appropriate mechanisms to reduce the in-use deterioration of emission control systems (based on an inspection and maintenance programme) and "improvements in fuel quality as far as vehicle emissions of dangerous substances (in particular benzene) are concerned".

The proposal forms part of a global Community strategy which will include strengthened requirements for passenger cars, light commercial vehicles and heavy duty vehicles from year 2000, new minimum standards for motor fuels and enhanced in-use vehicle emission requirements. This combination of measures represents, in view of the Commission, an optimal package of legislative actions which will ensure that the Air Quality targets identified in the course of the implementation of the Auto/Oil programme will be met by year 2010. In addition, the present proposal includes a revision of the framework for emission-related fiscal incentives and emissions values corresponding to the foreseen Stage 2005 car emission standards.

9.3 Monitoring and evaluation of the operation

The Commission, in cooperation with the Member States, will monitor the development of air quality on an urban and regional level in order to verify the air quality predictions which have guided the currently proposed legislative measures.

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