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Czech Notification 2006 0548 CZ

Government Decree on emission limits and other conditions for the operation of fixed combustion sources of atmospheric pollution

Position Paper – December 2006

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EUROMOT
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Euromot is the **European Association of Internal Combustion Engine Manufacturers**.

We represent the leading manufacturers of internal combustion engines used in a broad range of nonroad and marine applications (construction, mining and material handling equipment, trucks and buses, agricultural and forestry equipment, commercial marine and seagoing vessels, workboats and pleasure boats, rail traction, lawn/garden and recreational equipment, power generation).

Euromot has been working for many years with international regulatory bodies, eg European Union, the UN Economic Commission for Europe (UNECE), the UN International Maritime Organizations (IMO) and the Central Commission for the Navigation on the Rhine (CCNR). In addition, we are seeking an open and fair dialogue with national governments to provide reliable know-how on advanced internal combustion engine technologies in general and, in particular, on the feasibility of environmental as well as cost-effective product regulations. To achieve a pro-active engagement of all stakeholders in international harmonisation of regulations affecting engines and equipment, we coordinate our activities worldwide with trade associations of the non-road and marine industry sector.

For further information about our Association please refer to our Annual Report 2003 or pay us a virtual visit at **http://www.euromot.org** – your bookmark for engine power worldwide.

1. Introduction

The Czech Republic published on 9 October 2006 a draft proposal for the regulation of the air emissions from fixed combustion sources.

The emission limits proposed in the Czech notification 2006 0548 CZ for boiler and gas turbine plants seem to be largely based on the LCP Directive 2001/80/EC. For stationary piston combustion engines the proposed emission limits are largely based on the former German TA-LUFT 1986 legislation and the UNECE Gothenburgh ("Protocol to the 1979 Convention on Long-Range Transboundary Air pollution to Abate Acidification, Eutrophication and ground Level Ozone") Protocol.

In this document we want to draw your attention to the concerns of the piston (reciprocating) engine manufacturers especially on the technical and economic consequences of the stipulated emission limits of the notification. We have made a counterproposal based on the cost-effective environmental quality need driven approach. Legislation in many countries are based on this principle e.g. in Japan, Finland, UK and it is also used internationally e.g. in the World Bank Guidelines ("Thermal Power - Guidelines for New Plants" 1998).

2. Main concerns

2.1 General recommendation

It should be clearly stated that the limits in annexes 1 and 2 are only for boiler and gas turbine plants. In annex 3 it has to be clarified that the emission limits are only for boiler plants. Furthermore we see the necessity to clarify that the limits in annex 4 ("Emission limits for large and medium combustion sources by type of fuel burnt and type of combustion chamber") are for boiler plants. The limits in annex 5 are for combustion of alternative fuel. It seems that these limits are for boiler plants **(possibly for incinerator plants).** We therefore recommend that annex 5 should content a description of the application that can use alternative fuel with the emission limits.

Furthermore we recommend to include a clear differentiation of the different application (boilers, gas turbines, large combustion sources, particularly large combustuion sources). In our opinion it is not clear if the emission limit values for fixed piston combustion engines are only in annex 4.2 ("Emission limits for fixed piston combustion engines").

A clear differentiation would make the whole notification much more comprehensible and user-friendly.

2.2 Concerns relating to annex 4.2 – Fixed piston combustion engines

In annex 4 section 2 "Emission limits for fixed piston combustion engines" emission limits are given for piston engines. Emission limits in table "A" are for engines for which the construction and reconstruction has started before 17 May 2006. This table seems to be mainly the same as TA-LUFT 1986, however there are some big differences:

1. The "organic substances except methane" are given at 5 vol-% O_2.
- In TA-LUFT 1986 the Non Methane Hydrocarbon (NMHC) is given at "actual conditions" not at 5 vol.% O_2. In Euromot document /1/ has been explained the O_2-% for different prime movers and shown that 5 vol-% O_2 is far away from actual conditions for a bigger stationary reciprocating engine.

2. The sulphur content of the diesel fuel is regulated to maximum 0.05 wt-%.
- In TA-LUFT 1986 the sulphur content limit of the liquid fuel was set to 0.2 wt-% NOT 0.05 wt-%.

3. The SO_2 emissions for Spark Ignition gas engines are not specified clearly. The notification contains that the emission limit refers to a "special legislation" but it is not clear what the exact content of this legislation should be.

Table "B" that contains emission limit values for sources those construction or reconstruction started after 17 May 2006. However for engines > 1 MWth the NO_x-limit from table "A" shall be applied up to to 31.12. 2007. These engines have been further tightened with figures similar to the recommendations in the UNECE Gothenburgh Protocol with some differences.

The table "B" gives very low values for the NO_x emission limits for Spark Ignition Engines above 1MW fired with biogas and landfill gas. This is not logical: the limits for natural gas fuel case are higher and for 0.2 – 1 MW engine category the NO_x limit for biogas and landfill gas is higher than for natural gas as would be expected. Please note that in TA Luft 1986 bigger gas engines had similar NO_x limits (compression ignition = 2000 mg/Nm^3 (5% O_2)) and other engine types 500-800 mg/Nm^3 (5% O_2) for all gas fuel types. E.g. relating to engines ≥ 1 MW in the notification TA-Luft shows higher NO_x limits (500 mg/Nm^3) for all Spark Ignition engines that are fired with biogas etc. The 250 mg/Nm^3 NO_x limit shown here is not realistic with biogas and landfill gas due to the variation in the fuel which makes the operation of a gas engine at these NO_x levels very difficult, uneconomical and so almost impossible. It will certainly also cause a tremendous increase of CO and HC emissions.

For the NMHC, SO_2 and the sulphur content the same comments as above apply.

The proposal for the emission regulation is not based on a cost-effective environmental quality need driven approach as it is the case in many countries around the world, such as in Japan /2/ and Finland /3/. In UK the diesel piston engine plant > 50 MWth has to apply BAT (Best Available Technique) (according to the EU IPPC Directive 96/61/EC) and in smaller plants BATNEEC (Best Available Technique Not Entailing Excessive Costs) has to be applied. In the annex A of this document the limits for a small/medium size engine plant in UK /4/, Finland and Japan are given.

2.2.1 Liquid fired engines

The proposed limits for piston engines in the Czech proposal are very strict. E.g. a boiler plant (50 – 100 MWth) can burn a max 0.5 wt-% S heavy fuel oil according to annex 1 part C and anyway fulfil the SO_2-limit of 850 mg/Nm^3 (3 % O_2). A gas turbine have the SO_2-limit of 1700 mg/Nm^3 (15 % O_2) according to table in A2 of annex 1 in the proposal, this means that the gas turbine can burn a maximum 2.9 wt-% S (!?) oil without need of any FGD (Flue Gas Desulphurisation) plant. The NO_x-limits for these sizes of boiler and gas turbine plants can also be fulfilled by primary methods (low NO_x burners). A small liquid fired piston engine (> 1 MWth) plant has on the other hand always to use an ultra low sulphur diesel oil or alternatively apply a FGD-plant (for SO_2) and a SCR (Selective Catalytic Reduction) (for NO_x). In our opinion this is neither a fair nor a cost-effective approach. To be noted is that the EU "Fuel" Directive 1999/32/EC prescribes for combustion plants not affected by the LCPD (LCP regulates big boiler and gas turbine plants but not engine plants (Article 2 item 7j) to use a maximum 1.00 wt-% S heavy fuel oil (from 1. January 2003) and in case of light fuel oil maximum 0.2 wt-% S (from July 2000). From January 1, 2008 the sulphur content of the light fuel oil is lowered to maximum 0.10 wt-%. To be noted also is that bigger boilers in Germany (sizes 5 …50 MWth) are allowed to operate on low sulphur heavy fuel oil (max. 0.5 wt-% S) without usage of a FGD.

In /7/ on page 360 has also been listed some aspects to be noted concerning SCR use in a diesel engine plant. Especially in plants with a frequent load variation, including frequent start-ups and shut-downs SCR can not be considered to represent BAT, in these installations the operation conditions are varying and as a consequence the catalyst temperature might fluctuate outside the necessary temperature window. On European Union level there exist no EU Directive regulating NO_x-emissions from bigger

stationary piston engine plants, to be also noted is the “alternative approach” flexible mechanism in the UNECE Gothenburgh Protocol.

The only regulations on EU level regulating bigger stationary reciprocating engines area is the IPPC Directive asking for BAT in big > 50 MWth combustion plants and the above mentioned “fuel directive”. In Euromot documents /11/ and /12/ the industrial point of view is given the Gothenburgh Protocol, e.g. Germany and Finland has used the “alternative approach” alternative, e.g. see Finnish limits in Annex A.

The Finnish limits for a < 50 MWth engine plant can be reached by using a max. 1 wt-% S heavy fuel oil (as per 1999/32/EC Directive) and by applying primary NO_x-reduction methods in general (“other”) areas and SCR in cities, this is an approach taking both the environmental and cost aspects into considerations. In Japan limits are leaner in rural areas and stricter in cities (see annex A). Note in Japan big diesel engine units with a ≥ 400 mm bore has a higher NO_x-limit than smaller units.

In the Euromot paper /5/ the emissions of today and the expected in the near future (starting from 2008) (based on engine development) are listed. In Euromot document /6/ has been shown the NO_x abatement costs for the liquid fired stationary piston (reciprocating) engine and concluded that the BAT NO_x-limits are:

1600 mg/Nm^3 (15 % O_2) in “other” areas (such as rural, etc.)
750 mg/ Nm^3 (15 % O_2) in city areas and special areas

In order to maintain the fuel efficiency (in line with the “Kyoto Protocol spirit”) **we anyway propose** the NO_x-limit for ≥ 400 mm bore liquid fired diesel engines (and liquid fired all size dual fuel engines and gas diesel units) to 1850 mg/Nm^3 (15 % O_2) in “other” areas . This limit is equal to the Japanese limit for big engines ≥ 400 mm bore (see annex A).

Please see our comment relating to NMHC below.

2.2.2 Gas engines (that are fired with all gases)

Only spark ignition and compression ignition engines on gas are listed in the proposal. The low pressure gas dual fuel engine type is missing. In CIMAC document /10/ on page 3 in chapter 2.1 a short description of the different engine types are given. See also pages 413 .. 414 in /7/.

In the proposal “table B” new bio/landfill gas fired engines have a very low NO_x-limit. These gas types contain often volatile organic silica compounds forming siloxanes, etc. which will have an indirect impact on the combustion parameters by deposits in the combustion chambers and thereby on the emissions. Therefore there is a need to raise the NO_x-limit because due to possible fouling and operational problems. The NO_x-limit should be raised to the same level as for the natural gas fired spark ignited engines 500 mg/Nm^3 (5 % O_2) what is equal to 190 mg/Nm^3 (15 % O_2).

Our recommendations for NO_x are:
Gas fired engines:
Lean burn spark ignited engines: 190 mg/Nm^3 (15% O_2)
Lean burn dual fuel engines (gas mode): 400 mg/Nm^3 (15 % O_2)
High pressure gas diesel engines (gas mode):
1600 mg/Nm^3 (15 % O_2) in “other” areas (such as rural, etc.)
750 mg/Nm^3 (15 % O_2) in special areas (such as cities)

The stipulated NMHC (“fuel related emission”) limit in tables A and B of 150 mg/Nm^3 (5% O_2) is very strict and will for many natural gases lead to non-compliance, especially with natural gases containing slightly higher hydrocarbon (ethane, propane, etc.) fractions. Ethane is very difficult to reduce from the flue gas and suppliers of oxidation catalysts do not generally guarantee ethane reductions. According to /13/ field tests showed with a normal sized Pt-based catalyst, the ethane and propane reduction rates to be only about 3 % respectively 15 %. It has also been seen in some

field tests that the reduction efficiency of an oxidation catalyst for the NMHC abatement will decrease with time. Besides platinum, palladium is sometimes used in oxidation catalysts. Palladium is said to be an efficient catalyst in general, but the flue gas temperature of a fuel-efficient lean burn engine is too low for an efficient abatement of ethane and propane by usage of Pd-based oxidation catalysts /13/. As stated above NMHC is mainly a fuel related emission (dependent on the fuel and gas compostion) and an oxidation catalyst should in many cases not be sufficient enough or it could be deactivated due to the fuel composition. In some national legislation such as in Finland /3/ this emission component is therefore not regulated and in some other legislation NMHC is regulated with a higher value such as in UK /4/.

We therefore recommend not to regulate NMHC or if it is to be regulated to change the proposal to the British value of 200 mg/Nm^3 (15% O_2) calculated as C. This is in order not to exclude most normal natural gas qualities from use in high-efficient gas engines. Please note there is an efficiency correction in the British norm that is in other words a bonus.

2.3 Other concerns

In light of the Kyoto Protocol, high fuel efficiencies should be promoted in order to decrease specific CO_2 emissions. The contribution of the high efficiency engine power plants to reduce CO_2 ("the most important green house gas") is however not honoured by the proposed limits. Therefore it should be logical to introduce efficiency bonuses for all emissions. An efficiency bonus in general should include high efficient single cycles, combined heat and power plants, plants operating on sustainable fuels (bio-fuels), etc. In Euromot paper /5/ on page 8 for proposals (e.g. for a single cycle > 5 MWth engine a linear scaling upwards from 40 %). E.g. in UK /4/ efficiency bonuses are granted for efficient engine ("piston") plants.

3. Conclusions and main recommendations

In order to get a balance between environmental and cost aspects an environmental quality need driven approach is proposed. Different prime movers should also be treated fairly, e.g. a big liquid fired piston engine plant (50 … 100 MWth) should also be able to operate on e.g. same fuel oil qualities as the gas turbine and boiler plants without need of a FGD (Flue Gas Desulphurization) plant. For smaller diesel engine plants the sulphur content should be according to the EU Directive 1999/32/EC (approach followed in France and Finland). By avoiding use of FGD also the IPPC principle is followed, no by-product disposal problems, huge water resources are saved, etc. An environmental quality need driven approach means that emission limits should be reachable by primary methods e.g. by correct fuel choice and latest engine design in most cases and in only special areas a secondary technology should be applied.

Therefore we propose for > 5 MWth engine unit plants following:

- **NO_x:**
  Liquid fired:
  - < 400 mm bore engine: 1600 mg/Nm^3 (15% O_2) in "other" areas
  - ≥ 400 mm bore engine (and all size liquid fired dual and gas diesel engines): 1850 mg/Nm^3 (15% O_2) in "other" areas

  - For both bore-categories:
    750 mg/Nm^3 (15% O_2) in special areas (such as cities)

Gas fired:
Lean burn spark ignited engines: 190 mg/Nm^3 (15% O_2)
Lean burn dual fuel engines: 400 mg/Nm^3 (15% O_2)
High pressure gas diesel engines:
-1600 mg/Nm^3 (15% O_2) in "other" areas
-In special areas 750 mg/Nm^3 (15% O_2).

- **SO_2:**
  580 mg/Nm^3 (15% O_2) (equal usage of a max. 1 % S heavy fuel oil)
  (In /7/ also BAT recommendations for SO_2, particulate has been given for > 50 MWth engine plants on page 405 and 406).

- **Particulate (this is a fuel related emission):**
  - 60 mg/Nm^3 (15% O_2) in special areas (such as cities)
  - 75 mg/Nm^3 (15% O_2) in "other areas"

- We accept the CO limit value as given in the proposal, but it has to be corrected to and expressed at 15 vol-% O_2.

- We propose to take NMHC out of the notification. Please see chapter 2.2.2 for more information.

- See comment about emission bonuses above.
  (The annex 1 C of the proposal new gas turbines commissioned after 27 November 2003 has efficiency bonuses).

- Emissions should be measured at 85 .. 100 % MCR steady state load conditions. Surrogate measurements with regular intermittent measurements are preferred, see /8, 9/.

- Emission obligation exemptions of engines for peak shaving up to 500 hour/year and emergency use of dual fuel/gas diesel engines in liquid mode in gas delivery interruptions should be allowed.

In BREF /7/ is explained why the emission concentration limits for bigger diesel (see page 404) and gas engines should be given at 15 vol-% O_2. In Euromot document /1/ has been explained the O_2-% for different prime movers and shown that 5 vol-% O_2 is far away from actual conditions for a bigger stationary reciprocating engine and that 15 vol-% O_2 is the logical reference point. E.g. in Finland, UK the reference point -% used is 15 vol-% O_2. This is also the international approach e.g. in India and World Bank ("Thermal power – Guidelines for New Plants") 1998 for bigger stationary reciprocating engines. We have therefore given our counterproposals at 15 vol.-% O_2 reference point.

4. Sources and References

/1/: "O_2 Reference Point in Exhaust Emission Legislation, The Euromot Position" October 2002, see internet at:
http://www.euromot.org/download/news/positions/stationary_engines/O2_Refpoint_oct02.pdf

/2/: "Nationwide general limits"

/3/: "Paras käytettävissä oleva tekniikka (BAT) 5 – 50 MW:n laitoksissa Suomessa 2004" (Guideline values for BAT in Finland for small sttaionary engine/gas turbine

plants 3 ..50 MWth, page 102 (in English) tables 29 and 30. See http://www.ymparisto.fi/download.asp?contentid=3708

/4/: "The Environmental Protection Act 1990, part 1 (1995 Revision), (PG1/5(95):Secretary of State´s Guidance-Compression Ignition Engines, 20-50 MW Net rated Thermal Input"

/5/: "´Stationary Engine Emission Legislation – Diesel and Gas", the Euromot Position November 2004. Internet: http://www.euromot.org/download/news/positions/stationary_engines/Future_stationary_engine_emission_legislation_Nov04.pdf

/6/ http://www.euromot.org/download/news/positions/stationary_engines/EIPPCB_BREF_backup_document_mar03.pdf

/7/ "Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques for Large Combustion Plants, 2006. European IPPC Bureau. See internet http://eippcb.jrc.es/pages/Fmembers.htm please enter the public area and choose document 19.

/8/: http://www.euromot.org/download/news/positions/stationary_engines/EIPPCB_BREF_backup_document_CEMS_jun03.pdf

/9/: "CIMAC Recommendation – Standards and Methods for Sampling and Analysing Emission Components in Non-Automotive Diesel and Gas Engine Exhaust Gases – Marine and Land Based Power Plant sources", CIMAC Working Group on exhaust Emissions February 2005. Document can be ordered from http://www.cimac.com/services/index1-techpaperdatabase.htm

/10/: Position of the CIMAC WG5 Exhaust Emissions Controls on "Prime Mover Technique Specific emission Limits Need Stationary Reciprocating Engine Plant". See internet: http://www.cimac.com/workinggroups/Index1-working-groups-exhaustemission.htm (see link under "Subgroup of WG 5 ..").

/11/: "Protocol to the 1979 Convention on Long-range Transboundary air Pollution And Ground Level Ozone – Alternative Reduction Strategy need in order to Reach BAT, The Euromot Position" as of may 2005, see internet: http://www.euromot.org/download/news/positions/stationary_engines/UNECE_CLRTAP_may05.pdf

/12/: "Protocol to the 1979 Convention on Long-range Transboundary air pollution to abate acidification, Eutrophication and ground Level Ozone, the euromot Position in Brief" as of april 2003, see internet: http://www.euromot.org/download/news/positions/stationary_engines/UNECE_CLRTAP_ABC_Analysis_080403.pdf

/13/: ICES2006-1362 "Field Experience and Laboratory Analysis of Oxidation Catalyst on Dual Fuel engines", Proceedings of ICES06: ASME Internal Engine Combustion Division 2006 Spring Technical Conference May 7 – 10 2006, Aachen Germany

Annex A
Japan /2/:

Japan ("nation wide general limits")

Federal Stack Emission Limits for Diesel Engines in Japan,
Stricter limits may be stipulated locally, e.g. in Tokyo max. allowed NOx-value is 114 ppm-v (dry, 13 vol-% O2)

	NO_x	SO_x	Particles
Diesel Engines (> 50 l/h fuel oil)	950 ppm-v * 1200 ppm-v **		100 mg/Nm^3(all areas) 80 mg/Nm^3 (special areas)

The limits are given at 13 % O_2 (dry gas) for diesel engines, (Nm^3 defined at 273 K, 101.3 kPa).
* Cylinder diameter < 400 mm
** Cylinder diameter ≥ 400 mm
The allowed SO_X level is regulated locally by a total quantity approach (max. SO_2 quantity per time unit (Nm^3/h)).

Finland /3/:

Finland ("BAT 5 – 50 MWth Plant Guideline")

Emission unit in tables are: mg/Nm3 (dry, 15 % O2), Nm3 at 0 degree C and 101.3 kPa, NOx-emission value within brackets for "special area" such as cities

Oil diesel engine

Component	Existing sources	New sources
Particles	70	60
Nitrogen oxides	2300	1600 (750)
Sulfur dioxide	600	600

Gas diesel engine

Component	Existing sources	New sources
Nitrogen oxides	1750	1600 (750)

Gas fired Spark ignited/Dual fuel engines

Component	Existing sources	New sources
Nitrogen oxides	185	175

"BAT 5 – 50 MWth Plants Guideline ("Paras käytettävissä oleva tekniikka (BAT)"), issued August 2003

UK /4/:

United Kingdom

The Environmental Protection Act 1990, Part 1 (1995 Revision) Engine of 20 to 50 MWth)

	NO_x (after 01.04.98)	**SO_2***	**Particles**	**CO**	**Non-Methane Hydrocarbons** (as C)
Distallate oil	1300 mg/Nm^3		100 mg/Nm^3 **	150 mg/Nm^3	150 mg/Nm^3
Heavy fuel oil	1400 mg/Nm^3		100 mg/Nm^3 **	150 mg/Nm^3	150 mg/Nm^3
Gas (dual fuel)	500 mg/Nm^3		50 mg/Nm^3 (for new plants)	450 mg/Nm^3	200 mg/Nm^3

The limits are given at 15 % O_2 (dry gas), NO_x as NO_2 (Nm^3 defined at 273 K, 101.3 kPa).
* The sulphur content of heavy fuel oil (residual oil) should not exceed 2 wt-%, with distillate oil the sulphur content should not exceed 0.2 wt-%.
** Consideration should be given for new prosess at the time of application to whether 50 mg/Nm^3 is achievable.
Corrected emission limit (mg/Nm^3) = emission limit (mg/Nm^3) *ISO Net Base Efficiency/40. ISO Net Base Efficiency is calculated according to ISO 3046 Part 1.