

Directive 97/68/EC on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion (Compression Ignition and spark ignition) engines to be installed in non-road mobile machinery, inland waterway vessels and railway applications.

European Commission DG Enterprise

# NON ROAD MOBILE MACHINERY



# Definition of Non-Road Mobile Machinery

*Non-Road Mobile Machinery* shall mean any mobile machine, transportable industrial equipment or vehicle with or without body work, not intended for the use of passenger- or goods-transport on the road, in which an internal combustion engine as specified in Annex I section 1 is installed.

The group "Non Road Mobile Machinery" (NRMM) is today covered by an exhaust emission directive called 97/68/EC. There are 2 amending Directives following the 97/68/EC, 1<sup>st</sup> for the spark ignition engines, 2002/88/EC and the 2<sup>nd</sup> for the compression engines, 2004/26/EC.

The 97/68 directive covers all landbased diesel fuelled engines placed in Non Road Mobile Machinery (NRMM). The directive has 2 stages. Stage I went into force 31 of December 1998 and stage II between 31 of December 2000 and 31 of December 2003 depending of the size of the engine.

# Limit values for stage I

<u>Power</u>	<u>CO</u>	<u>HC</u>	<u>NO<sub>x</sub></u>	<u>PM</u>
130 – 560	5,0	1,3	9,2	0,54
75 – 130	5,0	1,3	9,2	0,70
37 – 75	6,5	1,3	9,2	0,85

(All limitvalues are in g/kWh)

# Limit values for stage II

<u>Power</u>	<u>CO</u>	<u>HC</u>	<u>NO<sub>x</sub></u>	<u>PM</u>
130 – 560	3,5	1,0	6,0	0,2
75 – 130	5,0	1,0	6,0	0,3
37 – 75	5,0	1,3	7,0	0,4
18 – 37	5,5	1,5	8,0	0,8

(All limitvalues are in g/kWh)

2002/88/EC covers spark ignition engines up to 18 kW and is implemented in 2 stages. The different stages entered into force in February 2005 depending on the application and size of the engine. The directive regulates the emissions of carbon monoxide, CO, hydrocarbons and nitrogen oxides and covers all spark ignition engines except for recreational crafts, vehicles and toys.



- The spark ignition (SI) engines is divided in handheld or not handheld Classes.

- Handheld Classes:

<u>Class/category</u>	<u>Displacement <math>\text{cm}^3</math></u>
Class SH:1	$< 20$
Class SH:2	$\geq 20 < 50$
Class SH:3	$\geq 50$

- Non Handheld classes:

<u>Class/category</u>	<u>Displacement cm<sup>3</sup></u>
Class SN:1	< 66
Class SN:2	$\geq 66$ < 100
Class SN:3	> 100 < 225
Class SN:4	< 225

# Limitvalues for SI engines, stage I

- | <u>Class</u> | <u>CO</u> | <u>HC</u> | <u>NO<sub>x</sub></u> | <u>HC+NO<sub>x</sub></u> |
|--------------|-----------|-----------|-----------------------|--------------------------|
| SH:1         | 805       | 295       | 5,36                  |                          |
| SH:2         | 805       | 241       | 5,36                  |                          |
| SH:3         | 603       | 161       | 5,36                  |                          |
| SN:1         | 519       |           |                       | 50                       |
| SN:2         | 519       |           |                       | 40                       |
| SN:3         | 519       |           |                       | 16,1                     |
| SN:4         | 519       |           |                       | 13,4                     |

(Limitvalues are i g/kWh)

- The amendments 2004/26/EC tightened the emission limit values for gaseous pollutants and particulate matter and extended the scope of the Directive to also cover
  - Engines for inland waterways vessels and railway, Locomotives and railcars was added to the scope. European Commission policy is to encourage a shift of transport away from roads and towards other more environmentally friendly modes including inland shipping. Thus, these modes must address their own environmental impact, and the present directive is a part of that.
  - The upper power limit of 560 kW for propulsion engines on the above (main engines, auxiliary engines for propulsion and bow propellers etc.) has been removed.

- The 2004/26/EC includes further Stage III and IV limit values which will be implemented in three steps, III A, III B and IV between 2006 and 2014 depending on size and application of the engine.
- For "normal" landbased NRMM the engines have to comply with stage IIIA, IIIB and stage IV. Railcars and locomotives have to comply with stage IIIA and III B. Engines for inland waterway vessels have to comply with stage IIIA.

## Stage IIIA

- covering only gaseous pollutants
- about 30% NO<sub>x</sub> emission reduction comparing to stage II.
- Will enter into force between 31 Dec 2005 and 31 Dec 2007 depending on size of the engine and application
- Limits are equivalent to the corresponding legislation in USA
- Covering propulsion engines for railcars/locomotives and Inland waterway vessels (main engines, bow propellers etc.)

# Limitvalues

- Stage III A

- Engines for use in other applications than propulsion of inland waterway vessels, locomotives and railcars:

- Category:

Net power (kW)	CO	HC+NO <sub>x</sub>	PM
H: $130 \text{ kW} \leq P \leq 560$	3,5	4,0	0,2
I: $75 \text{ kW} \leq P < 130$	5,0	4,0	0,3
J: $37 \text{ kW} \leq P < 75$	5,0	4,7	0,4
K: $19 \text{ kW} \leq P < 37$	5,5	7,5	0,6

(Limit values in g/kWh)

# Engines for propulsion of inland waterway vessels

## Stage III A

- Category:

Swept volume/

net power(SV/P )

CO

HC+NO<sub>x</sub>

PM

V1:1 SV < 0,9; P ≥ 37 kW

5.0

7.5

0.40

V1:2 0,9 ≤ SV < 1,2

5.0

7.2

0.30

V1:3 1,2 ≤ SV < 2,5

5.0

7.2

0.20

V1:4 2,5 ≤ SV < 5

5.0

7.2

0.20

V2:1 5 ≤ SV < 15

5.0

7.8

0.27

V2:2 15 ≤ SV < 20;

P < 3300 k

5.0

8.7

0.50

V2:3 15 ≤ SV < 20;

P ≥ 3300 kW

5.0

9.8

0.50

V2:4 20 ≤ SV < 25

5,0

9.8

0.50

V2:5 25 ≤ SV < 30

5,0

11.0

0.50

(Volume in Litres per cylinder. Limit values in g/kWh)



# Engines for propulsion of locomotives

## Stage III A

Category:

Net power(P kW)	CO	HC+NO <sub>x</sub>	PM	
RL A: $130 \text{ kW} \leq P \leq 560 \text{ kW}$	3,5	4,0	0,2	
		HC	NO <sub>x</sub>	
RHA: $P > 560 \text{ kW}$	3,5	0,5	6,0	0,2
RH A Engines with $P > 2000 \text{ kW}$ and $SV > 5 \text{ l/cylinder}$	3,5	0,4	7,4	0,2

(Limit values in g/kWh)

# Engines for propulsion of railcars

## Stage III A

Category:

net power (P kW)	CO	HC+NO <sub>x</sub>	PM
RC A: 130 kW < P	3,5	4,0	0,20

## Stage IIIB

- covering particulate emissions
- 90 % reduction of particulate matter emission from engine comparing to stage II
- Will enter into force between 31 Dec 2010 and 31 Dec 2011
- to meet the limits, engines with current technology will need after treatment devices, which require low sulphur fuel
- Covering propulsion engines in railcars and locomotives.
- Propulsion engines for Inland waterway vessels are for the moment excluded from stage III B

# Stage III B

Engines for use in other applications than propulsion of inland waterway vessels, locomotives and railcars:

Category:

Net power (kW)	CO	HC	NO <sub>x</sub>	PM
L: $130 \text{ kW} \leq P \leq 560$	3,5	0,19	2,0	0,025:
M: $75 \text{ kW} \leq P < 130$	5,0	4,0	3,3	0,025
J: $56 \text{ kW} \leq P < 75$	5,0	4,7	3,3	0,025
P: $37 \text{ kW} \leq P < 56$	5,0	HC+NOX	4,7	0,025

(Limit values in g/kWh)

# Stage III B

## Engines for propulsion of locomotives

Category:

Net power P kW	CO	HC+NO <sub>x</sub>	PM
R B: 130 kW < P	3,5	4,0	0,025

(All limit values in g/kWh)

# Stage III B

## Engines for propulsion of railcars

Category:

net power (P kW)	CO	HC	NO <sub>x</sub>	PM
RC B: 130 kW < P	3,5	0.19	2,0	0,025

(All limit values in g/kWh)

## Stage IV

- Covering nitrous gaseous emissions
- 80 % reduction of nitrous gaseous emission from engine comparing to stage III B
- Will enter into force between 31 Dec 2013 and 31 Sept 2014
- Total harmonization with the US TIER IV will be achieved
- Propulsion engines for Inland waterway vessels and railcars/locomotives are excluded from stage IV

# Stage IV

Engines for use in other applications than propulsion of locomotives, railcars and inland waterway vessels

Category: Net power(P kW)	CO	HC	NO <sub>x</sub>	PM
Q: $130 \text{ kW} \leq P \leq 560 \text{ kW}$	3,5	0,19	0,4	0,025
R: $56 \text{ kW} \leq P < 130 \text{ kW}$	5,0	0,19	0,4	0,025

(Limit values are in g/kWh)



# Placing on the market of Engine, production dates

## Stage III A other than constant speed engines

Category H:	31 December 2005
Category I:	31 December 2006
Category J:	31 December 2007
Category K:	31 December 2006

## Stage III A Inland waterway vessel engines

Category V1:1:	31 December 2006
Category V1:2:	31 December 2006
Category V1:3:	31 December 2006
Category V1:4:	31 December 2008
Categories V2:	31 December 2008.

# Placing on the market of Engine, production dates

## Stage III A constant speed engines

Category H:	31 December 2010
Category I:	31 December 2010
Category J:	31 December 2011
Category K:	31 December 2010

## Stage III A railcar engines

Category RC A:	31 December 2005
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## Stage III A locomotive engines

Category RL A:31	December 2006
Category RH A:31	December 2008

# Placing on the market of Engine, production dates

## Stage III B other than constant speed engines

Category L:	31 December 2010
Category M:	31 December 2011
Category N:	31 December 2011
Category P:	31 December 2012

## Stage III B railcar engines

Category RC B:	31 December 2011
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## Stage III B locomotive engines

Category R B:	31 December 2011
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## Stage IV other than constant speed engines

Category Q:	31 December 2013
Category R:	30 September 2014

# Test Procedures

- Engines are tested after special test cycles depending on the intended application for the engine.
- Engines for landbased engines, such as frontloaders, excavators, bulldozers etc. are being tested according to a steady state cycle (stage III A) and a transient test cycle (Stage III B and IV).
  - Steady state means different steps of speed, modes, in series of 4, 6 or 8. Transient cycle means a continuous acceleration or deceleration of speed after a certain pattern. Transient cycle is more corresponding to real life use.
- Engines for rail applications and inland waterway vessels are being tested to steady state cycles.
- Spark ignition engines are tested after a steady state cycle with 5 different modes.

# Type approval of engines

- Manufacturers make the testing of the engine or engines under supervision of a notified technical service.
- A Notified Body (authority) in a memberstate authorize the type approval for the engine or the engines.
- Each engine are supplied with an approval document when it is placed on the market.
- Changes acn not be made once the engine is approved and placed on the market. Only the manufacturer can make changes and have to apply for a extended type approval.
- The costs for a complete certification is between 5000 and 25000 Euro, depending on witness testing at the manufacturers or testing at the technical services own laboratories.

# Global alignment

- The Directive is globally aligned - it was closely discussed with authorities and industry in Europe, USA (in particular with EPA) and also Japan.
- US-EPA has presented a corresponding legislation, the TIER IV, in April last year and they plan to have the legislation on phase with EU.
- Stage III A corresponds to the US Tier III
- Stage III B corresponds to US-EPA first phase of Tier IV
- Stage IV corresponds to US-EPA second phase of TIER IV

# Alignment with the CCNR

(Central Commission for Navigating on the Rhine)

- The proposal is aligned with the CCNR regulations as an equivalence between each others approvals.
- A vessel with an approval according to the stage III A is equal to the CCNR approval stage I and II.
- Approval according to the CCNR stage I is equal to the stage III A until the 30 June 2007.
- From 1 July 2007 engines placed on the market to be used in a vessel must be approved according to the CCNR Stage II to be equal to the stage III A.
- CCNR has announced that they are planning a further stage and hand over that to the Commission for the review 2007

# Technical review

A technical review of the directive is planned in 2007 and the outcome of the CAFÉ-program (Clean Air For Europe) together with the cost effectiveness of emission reduction systems, global alignment and the progress of the R&D by the manufacturers will be studied for the possibility for further stage of emission reductions. Also in-use-compliance, cycle beating and other areas of interest for future reduction of gaseous and particulates emissions will be investigated.



# Monitoring

- The directive is published in all languages and in force in all memberstates since the end of 1999.
- The amendments are being transposed into the legislations of all memberstates.
- The regulations of the directive can be found on the Commission Eurolex website or in the memberstates legislation.

*A better and sustainable environment,  
for us and for the following generations.*

