

EU: NONROAD: EMISSIONS

History

Stage I/II

The first European legislation to regulate emissions from nonroad (off-road) mobile equipment was promulgated on 16 December 1997 (Directive 97/68/EC).

The regulations for nonroad diesels were introduced in two stages: Stage I was implemented in 1999, and Stage II was implemented from 2001 to 2004, dependent upon the engine power output.

On 9 December 2002, the European Parliament adopted Directive 2002/88/EC, amending the nonroad Directive 97/68/EC by adding emission standards for small, gasoline fueled utility engines below 19 kW. The Directive also extended the applicability of Stage II standards on constant speed engines. The utility engine emission standards are to a large degree aligned with the US emission standards for small utility engines.

Stage III/IV

Stage III/IV emission standards for nonroad engines were adopted by the European Parliament in April 2004 (Directive 2004/26/EC), and for agricultural and forestry tractors on February 2005 (Directive 2005/13/EC).

Stage III standards, which are further divided into Stages IIIA and IIIB, are phased-in between 2006 and 2013, while Stage IV enters into force in 2014. In addition to the engine categories regulated at Stage I/II, Stage III A standards also cover engines used in inland waterway vessels. Stage III A and III B standards have been adopted for certain classes of locomotive engines as well.

Two additional Directives were adopted in 2010: Directive 2010/26/EU provides further technical details on the testing and approvals of Stage IIIB and Stage IV engines, and Directive 2010/22/EU amends the earlier legislation applicable to agricultural and forestry tractors.

Harmonizing Global Standards

Regulatory authorities in the EU, USA, and Japan have been under pressure from engine and equipment manufacturers to harmonize worldwide emission standards, in order to streamline engine development and emission type approval/certification for different markets. Stage I/II limits were in part harmonized with US regulations. Stage III/IV limits are harmonized with the US Tier 3/4 standards.

Technical Standards

a. Stage I/II Standards

EU nonroad emission standards usually specify two sets of implementation dates:

- *Type approval* dates, after which all newly type approved models must meet the standard, and
- *Market placement* (or first registration) dates, after which all new engines placed on the market must meet the standard.

The dates listed in the following tables are the market placement dates. In most cases, new type approval dates are one year before the respective market placement dates. Stage I and Stage II emissions shall not exceed the amount shown below. The Stage I emissions are engine-out limits and shall be achieved before any exhaust aftertreatment device.

EU Stage I/II Emission Standards for Nonroad Diesel Engines						
Category	Net Power	Date*	CO	HC	NO_x	PM
	<i>kW</i>		<i>g/kWh</i>			
Stage I						
A	$130 \leq P \leq 560$	January 1999	5.0	1.3	9.2	0.54
B	$75 \leq P < 130$	January 1999	5.0	1.3	9.2	0.70
C	$37 \leq P < 75$	April 1999	6.5	1.3	9.2	0.85
Stage II						
E	$130 \leq P \leq 560$	January 2002	3.5	1.0	6.0	0.2
F	$75 \leq P < 130$	January 2003	5.0	1.0	6.0	0.3
G	$37 \leq P < 75$	January 2004	5.0	1.3	7.0	0.4
D	$18 \leq P < 37$	January 2001	5.5	1.5	8.0	0.8
Notes:						
* Stage II also applies to constant speed engines effective January 2007						

A sell-off period of up to two years is allowed for engines produced prior to the respective market placement date. Since the sell-off period—between zero and two years—is determined by each Member State, the exact timeframe of the regulations may be different in different countries.

Applicability

The equipment covered by the standard included industrial drilling rigs, compressors, construction wheel loaders, bulldozers, nonroad trucks, highway excavators, forklift trucks, road maintenance equipment, snow plows, ground support equipment in airports, aerial lifts and mobile cranes. Agricultural and forestry tractors had the same emission standards but different implementation dates, as specified in Directive 2000/25/EC. Engines used in ships, railway locomotives, aircraft, and generating sets were not covered by the Stage I/II standards.

b. Stage III/IV Standards

Stage III standards—which are further divided into two sub-stages: Stage III A and Stage III B—and Stage IV standards for nonroad diesel engines and are listed in the tables below. These limit values apply to all nonroad diesel engines of indicated power range for use in applications other than propulsion of locomotives, railcars and inland waterway vessels.

The implementation dates in the following tables refer to the *market placement* dates. For all engine categories, a sell-off period of two years is allowed for engines produced prior to the respective market placement date. The dates for *new type approvals* are, with some exceptions, one year ahead of the respective market placement date.

Stage III A Standards for Nonroad Engines						
Category	Net Power	Date†	CO	NO _x +HC	PM	
	<i>kW</i>		<i>g/kWh</i>			
H	130 ≤ P ≤ 560	2006.01	3.5	4.0	0.2	
I	75 ≤ P < 130	2007.01	5.0	4.0	0.3	
J	37 ≤ P < 75	2008.01	5.0	4.7	0.4	
K	19 ≤ P < 37	2007.01	5.5	7.5	0.6	
Notes: † dates for constant speed engines are: 2011.01 for categories H, I and K; 2012.01 for category J.						
Stage III B Standards for Nonroad Engines						
Category	Net Power	Date	CO	HC	NO _x	PM
	<i>kW</i>		<i>g/kWh</i>			
L	130 ≤ P ≤ 560	2011.01	3.5	0.19	2.0	0.025
M	75 ≤ P < 130	2012.01	5.0	0.19	3.3	0.025
N	56 ≤ P < 75	2012.01	5.0	0.19	3.3	0.025
P	37 ≤ P < 56	2013.01	5.0	4.7†		0.025
Notes: † NO _x +HC						

Stage IV Standards for Nonroad Engines						
Category	Net Power	Date	CO	HC	NO _x	PM
	<i>kW</i>		<i>g/kWh</i>			
Q	130 ≤ P ≤ 560	2014.01	3.5	0.19	0.4	0.025
R	56 ≤ P < 130	2014.10	5.0	0.19	0.4	0.025

Stage III/IV standards also include a limit for ammonia emissions, which must not exceed a mean of 25 ppm over the test cycle.

Stage III B standards introduce PM limit of 0.025 g/kWh, representing about 90% emission reduction relative to Stage II. To meet this limit value, it is anticipated that engines will have to be equipped with particulate filters. Stage IV also introduces a very stringent NO_x limit of 0.4 g/kWh, which is expected to require NO_x aftertreatment.

Applicability

Stage III/IV legislation applies only to new vehicles and equipment; replacement engines to be used in machinery already in use (except for railcar, locomotive and inland waterway vessel propulsion engines) should comply with the limit values that the engine to be replaced had to meet when originally placed on the market.

Other Provisions

- *Reagents* - In aftertreatment systems using reagents—such as urea in SCR systems for NO_x control—monitoring is required of low reagent levels, reagent quality and dosing Directive 2010/26/EU.
- *Fuels* - Reference fuel used for type approvals and to verify conformity of production at the Stage III A level should contain no more than 300 ppm sulfur. Some of the aftertreatment technologies to be used for PM and NO_x control to meet Stage IIIB and Stage IV limit values will require the use of ultra low sulfur fuel. Thus, the Stage III B and Stage IV reference fuel should contain no more than 10 ppm sulfur.
- *Durability* - The engine useful life (emission durability period, EDP) is defined at Stage III/IV as 3000/5000 hours for engines at or below 37 kW (constant/non-constant speed, respectively) and 8000 hours for engines above 37 kW.

c. Testing

Stage I/II engine emissions are measured on the ISO 8178 C1 8-mode cycle and expressed in g/kWh. Stage I/II engines are tested using fuel of 0.1-0.2% (wt.) sulfur content.

To represent emissions during real conditions, a new transient test procedure - the Non-Road Transient Cycle (NRTC) - was developed in cooperation with the US EPA. The NRTC is run twice - with a cold and a hot start. The final emission results are weighted averages of 10% for the cold start and 90% for the hot start run. The new test will be used in parallel with the prior steady-state schedule, ISO 8178 C1, referred to as the Non-Road Steady Cycle (NRSC).

- The NRSC (steady-state) shall be used for stages I, II and III A, as well as for constant speed engines at all stages. The NRTC (transient) can be used for Stage III A testing by the choice of the manufacturer.
- Both NRSC and NRTC cycles shall be used for Stage III B and IV testing (gaseous and particulate pollutants).

Source: http://transportpolicy.net/index.php?title=EU:_Nonroad:_Emissions