

INDIA BHARAT STAGE IV AND V NON-ROAD EMISSION STANDARDS

ICCT POLICY UPDATES

SUMMARIZE
REGULATORY
AND OTHER
DEVELOPMENTS
RELATED TO CLEAN
TRANSPORTATION
WORLDWIDE.

On March 5, 2018, India's Ministry of Road Transport and Highways released the final rule for non-road Bharat Stage (CEV/Trem) IV and V emission standards,¹ including stringent emission limits on particulate matter (PM), particulate number (PN) (BS V only), nitrogen oxide (NO_x), hydrocarbon (HC), and carbon monoxide (CO). This is the first time India has adopted one set of consistent standards regulating both agricultural and construction equipment. The BS (CEV/Trem) IV and V standards are in general alignment with the European Stage IV and V standards for diesel engines used in non-road mobile machinery. India has now become the first region outside of the European Union to adopt Stage V-equivalent emission standards, moving ahead of countries such as the United States, Japan and China in its control of emissions from new diesel powered non-road equipment.

The regulation applies to diesel engine equipment, including agricultural tractors, construction equipment vehicles, and combine harvesters. The BS (CEV/Trem) IV standards set requirements for diesel engines between 37 and 560 kW, starting October 1, 2020. The BS (CEV/Trem) V standards, starting from April 1, 2024, cover a wider range of engines, including those smaller than 8 kW and those larger than 560 kW, and introduce PN limits for those engines with rated power between 19 and 560 kW. The required emission limits (Table 1), durability periods deterioration factors, and test cycles are consistent with those in the European Stage IV and V standards. The stringent PM and PN limits are set at a level which will ensure diesel particulate filters, the key technology needed to effectively control particulate matter emissions from diesel engines, adopted as expected in the European Stage V standards. Engines equipped with selective catalytic reduction also must meet ammonia emission limits of 25 ppm for those less than 56 kW, and 10 ppm for those above 56 kW.

¹ Ministry of Road Transport and Highways, "Notification no. G.S.R. (201) (E) dated 05.03.2018 regarding Emission standards for CEV and Agricultural tractors," May 3, 2018. Retrieved from <http://morth.nic.in/showfile.asp?lid=3180>

Table 1. Emission limits for BS (CEV/Trem) IV and V

| Category (kW) | Applicable with effect from | CO | HC | NO _x | PM | PN | Test cycle |
|-----------------------------------|-----------------------------|-------|-----------------------------|-----------------|-------|--------------------|---------------|
| | | g/kWh | | | | #/kWh | |
| Bharat Stage (CEV/Trem) IV | | | | | | | |
| 37 ≤ P < 56 | October 1, 2020 | 5.0 | 4.7 (HC + NO _x) | | 0.025 | - | NRSC and NRTC |
| 56 ≤ P < 130 | | 5.0 | 0.19 | 0.4 | 0.025 | - | |
| 130 ≤ P < 560 | | 3.5 | 0.19 | 0.4 | 0.025 | - | |
| Bharat Stage (CEV/Trem) V | | | | | | | |
| P < 8 | April 1, 2024 | 8.0 | 7.5 (HC + NO _x) | | 0.4 | - | NRSC |
| 8 ≤ P < 19 | | 6.6 | 7.5 (HC + NO _x) | | 0.4 | - | |
| 19 ≤ P < 37 | | 5.0 | 4.7 (HC + NO _x) | | 0.015 | 1*10 ¹² | NRSC and NRTC |
| 37 ≤ P < 56 | | 5.0 | 4.7 (HC + NO _x) | | 0.015 | 1*10 ¹² | |
| 56 ≤ P < 130 | | 5.0 | 0.19 | 0.4 | 0.015 | 1*10 ¹² | |
| 130 ≤ P < 560 | | 3.5 | 0.19 | 0.4 | 0.015 | 1*10 ¹² | |
| P ≥ 560 | | 3.5 | 0.19 | 3.5 | 0.015 | - | NRSC |

Several elements of the BS (CEV/Trem) IV and V regulations have not been fully defined even though they are fully specified in the equivalent European regulations. These include, but are not limited to, in-service conformity testing using portable emission measurement systems (PEMS), off-cycle emission testing, conformity of production procedures and technical requirements for NO_x and PM control measures. These elements are expected to be addressed in the forthcoming Automotive Industry Standard (AIS) no. 137. Due to the significance of these elements, it is important that AIS 137 faithfully adopt the corresponding elements from the Euro regulations, and a draft of AIS 137 should be released for public comments as soon as possible.

In-use conformity requirements, a highlight of the European Stage V non-road standards, will adopt PEMS to monitor PM and ozone precursors (HC and NO_x) over normal operating duty cycles, along with the test procedure consistent with the heavy-duty vehicle Euro VI emission standards to increase compliance and enforcement.² This provision, along with the off-cycle test requirements, will be particularly important for India to faithfully implement. Real-world and off-cycle test requirements are critical to ensure the effectiveness of the regulation, as demonstrated by the relative success of the Euro VI regulation in controlling emissions from on-road heavy-duty vehicles in Europe.

The current standards leave equipment with engines smaller than 37 kW without stringent requirements until April 2024, and substantially delay introduction of emission standards for engines used in the majority of India’s agricultural tractors and

2 Commission delegated regulation (EU) 2017/655 of 19 December 2016 supplementing Regulation (EU) 2016/1628 of the European Parliament and of the Council with regard to monitoring of gaseous pollutant emissions from in-service internal combustion engines installed in non-road mobile machinery, Official Journal of the European Union. L102/334-363. Retrieved from <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017R0655>

similarly sized non-road equipment.³ Amendments to the standards that set stringent limits equivalent with the U.S. Tier 4 final standards for engines smaller than 37 kW are needed to address this delay.

Under the announced timeline and standards, India will achieve significant reductions of NO_x and PM from agricultural tractors and construction equipment, as shown in the table below. As shown in our previous study on emission controls scenarios in India, stringent emission regulations are urgently needed to prevent a significant increase in air pollution from non-road diesel equipment in the coming decades.⁴

Table 2. NO_x and PM savings by equipment type

| Unit: kilotons | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|--|------|------------|------------|--------------|--------------|--------------|
| NO_x emission Baseline | 444 | 690 | 1,115 | 1,856 | 3,173 | 5,580 |
| NO_x emission with policy | 444 | 470 | 548 | 752 | 1,131 | 1,760 |
| NO_x savings | - | 220 | 567 | 1,104 | 2,042 | 3,819 |
| Agricultural tractor | - | 72 | 170 | 300 | 446 | 643 |
| Backhoe loader | - | 18 | 47 | 83 | 143 | 246 |
| Compactor | - | 3 | 8 | 16 | 31 | 59 |
| Crane | - | 4 | 11 | 20 | 35 | 62 |
| Excavator | - | 96 | 262 | 538 | 1,083 | 2,179 |
| Wheeled loader | - | 19 | 55 | 122 | 263 | 567 |
| Other construction equipment | - | 6 | 14 | 24 | 40 | 64 |
| PM emission Baseline | 46 | 69 | 108 | 174 | 285 | 481 |
| PM emission with policy | 46 | 37 | 24 | 13 | 12 | 16 |
| PM savings | - | 32 | 84 | 161 | 273 | 465 |
| Agricultural tractor | - | 19 | 47 | 87 | 132 | 190 |
| Backhoe loader | - | 4 | 11 | 20 | 34 | 58 |
| Compactor | - | 0 | 1 | 1 | 2 | 4 |
| Crane | - | 0 | 1 | 2 | 4 | 7 |
| Excavator | - | 7 | 19 | 40 | 81 | 163 |
| Wheeled loader | - | 1 | 4 | 8 | 18 | 38 |
| Other construction equipment | - | 0 | 1 | 2 | 3 | 4 |

3 Tim Dallman, *A sneak preview of future stages of Indian emission standards for non-road engines reveals a tractor-sized loophole*. (ICCT: Washington DC, 2017). Retrieved from <https://www.theicct.org/blogs/staff/future-stages-of-Indian-emission-standards-for-non-road-engines-reveals-tractor-sized-loophole>

4 Tim Dallmann, Zhenying Shao, *Evaluation of emission-control scenarios for agricultural tractors and construction equipment in India* (ICCT: Washington, DC, 2016). Retrieved from <https://www.theicct.org/publications/evaluation-emission-control-scenarios-agricultural-tractors-and-construction-equipment>