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Review of Bharat Stage 6 Emission Norms

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Abstract - *The rapid growth of automotive industry in India is facing environmental issues. To improve the current status of exhaust emissions from automobiles Government of India decided to implement Bharat Stage VI (BS-VI) norms from April 2020, by skipping of BS-V, Indian original equipment manufacturers (OEMs) are now facing a big challenge of confirming these norms. Sustainable mobility is the only solution which includes improvements in existing engine technology, fuel and use of after-treatment devices, this paper briefly explains key features of BS-VI .*

1. Bharat stage Emission Standards (BSES)

Bharat stage Emission Standards (BSES) are emission standards instituted by the Government of India to regulate the output of air pollutants from internal combustion engines including motor vehicles. The standards, based on European regulations were first introduced in 2000. All new vehicles manufactured after the implementation of the norms have to be compliant with the regulations. Since October 2010, Bharat Stage (BS) III norms have been enforced across the country. In 13 major cities, Bharat Stage IV emission norms have been in place since April 2010 and it has been enforced for entire country since April 2017. In 2016, the Indian government announced that the country would skip the BS-V norms altogether and adopt BS-VI norms by 2020. In its recent judgment, the Supreme Court has banned the sale and registration of motor vehicles conforming to the emission standard Bharat Stage-IV in the entire country from April 1, 2020.

Standard	Reference	YEAR	Region
India 2000	Euro 1	2000	Nationwide
Bharat Stage II	Euro 2	2001	NCR, Mumbai, Kolkata, Chennai
		April 2003	NCR, 13 Cities
		April 2005	Nationwide
Bharat Stage III	Euro 3	April 2005	NCR, 13 Cities
		April 2010	Nationwide
Bharat Stage IV	Euro 4	April 2010	NCR, 13 Cities
		April 2017	Nationwide
Bharat Stage V	Euro 5	(to be skipped)	
Bharat Stage VI	Euro 6	April 2018	Delhi
		April 2019	NCR
		April 2020	Nationwide

Table No1.1 Emission Norms Implementation

NRC: National Capital Region (Delhi)

13 Cities: Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad, Pune, Surat, Kanpur, Lucknow, Sholapur, Jamshedpur and Agra

2. What are the major types of pollutants?

Internal combustion engines are primarily notorious for the production of carbon dioxide (CO2), carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NOx). Particulate matter (PM), or carbon soot, is another by-product of diesel as well as direct-injection petrol engines.

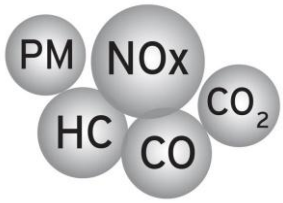

Figure No 2.1 Types of Pollutant

3. Emission Target

Under the upcoming emission regime, NOx levels will go down by 25 percent for petrol and a drastic 68 percent for diesel engines. The latter will also be met with the requirement of a severe 82 percent reduction in PM levels. And for the first time, petrol engines (with direct injection) will attract regulation for their particulate-matter production.

Table No3.1 Emission Targets

Engine type	Exhaust Gases	BS IV limit	BS VI Limit	Percentage Decrease
Petrol	CO(Mg/Km)	1000	1000	Nil
	HC(Mg/Km)	100	100	Nil
	NOx(Mg/Km)	80	60	25%
	PM	---	4.5	
Diesel	CO(Mg/Km)	500	500	Nil
	HC(Mg/Km)	300	170	43%
	NOx(Mg/Km)	250	80	68%
	PM	25	4.5	82%

4. Impact on performance and fuel efficiency?

Moving to more stringent emission norms posts challenges for automakers in more ways than one. Lowering exhaust emissions generally results in a penalty on performance and fuel efficiency. So not only do car manufacturers have to minimize pollution, they also have to proactively work towards retaining the vehicles' drivability. Cleaner engines generally employ a slower combustion process. Additionally, exhaust after treatment systems increase back pressure on the engine and some of these systems, like particulate filters and NOx traps, have to periodically undergo regeneration (a process which involves the exhaust material build-up in the filter being combusted by using fuel). It is also understood that the process to reduce sulphur content in diesel can negatively impact the energy content of the fuel. These factors collectively tend to take a toll on the vehicle's performance and efficiency. Automakers are adopting varied approaches to tackle these challenges

4. What will be the impact on the cost?

Industry experts believe the high cost of upgrading diesel vehicles to meet BS6 norms will certainly make them more expensive but will not push them beyond the reach of customers. Petrol-car prices are expected to go up in the range of Rs10,000-20,000, while diesel cars could get dearer by Rs 80,000-1,00,000.

5. BS4 and BS6 grade fuels

Sl. No.	Parameters	Unit	BS -VI Spec (Manufacturing)
1	Density @ 15 ^{0} C	Kg/m3	821.5-845
2	Distillation- T -95	^{0}C max	360
3	Sulphur, Total	mg/kg max	8
4	Cetane Number	Min.	51.4
5	Cetane Index	Min.	46
6	Flash Point	^{0}C min	42
7	Kinematic Viscosity at 40 ^{0} C	Cst	2.15-4.5
8	PAH	% wt-max	11
9	Total Contaminants	mg/kg-max	24
10	Oxidation Stability	g/m3-max	21/18
11	RCR on 10% Residue	% wt-max	0.3
12	CCR on 10% Residue	% wt-max	-
13	Water Content	mg/kg-max	200
14	Lubricity corrected WSD	microns-max	420
15	Ash	%wt-max	0.01

Table No 5.1 BS VI Diesel

1	Density @ 15 ^{0} C	Kg/m3	720-773.7
2	Distillation		
	E-70	% Vol	11-45
	E-100	% Vol	40-70
	E-150	% Vol	75
	FBP	^{0}C max	200
	Residue	% Vol. Max	2
3	Sulphur, Total	mg/kg max	8
4	RON	Min.	91.4 (Note-1)
5	MON	Min.	81.4
6	RVP @ 38 deg C	Kpa	60
7	VLI (10RVP+7E70)		
	Summer (May to Jul)	Max	750
	Others	Max	950
8	Benzene	% Vol-max	1
9	Aromatics	% Vol-max	35
10	Olefin	% Vol-max	21
11	Existent Gum	g/m3-max	
12	Gum(Solvent washed)	mg/100 ml max	5
13	Oxidation Stability	Minutes-Min	360
14	Lead as Pb	g/l-max	0.005
15	Oxygen	%wt-max	2.7

Table No 5.2 BS VI Petrol

6. Can BS6 cars run on BS4 fuel?

Considering that the upcoming emission norms bear greater ramifications for diesels, these engines generally employ exhaust after treatment techniques like diesel particulate filters (DPF) in conjunction with either LNT or SCR systems. Higher sulphur content in BS4 grade fuel has the potential to poison catalysts in these systems and have an adverse impact on their operation. Thus, running a BS6 diesel engine on the appropriate fuel is all the more critical. However, there are exceptions. Luxury carmaker Mercedes claims to be employing superior catalysts in its emission control devices that permits its BS6 diesel vehicles to run on a diet of BS4 fuel.

For petrol engines, on the other hand, it's a different case. Generally only utilising better engine component designs for achieving lower emissions, industry experts suggest that sulphur poisoning is not a major concern and as such, BS6 petrol vehicles can be operated safely even with BS4 fuel.

It is worth mentioning at this stage that while using the correct fuel is crucial, so is using the right type of lubricants. To that effect, it is recommended that only low SAPS (Sulphated Ash, Phosphorous and Sulphur) engine oils be used for all types of BS6 vehicles.

7. Can BS4 cars run on BS6 fuel?

Operating BS4 vehicles on the cleaner fuel shouldn't pose any serious challenges as the only major difference between BS4 and BS6 grade fuels is the significant reduction in sulphur content, as mentioned earlier. Moreover, using BS6

fuel can be expected to yield a slight reduction in emission levels even on the older engines.

8. Is BS6 emission norms same as Euro 6?

While the emission targets under both protocols are the same, exclusive adaptations are required for Indian driving cycles because the average speed is much lower. Moreover, India has different fuels and oils and the performance, and reliability and robustness requirements are also different. In short, a Euro 6-compliant car need not be BS6-compliant without some technical intervention.

9. CONCLUSIONS

BS-VI will definitely going to bring drastic change in automotive market in India.

- We will get more fuel efficient and very low emission producing vehicles in near future. Downsizing and down speeding will yield smaller and powerful engines. Diesel vehicles will get more expensive as they required more after treatment to stay clean. This will attract OEMs towards alternative fuels and hybrid technologies.

- To achieve emission limits specified in BS-VI ample amount of engine electronics will required. This will enhance business of domestic and MNC automotive electronic suppliers. Vendors and engineering solution providing companies for Eco testing, fuel system testing and emission testing are also going to benefit a lot.

- Through all these efforts people can ensure significant reduction in air pollution from automobiles. This will bring remarkable improvement in air quality in highly populated cities as automobiles are main source of air pollution in cities.

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