

Ultimate Guide to Motorcycle Emissions Legislation for 2021

European Union

Euro 5 Stage 1 and 2

Euro 5 is a set of regulated emissions standards that manufacturers are required to meet to sell their products in the EU and the European Free Trade Area (EFTA). Increasingly Euro 5 is being used by other manufacturers globally (India, China, Japan) to design and build their models to the highest standard and level of emissions regulations.

Regulation (EU) No 168/2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles

Euro 5 step								
Vehicle category	Vehicle category name	Propulsion class	Mass of (mg/km)					Test cycle
			CO	THC	NHMC	NOx	PM ^{2.5}	
			L ₁	L _{2a}	L _{2b}	L ₃	L ₄	
L1e-A	Powered cycle	PI/CI/Hybrid	500	100	68	60	4.5	Revised WMTC ³⁾
L1e-B-L7e	All other L-category vehicles	PI/CI/Hybrid	1,000	100	68	60	4.5	Revised WMTC
		CI/CI/Hybrid	500	100	68	90	4.5	Revised WMTC

History of Bike Regulations in Europe

2013	2013	Jan 2016	Jan 2017	Jan 2020	Jan 2021
Europe	Law to reduce motorcycle emissions	Euro 4 applied to all newly-homologated motorcycles	Euro 4 the same rules were applied to existing models	Euro 5 applied to all new models	Euro 5 the same rules were applied to existing models

There are four different types of exhaust emissions covered by the Euro 5 legislation. The three measures common to both Euro 4 & 5 are carbon monoxide, total hydrocarbons and nitrogen oxide (NOx), while the new measure for Euro 5 is non-methane hydrocarbons.

Key Points:

- The limit on the amount of non-methane hydrocarbons in the exhaust is proving to be a particular challenge for engine designers.
- OBD Stage II monitoring systems - Euro 5 motorcycle emissions regulations requires OEMs to test their OBD systems to show they will effectively work when emissions levels of CO, THC and NOx pass a threshold limit.
This legislation will come into effect for new vehicles in 2024 and existing vehicles in 2025.

USA

EPA and CARB

Motorcycles being sold in the U.S. have to meet the Environmental Protection Agency's (EPA's) standards (or the California Air Resources Board for the Golden State - CARB).

US EPA Motorcycle Standards (g.km)

Year	Class	Disp. (cc)	HC corp.ave	CO	HC + NOx	
					corp.ave	max
2006+	I	50-169	1.0	12		
	II	170-279	1.0	12		
2006-09	III	≥ 280	1.0	12	1.4	5.0
2010+	III	≥ 280		12	0.8	5.0

Starting with the 2006 model year EPA re-defined Class I to include motorcycles with engines smaller than 50 cubic centimetres. These new previously unregulated vehicles are Class I-A, and the pre-existing Class I became Class I-B.

CARB

The California Air Resources Board administers a program to reduce the air quality impact from this vehicle category, and is currently in the regulatory development process with the goal of developing more stringent ONMC (On Road Motorcycles) standards. The California exhaust emission test procedures are adopted from the U.S. Environmental Protection Agency's (U.S. EPA's) exhaust test procedures. CARB staff are currently in the preliminary stages of developing new regulations for ONMC and are discussing potential harmonization with the recently adopted EURO 5 1&2 (EU) standards for motorcycles, starting with the 2024 model year.

In addition to updating emissions standards to reflect the European Euro 5 emissions limits, CARB is also planning to propose the following elements:

- Updated test procedures to reflect real world motorcycle usage.
- On Board Diagnostics (OBD) to identify malfunctions in emissions controls and encourage timely repairs.
- New durability requirements to ensure emissions control components function as intended for the useful life of the vehicle.
- Requirements to accelerate development and widespread adoption of zero emissions motorcycles (ZEMs).

India

Bharat Stage VI (BS VI)

Emission standards for 2- and 3-wheelers became effective in 1991. Since then, the standards have been progressively tightened following the consecutive stages of the Bharat emission regulations.

Bharat Stage VI Standards

Standard	Description	Class	Definition	Test Cycle	
India	BS VI	2W vehicle classification and testing requirements	Class 1	50 < D < 150 CC, v _{max} ≤ 50 km/h or D < 150 CC, 50 < v _{max} < 100 km/h	Part 1 reduced speed cold [0.5] + Part 1 reduced speed hot [0.5]
			Class 2-1	D < 150 CC, 100 ≤ v _{max} < 115 km/h or D ≥ 150 CC, v _{max} < 115 km/h	Part 1 reduced speed cold [0.5] + Part 1 reduced speed hot [0.5]
			Class 2-2	115 ≤ v _{max} < 130 km/h	Part 1 cold [0.3] + Part 2 hot [0.7]
			Class 3-1	130 < v _{max} < 140 km/h	Part 1 cold [0.25] + Part 2 hot [0.5] + Part 3 reduced speed [0.25]
			Class 3-2	v _{max} ≥ 140 km/h	Part 1 cold [0.25] + Part 2 hot [0.5] + Part 3 [0.25]
D – engine displacement; v _{max} – maximum design speed. WMTC phase sequence. Values in square brackets are weighting factors.					

Bharat Stage VI standards for 2- and 3-wheeled vehicles were proposed in February 2016 [3349] (skipping the Bharat Stage V stage). The proposed limits apply to new model 2-wheeled vehicles and all models of 3-wheeled vehicles. These proposed standards align with Euro 5 limits for these vehicles.

The BS VI regulation also includes emission standards for 2-wheelers with an SI engine and D ≤ 50 cc and V_{max} ≤ 50 km/h.

The applicable limits are:

- CO = 0.50 g/km
- HC = 0.35 g/km
- NO_x = 0.15 g/km

China

Stage IV

Application date	Vehicle type	Vehicle class	Engine size V (cc)	Top vehicle speed V _{max} (km/h)	Emission limits (mg/km)					Driving cycle	OBD requirement	Durability (km)
					HC	NO _x	CO	HC+NO _x	PM			
2018	2 Wheels	mopeds	≤ 50	V _{max} ≤ 50	630	170	1,000	-	-	ECE R47	Stage 1	11,000
		I	50 < V < 150	V _{max} ≤ 50	380	70	1,140	-	-	WMTC I		20,000
			V < 150	50 < V _{max} < 100						WMTC II-1		
		II	V < 150	100 ≤ V _{max} < 115	WMTC II-2							
			V ≥ 150	V _{max} < 115	WMTC III-1							
		III	V ≤ 1,500	115 ≤ V _{max} < 130	WMTC III-2							
	V ≤ 1,500		130 ≤ V _{max} < 140	170	90	1,140	-	-	ECE R47	35,000		
	3 Wheels	mopeds	≤ 50	V _{max} ≤ 50	730	170	1,900	-	-	ECE R47	11,000	
		PI engine	V > 50 or V _{max} > 50		550	250	2,000	-	-	ECE R40	20,000	
		CI engine	V > 50 or V _{max} > 50		-	390	740	460	60			

Brazil and Chile

Application date category	Displacement	HC	NO _x	HC+NO _x	CO	
						(g/km)
Phase-in: PROMOT 4 / WMTC cycle – Idle HC & CO – 2014: 400 ppm of HC revised, and 2% of CO revised – Fixed DR from Jan 2014. Annual prod: < 10,000 units – CO, HC, NO _x 20% > 10,000 units – Mopeds – DF based on 10,000 km. Motorcycles < 130 km/h – DF based on 18,000 km > 130 km/h – DF based on 30,000 km.						
Brazil	Mopeds (new models)	< 50 cc		0.8	1.0	0.15
	Motorcycles and similar (new models)	< 130 km/h	0.8	2.0	0.15	0.15
		> 130 km/h		0.3	2.0	
Chile	2012: LA-4 - Tier 2, ECE40+EUDC - Euro 3					

Indonesia and Japan

Indonesia		Motorcycle emissions legislation is equivalent to Euro 3				
		Current motorcycle emissions standards introduced in Sept 2013. Standards for motorcycles / larger mopeds use WMTC test cycles. Standards for smaller mopeds continue to be based upon ISDO 6460 test cycle. OBD and Evap emissions standards become compulsory				
Application	Description	CO (g/km)	thc (g/km)	NMHC (g/km)	NOx (g/km)	
Japan	Equivalent class 1	2.2	0.45	-	0.16	
	Prior 2016	2.62 (3.48)*	0.27 (0.36)*	-	0.21 (0.28)*	
	1 Oct 2016	Class 1 Between 50 cc and 150 cc & V _{max} < 50 km/h < 150 cc & V _{max} between 50 and 100 km/h	1.14	0.30	-	0.07
		Class 2 < 150 cc & V _{max} between 100 and 130 km/h > 150 cc & V _{max} < 130 km/h	1.14 (1.58)*	0.20 (0.24)*	-	0.07 (0.10)*
Class 3 V _{max} > 130 km/h (Class 3)		1.14 (1.58)*	0.17 (0.21)*	-	0.09 (0.14)*	
Dec 2020 Nov 2022		1.00 (1.33)* **	0.10 (0.13)*	0.068 (0.088)*	0.0045 (0.0063)*	

*Average values (max values) ** CO limit is idle 0.5(%)

Singapore, South Korea, Thailand and Vietnam

Singapore		Singapore Government's National Environment Agency is responsible for emissions legislation & air quality. Current emissions standards for motorcycles and scooters are equivalent to Euro 3 for 2W and Euro 2 for 3W, as specified in European Directive 97/24/EC.							
Standard	Application date	Description	Test Cycle	CO (g/km)	HC (g/km)	NOx (g/km)	HC+NOx (g/km)	Evap (g/test)	
South Korea	Euro 2	All 3w	CVS-40	7	1.5	0.4	-	-	
		2W < 150 CC PI	UDC Cold	2	0.8	0.15	-	-	
		2W > 150 CC PI	ECE40 + EUDC		0.3				
	Euro 3	Jan 2008	2W < 45 km/h	CVS-47	1	-	-	1.2	-
			2W ≤ 50 CC PI & V _{max} < 45 km/h	ECE R47	1	0.63	0.17	-	-
			2W ≤ 50 CC PI & V _{max} ≥ 45 km/h	WMTC	1.14	0.38	0.07	-	2.0 is only adapted V _{max} ≥ 130km/h
2W > 50 CC PI & V _{max} < 130 km/h	0.17	0.09							
Euro 4	Jan 2017	2W > 50 CC PI & V _{max} ≥ 130 km/h	WMTC	1.0	0.1	0.68	0.60	1.5	
Euro 5	Jan 2020		WMTC	1.0	0.1	0.68	0.60	1.5	
Thailand		Level 6 standards, equivalent to Euro 3, are currently in force.							
Vietnam		From 2017 motorcycle emissions standards equivalent to Euro 3 are applicable, nationally, replacing the Euro 2 level standards. They follow EU regulations.							

CATAGEN Services

With the introduction of these new limits, the challenges that face motorcycle developers are significant. CATAGEN has produced methodology to properly age motorcycle catalysts to the required OBD and other limits using catalyst modelling and a bespoke ageing process and proprietary toolset.

Find out more www.catagen.com/services

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