

TWO WHEELER SAFETY IN INDIA



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Presentation by

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Outline

ARAI- A Brief Introduction

Profile of Indian Two Wheeler Industry

Two Wheeler Accidents – Some Observations

Two-Wheeler - Safety Norms

Present

Future

Summary

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ARAI Overview



Establishment	: 1966
Location	: Pune, INDIA (150 km from Mumbai)
Manpower	: 575+
Facilities	: 12 Laboratories – Vehicle Evaluation, Powertrain, Emissions, Safety & Homologation, Passive Safety, Materials, Automotive Electronics, NVH, CAE, Structural Dynamics, Calibration, Post Graduate Academy & Forging Industry Division
Our Offices	: China, Korea and Chennai
Investments	: USD \$ 60 Million
Accreditations	: ISO 9001, 14001, OHSAS 18001 & NABL (ISO 17025)

ARAI Roles

- Ministry approved test agency to carry out certification testing.
- Engaged in sponsored R&D work and development testing.
- ARAI is actively engaged in
 - Preparation & Harmonization of standards.
 - Secretariat for AISC and CMVR-TSC.
 - Deliberation of policy matters affecting Auto R&D.
 - Creation of facilities and building up competence by undertaking forward looking research & technology demonstration projects.



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Profile of Indian Two-Wheeler Industry

- **2nd largest in the world**
- **90% are less than 125 cc.**
- **Maximum operating speed range from 50-70 km/h. due to traffic conditions**
- **Designed to be Fuel efficient and Low emission compliant.**
- **Two wheeler market in India is highly price sensitive.**
- **In the existing scenario, Indian vehicles are meeting the current ECE requirements**

Profile of Indian Two-Wheeler Industry

- **2nd largest 2W manufacturer in the world**
- **20% 2W vehicles use less than 125 cc engine**
- **Maximum operating speed range from 50 to 70 kmph due to inherent traffic conditions**
- **Designed to be fuel efficient and low emission compliant**
- **2W market in India is highly price sensitive**
- **In the current scenario, Indian 2W vehicles are meeting ECE requirements**

Automotive 2 wheeler industry Clusters in India

North / Central- Delhi-Gurgaon-Faridabad

Hero Motor Corporation
 Honda Motorcycles and Scooters Ltd.,
 Lohia Machines Ltd.,
 Suzuki Motorcycles Ltd.,
 Yamaha Motor India
 BMW Motorcycles India
 Triumph India



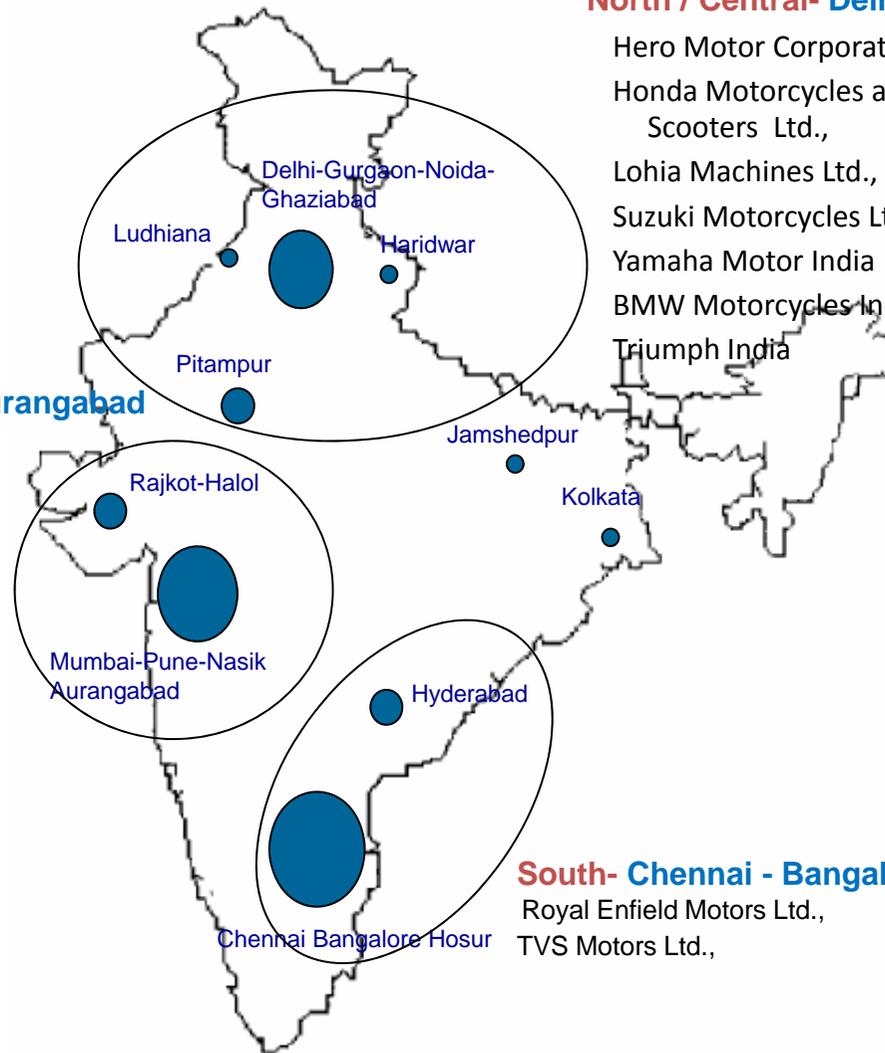
West- Mumbai-Pune-Nasik-Aurangabad

Bajaj Auto Ltd.,
 Mahindra & Mahindra Ltd.,
 DSK – Hyosung Ltd.,
 Piaggio Vehicles (Vespa)



South- Chennai - Bangalore-Hosur

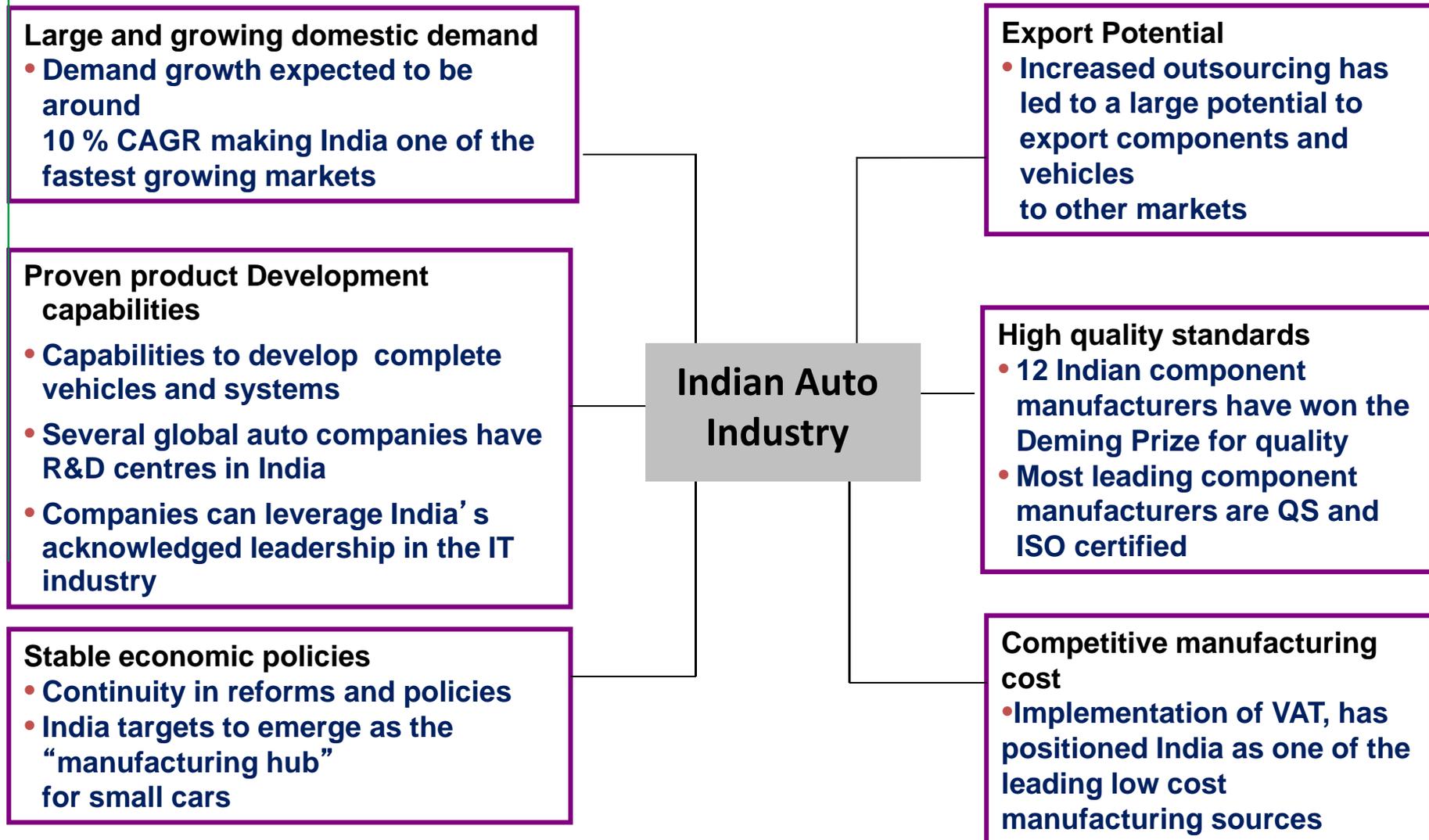
Royal Enfield Motors Ltd.,
 TVS Motors Ltd.,



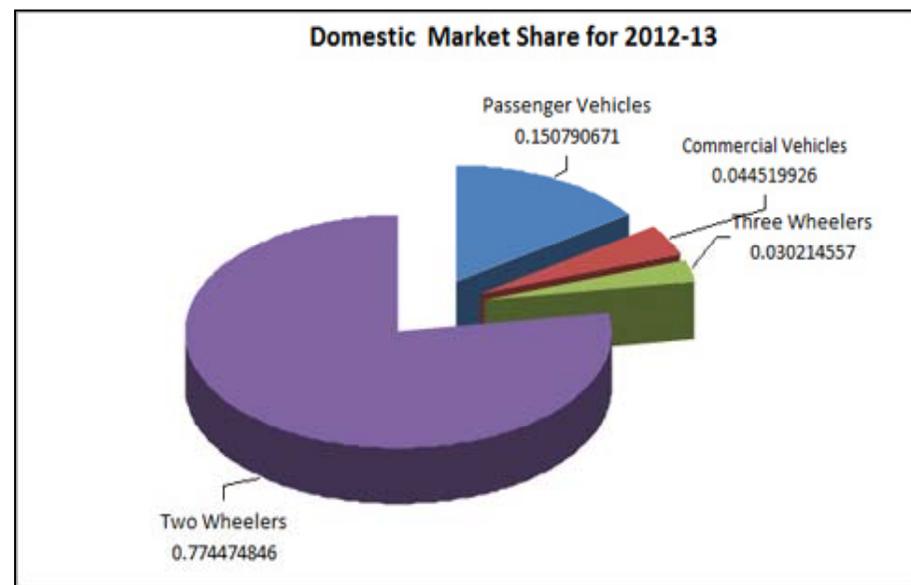
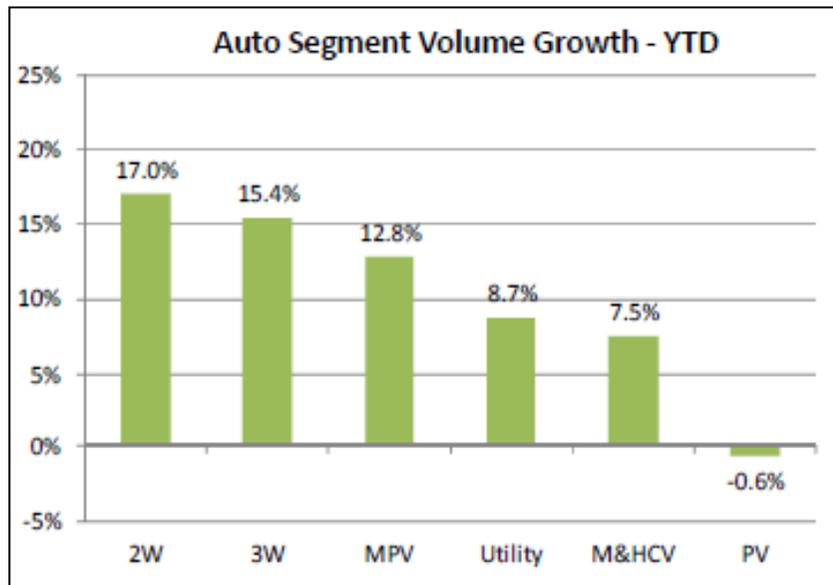
Growth drivers for the Indian Automotive Industry



Attractiveness of the Indian Automotive industry



2 Wheeler Market in India ...



Domestic volume growth has been strong over the past five years growing at about 11% CAGR

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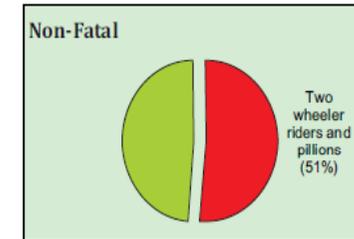
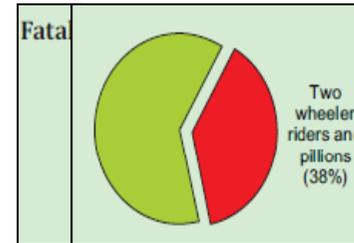
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Motor Cycle Accidents in the world – Concerns

- Three major causes of human casualties in 2020 as forecasted would be –
 - Heart disease
 - Major depression
 - Road traffic accidents**

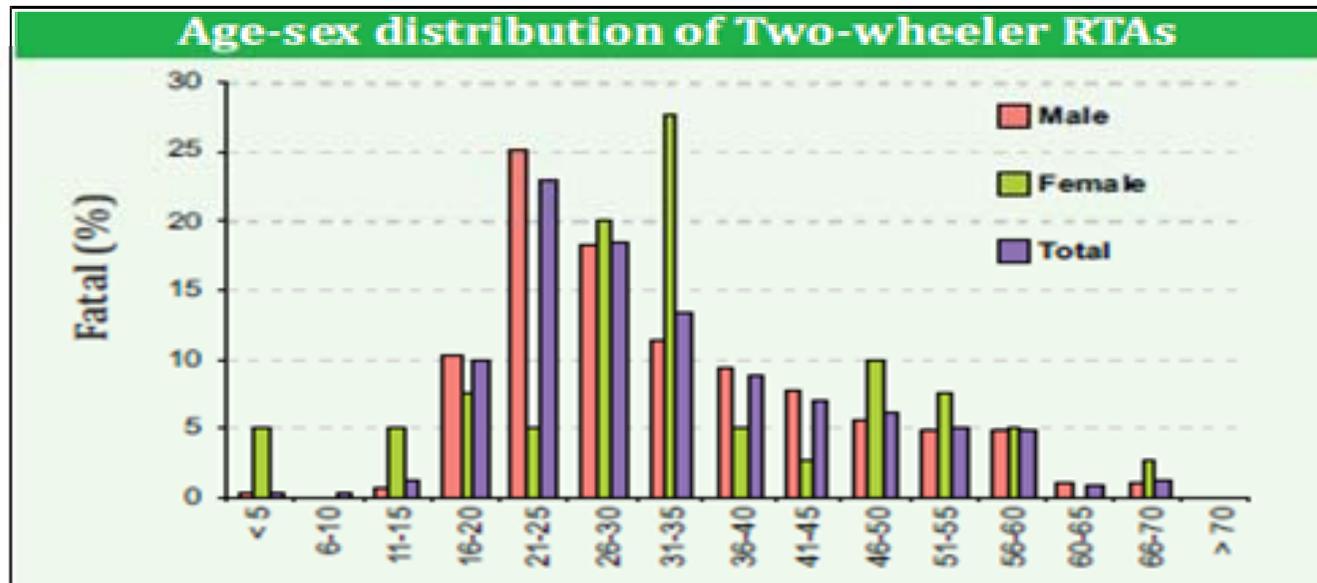


- Currently over 1 million people die in road accidents. By 2020 this figure will rise to 2 million. 75% of victims are pedestrians and two wheeler users.
- 85% of accidents happening worldwide occur in developing countries.
- Three fourths of registered vehicles in India are motorized two-wheelers.
- Two wheeler riders and pillion were the second leading road user category for both deaths (38%) and injuries (51%).
- Three fourths (87%) were amongst men.
- Brain and limb injuries were more frequent in this group.
- More than half (both fatal and non fatal injuries) had not worn helmets.

***According to an independent study by WHO*

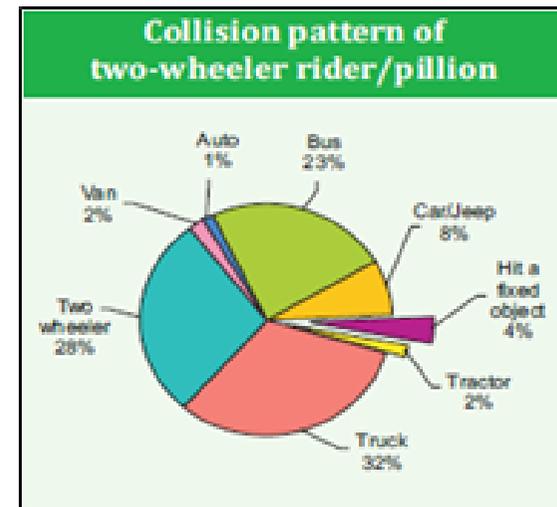
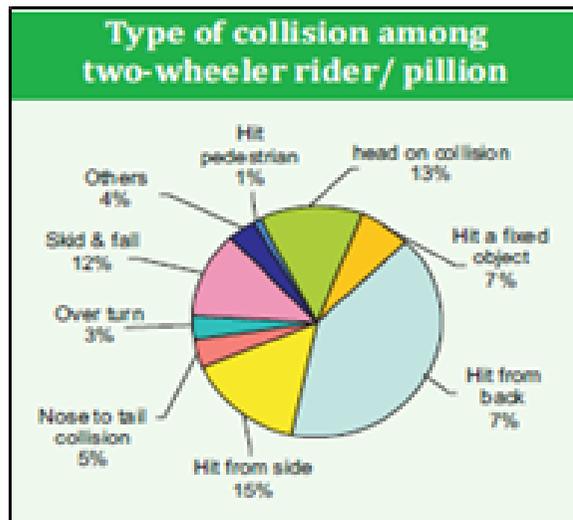
2 Wheeler Accidents – Fatal Injuries - Analysis

- Nearly three fourths of fatal and 82% of the non fatal two - wheeler injuries occur in the age group of 16 - 45 years with majority of them in 20 - 30 years.
- Three fourths (87%) of both fatal and non-fatal injuries in two wheeler riders occur among men.
- Women in < 15 yrs. and > 40 yrs. are involved in road crashes



2 Wheeler Collision Pattern

- More than half the deaths among two - wheeler riders and pillions occur due to collision with trucks (32%) and buses (23%).
- Injuries are severe in these crashes and hence, deaths are higher.
- Other two wheeler (28%) and cars (8%) collide with the vehicle of injured person in one fourth of crashes.
- Rear end collisions (40%) (with majority of roads becoming one ways), side angle collisions (15%), head on collisions (13%) and skid and fall (12%) were the common collision patterns.



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Trends in Auto regulations – Safety and Environment related

Regulation Road Map Targets

- Industry challenges to development
- Better vehicles: safer and more environment friendly



Approach

- Harmonization with ECE standards
- More Homologation and Certification testing agencies and centres



Indian automotive regulations are technically aligned to the ECE regulations. The table on the right shows the level of technical alignment of the Indian regulations with the ECE regulations

Status of Indian Regulations	Number of Regulations
Technically aligned	101
Partial level alignment	11
Items / Regulations to be covered	19
Total	131

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Safety norms at present - Vehicle level

- **An automobile has more weight and bulk than a motorcycle.**
- **It has door beams and a roof to provide some measure of protection from impact or rollover. It has cushioning and airbags to soften impact and safety belts to hold passengers in their seats.**
- **It has windshield washers and wipers to assist visibility in the rain and snow. An automobile has more stability because it's on four wheels, and because of its size, it is easier to see.**

- **A motorcycle suffers in comparison when considering vehicle characteristics that directly contribute to occupant safety.**
- **What a motorcycle sacrifices in weight, bulk, and other crashworthiness characteristics is somewhat offset by its agility, manoeuvrability, ability to stop quickly, and ability to swerve quickly when necessary.**

Safety norms at present - Vehicle level

Axle reactions

STANDARD – IS:11825-1986



- Motorcycles are weighed without any human intervention to physically support the vehicle on weight measurement pads.
- Measurements are made with a accuracy of 1 % of measured value.

Speedometer calibration

STANDARD – IS 11827- 2008



- Motorcycles equipped with a digital or analogue speedometer are calibrated (V) at speeds(v) of 40 kmph, 80kmph and 80% of maximum designed speed.
- Error measured should be within $0.1 V + 8 \text{ kmph}$
- Test procedure are aligned with UN R39

Gradeability Performance

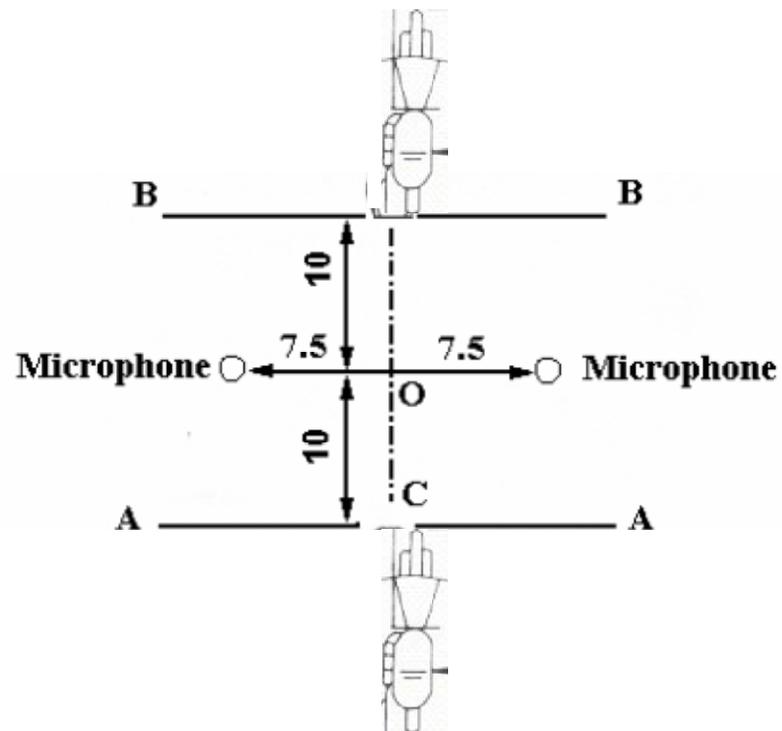
STANDARD – AIS 003, IS:13988-2002



- Statutory limit for grade ability is 7 degrees in the forward driving direction.
- The vehicle is checked for its stop start performance.

Pass by Noise Level

STANDARD – IS:3028-1998



- Noise produced by the motorcycle is measured during acceleration with a approach speed in relevant gears at two third of engine rpm producing maximum power in a stretch of 20m.
- The Noise level should not exceed 80 dB(A)
- Test procedure and noise limits aligned with UN R41

Foundation Brake Test

STANDARD – IS:14664-2010



- Two wheelers are tested for their stopping distance and deceleration performances in both laden and lightly loaded conditions at high speeds, with wet and hot brakes for both front and rear brakes individually.
- Test procedure is aligned with UN R78



ABS Test

STANDARD – IS:14664-2010



ABS ON	Speed
Stops on high friction surface	60 Km/h
Stops on low friction surface	60 Km/h
Wheel Lock check on high and Low friction	80 Km/h
Wheel Lock check -High to low friction surface transit	50 Km/h
Wheel Lock check -Low to High friction surface transit	50 Km/h
ABS OFF	
Stops with an ABS Electrical Failure	60 Km/h

Surface	Peak Braking Coefficient
Low Friction	< 0.45
High Friction	> 0.9



•Test procedure is aligned with UN R78

Tell Tales and Controls

STANDARD – AIS 071 PART 1 & 2



- All tell tales, indicators on the instrument panel are checked for illumination, colour and proper functioning.
- The symbols on the tell tales, controls and indicators are verified as mentioned in the standard .
- Functioning of all the controls are also verified
- Requirements have been aligned with UN R60

Rear Protection Device

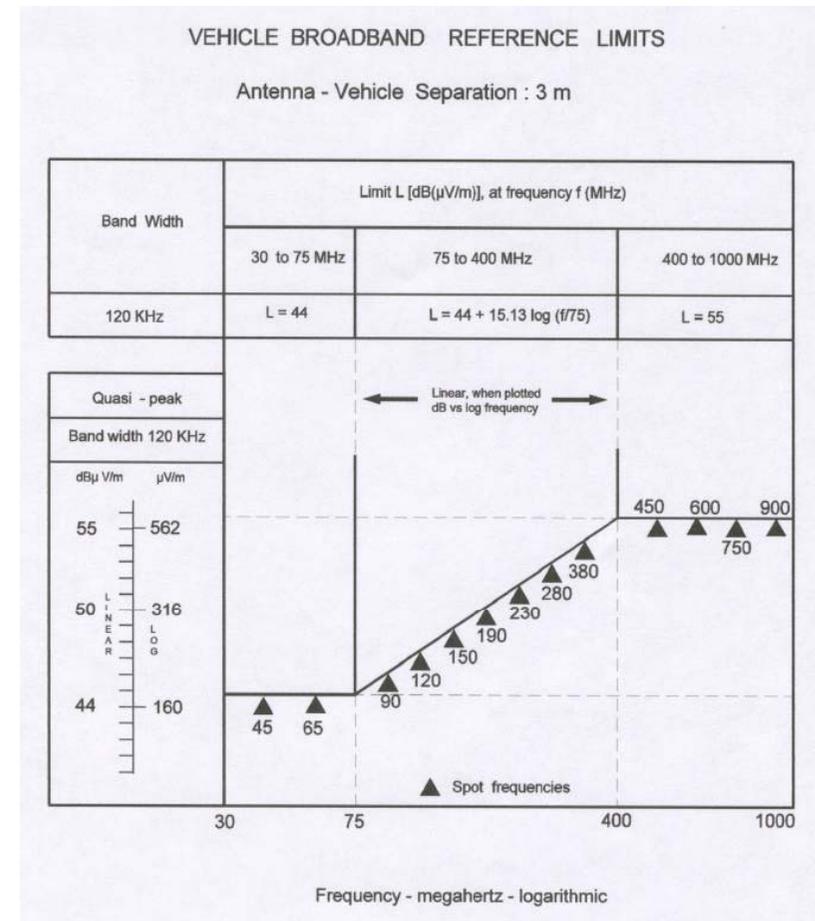
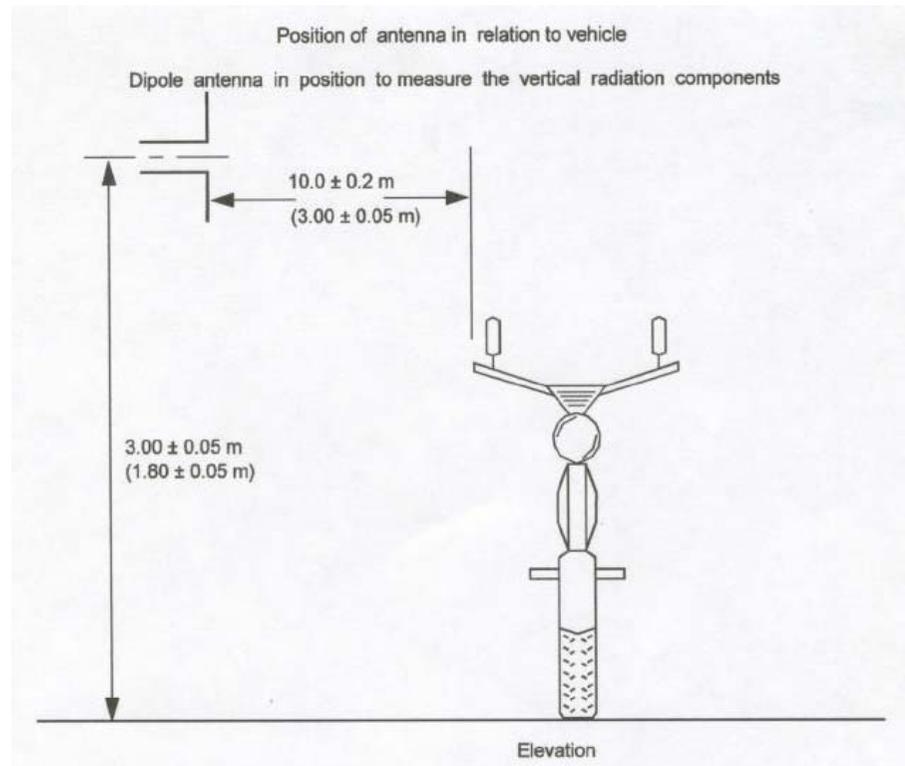
STANDARD – CMVR # 123



- All Motorcycles should be equipped with rear protection device covering half the wheel.
- It should prevent the intervention of loose clothes of pillion rider into the wheel.

Electromagnetic Interference

STANDARD – AIS 004 PART 1



- Requirements have been aligned with UN R10

Pillion Hand Hold Test

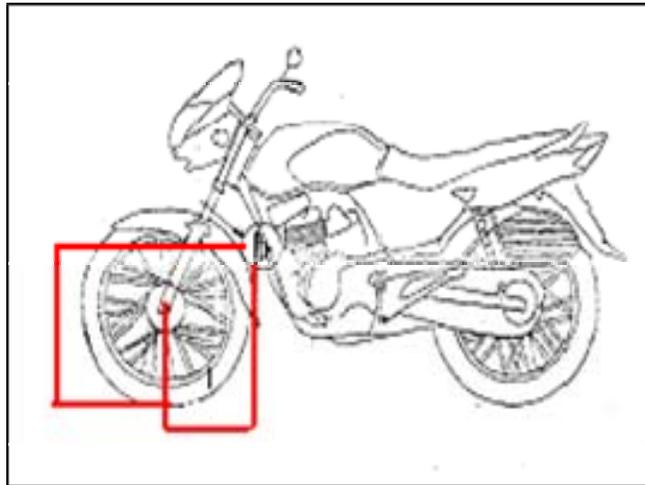
STANDARD – IS :14495



- Strength requirements of pillion straps and hand holds are checked.
- The straps and its attachment shall withstand a vertical traction force of 200 kg applied statically to the center of the surface at a maximum pressure of 2 MPa, without snapping.
- The two hand grips should be mounted one on each side symmetrical manner which shall withstand a vertical traction force of 100 kg applied statically to the center of the surface at a maximum pressure of 1 MPa, without snapping.

Horn installation

STANDARD – AIS 014 :2001



- Sound pressure level emitted by the device(s) fitted on the vehicle shall be measured at a distance of 7 m in front of the vehicle . The maximum sound pressure level shall be sought within the range of 0.5 and 1.5 m above the ground.
- Maximum Sound Pressure Level measured on 2 Wheelers of a power less than 7 kW is between 83 dB(A) to 112 dB(A)
- Test procedure is aligned with UN R28

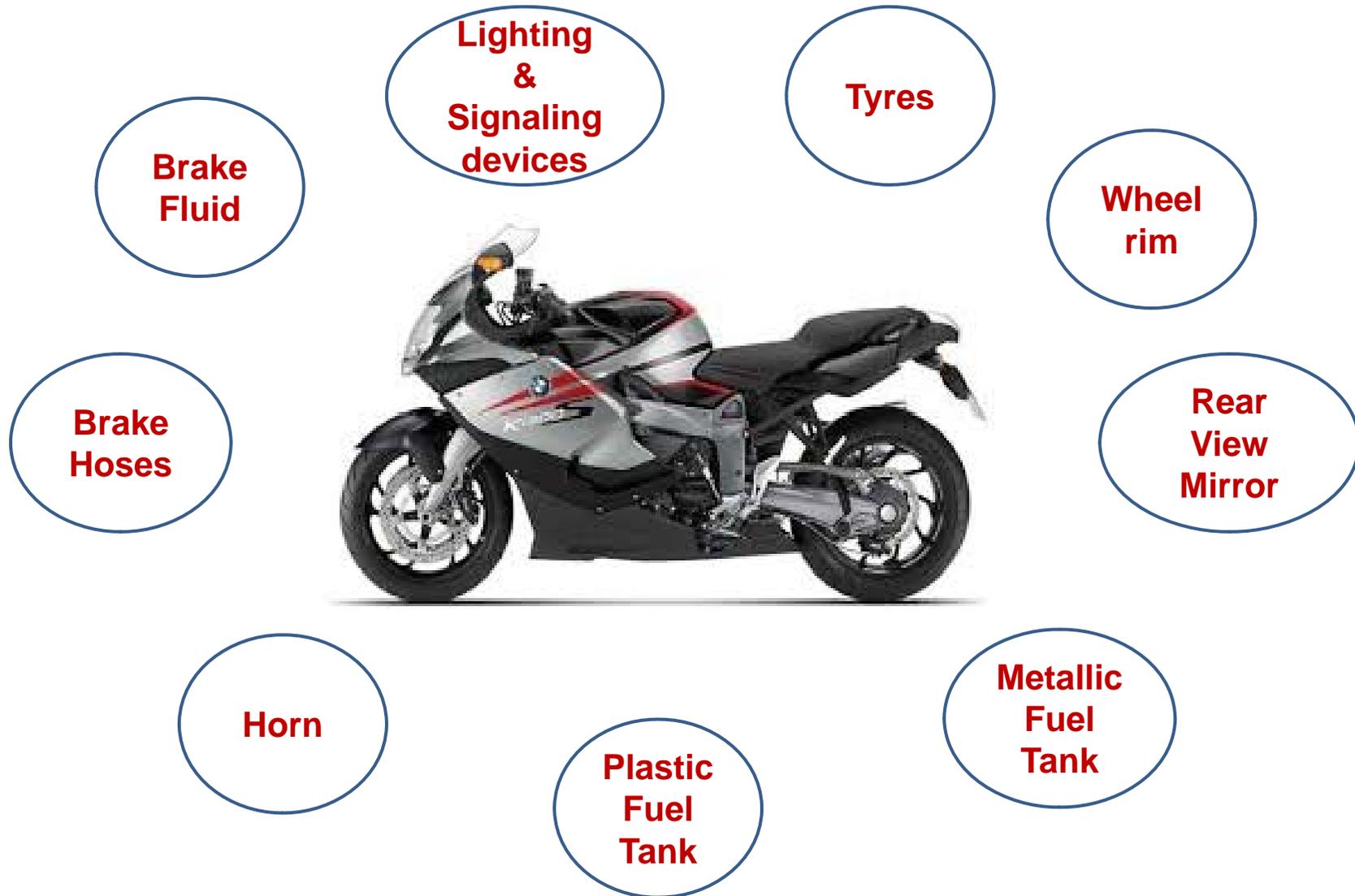
Installation requirements of rear view mirror

STANDARD – AIS 002



- Installation requirements cover, General requirements , Position requirements , Adjustment requirements, Field of visions.
- For 2 wheelers above 70cc shall have 2 mirror on LH and RH side and for 2 wheelers below 70 cc shall have one mirror on one side.
- When vehicle is tested at about 80% of max speed on test track for 10 min , the mirror shall not show move significantly to change the field of view.
- Test procedure is aligned with UN R46

Safety critical components for two-wheelers



Automotive Horn (Audible Warning Device)

STANDARD – IS 1884:1993



- These tests are basically required to check, Functional Performance, Reliability, Quality, etc.
- In an open space of radius 12m in which there are no obstacles in between, with background noise at least 10 dB below that produced by horns under test, and the horn to be mounted 1.2 m above ground and directed horizontally to microphone of sound level meter at a distance of 2m from front of the horn
- Test procedure is aligned with UN R28

Rear view mirror

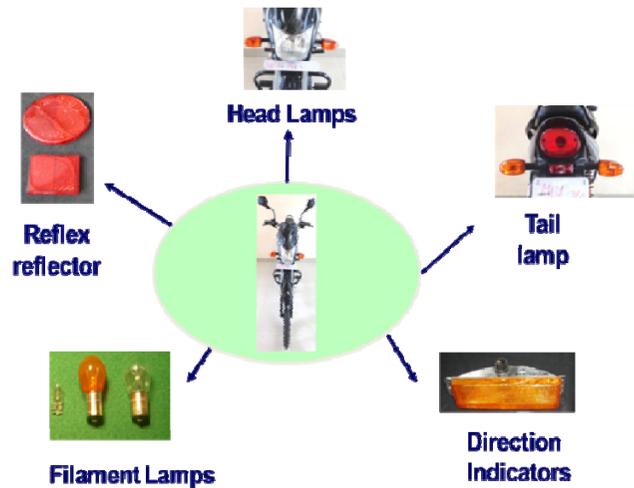
STANDARD – AIS 001



- Rear view mirrors are checked for Performance requirements, Mechanical Behaviour, Environmental Performance test
- Performance requirements
 - Radius of curvature and dimensions.
 - Reflectivity
 - Distortion factor
- Mechanical behavior
 - Impact test
 - Bending test
 - Vibration test
- Environmental performance test
 - Temperature resistance
 - Moisture resistance test
 - Salt spray test
 - Weather resistance test
- Test procedure is aligned with UN R46

Lighting and light- signalling devices

STANDARD – AIS : 010



Sr. No.	Lamp	Colour	No. of Lamps
1	Main-Beam Head Lamp	White	One or two
2	Dipped-Beam Head Lamp	White	One or two
3	Direction Indicator Lamps	Amber	One at the front and one at the rear on each side .
4	Rear Position Lamp (Tail Lamp)	Red	One or two in the case of two wheelers.
5	Rear Retro-Reflector	Red	One or two in the case of two wheelers.
6	Stop Lamp	Red	One or two in the case of two wheelers.
7	Rear Registration Mark (Rear Number Plate) Illuminating Lamp	White	One
8	Front Position Lamp	White or Amber	One on side car, if a side car is attached to a two wheeler.
9	Pedal Retro-Reflector	Amber	Two on each pedal only in case of L1 category of two wheelers fitted with pedals.

•Test procedure is aligned with UN R74

Hydraulic brake hoses

STANDARD – IS : 7079 – 1995



Whip, Burst & expansion
Test rig

Tests conducted

- Constriction Test
- Expansion test
- Pressure test
- Bursting strength test
- Whip Test
- Tensile Test
- Salt Spray test
- Cold bend test
- Ozone resistance test
- Hot Impulse test
- Brake Fluid compatibility Test

Fuel tank (Metallic and Plastic)

STANDARD – IS 14681



METALLIC FUEL TANK

Test conducted

➤ Leakage Test

- Ordinary position / upside position
- 50gms / min.

➤ Pressure Test

- Should withstand pressure of 130 kPa absolute without leakage.

Test procedure is aligned with 70/221/EEC

PLASTIC FUEL TANK

Tests conducted

- Corrosion test
- Over turn test
- Fuel permeability test
- Mechanical Strength Test
- Impact resistance test
- Fire resistance test
- Resistance to High temperature

Test procedure is aligned with UN R34



Tyre test

STANDARD – IS 15627



Plunger test



Endurance test

Tests conducted

- Dynamic growth test
- Endurance Test
- Load/Speed Performance Test
- Tyre Strength Test
- Bead Unseating Resistance Test
- Dynamic growth test

Test procedure is aligned with UN R75

Wheel rim test



STANDARD – AIS 073 PART 1, 2 & 3

Following tests are conducted on wheel rims (Light Alloy Wheel Rims, Sheet Metal Wheel Rims, Spoke Wheel Rims)

- Torsion Moment Test System
- Radial Impact Resistance Test
- Deflection test
- Air leak test



Impact test



Cornering test



Torsion test

SPRAY SUPPRESSION TEST

STANDARD – AIS 103



This standards is applicable to bikes with engine displacement volume more than 200 cc.

Requirement:

Width not less than the tyre overall width, upto 45 degrees of wheel coverage angle and width shall be less than half of the tyre overall width at 60 degrees of wheel coverage angle.



Two wheeler electric vehicles

Standard	Brief Requirements
AIS 038 (ECE R- 100)	Construction & Functional Safety – Battery mounting, ventilation, creepage distance, insulation resistance, protection against electric shock, on board charger, water effects tests (washing, flooding, heavy rainstorm)
AIS 039(ECE R-101)	Measurement of electrical energy consumption
AIS 040 (ECE R101)	Measurement of electrical range
AIS 041 (ECE R 101)	Measurement of net power, max. 30 min power
AIS 048 (USABC EV Battery Test Procedures Manual)	Safety Requirements for Traction Batteries – Electrical & Mechanical Abuse Tests
AIS 049	Type Approval of Electric Vehicles – Brake performance, grade ability, pass-by noise level, EMI, wiper, lighting system, safety belt, steering column, dashboard etc.



Emission test

STANDARD – As per Rule 115 of Central Motor Vehicle Rules

Scope: 2W (Gasoline)

Type I Test : Exhaust emissions (IDC)

Type II Test : Spark Ignition- Idle CO-HC
 Compression Ignition (3W only)- Free acceleration Smoke

Type III Test : The durability of Anti Pollution Device is determined either by an actual durability run over 30 000 km or by application of a fixed deterioration factor

Deterioration Factors

Engine category	CO	HC+NOx	PM
2W (Gasoline engines)	1.20	1.20	-

BS-III

Type I

	Effective Date	Category	CO g/km	HC + NOx g/km	PM g/km
Gasoline	1.10.2010	2W	1.00	1.00	-

DRIVING CYCLES

Type I Test : 6 cycles (IDC) sampling



Cold Start with 40 Sec Idling
 4 warm cycles (108 sec each) (only for petrol)
 6 sample cycles (108 sec each)
 Total Test Time: 648 sec
 Total Test Distance: 3,948
 Max speed: 42kmph

Two – Wheelers

	CO (g/km)	HC (g/km)	HC + NOx (g/km)
1991 Norms	12-30	8-12	-
1996 Norms	4.50	-	3.60
BS-I Norms (2000)	2.00	-	2.00
BS - II (2005)	1.50	-	1.50

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Daytime Running Lamp (DRL)

Daytime running lamp" means a lamp facing in a forward direction used to make the vehicle more easily visible when driving during daytime

- **DRL reduce daytime accidents by making vehicles more conspicuous to other road users**
- **DRLs provide not only improved visibility (detection) but also improved reaction times and estimation of speed and distance**
- **In addition to increasing the distance at which vehicles could be reliably detected, DRLs make vehicles appear closer. This makes drivers more likely to reject short gaps for a potentially hazardous manoeuvre.**



HID headlamps on motorcycles

- Gives the same illumination for a smaller electrical supply
- Colour temperature is similar to day light
- Increases effective night-time vision, for a constant generator output
- This provides a great potential for developing new lighting systems with greater and more reliable performance throughout the motorcycle range

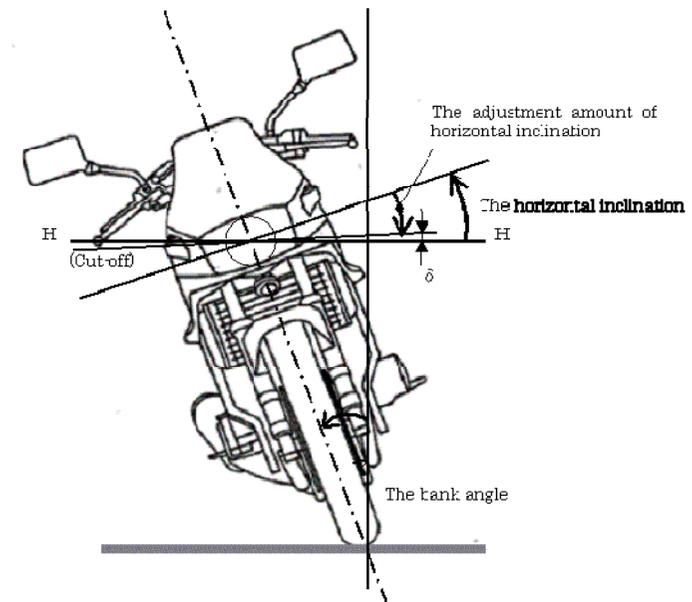
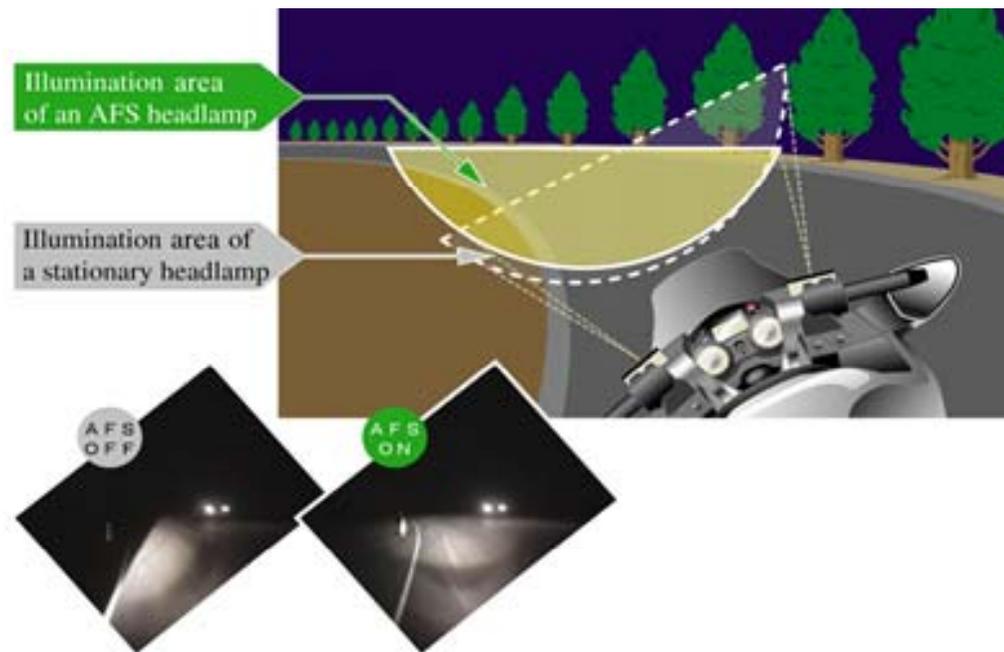


Standard Halogen Lighting



HID Lighting

Horizontal inclination adjustment system (HIAS)



HISA means a device that adjusts the horizontal inclination of the headlamp towards zero

- Headlamp visibility is improved by compensating the headlamp bank angle in curves.
- During the curves, the oncoming vehicle driver receives no glare when the headlamp bank angle is compensated to the same level as the vehicle body bank angle

Emission norms- BS IV (Future)

Table 1: Proposed BSIV Emission norms of Two Wheelers for Classes 1,2 & 3 with Gasoline engine					
Sub Class	Limit (g/km) WMTC based				Test Cycle
	BS III		BS IV proposal		
	CO	HC+NOx	CO	HC + NOx	
1 & 2-1	1.87	1.08	1.403	0.890	As per GTR 2 Amend 1&2 Alt-A and WMTC equivalent BSIII
2-2	2.62	0.92	1.970	0.690	
3-1 & 3-2	2.62	0.55	1.970	0.420	

- 1) D. F. is built into the above proposed emission norm.
- 2) These values are with BS IV fuel

Class 1	50 cm ³ < engine capacity < 150 cm ³ and v _{max} ≤ 50 km/h or engine capacity < 150 cm ³ and 50 km/h < v _{max} < 100 km/h
Sub Class 2-1	Engine capacity < 150 cm ³ and 100 km/h ≤ v _{max} < 115 km/h or Engine capacity ≥ 150 cm ³ and v _{max} < 115 km/h
Sub Class 2.2	115 km/h ≤ v _{max} < 130 km/h
Sub Class 3-1	130 ≤ v _{max} < 140 km/h
Sub Class 3-2	v _{max} ≤ 140 km/h subclass 3-2.

It can be seen from table below that reduction in HC +NOx (considering the impact of evaporative emission and reduction in CO, is more than 25%.)

Table 3: Effective reduction in the pollutants												
Class	CO (g/km)		Reduction	HC + NOx							Reduction	
	BSIII	BSIV		BSIII				BSIV				
				tail pipe(g/km)	Evaporative g/test	Equivalent tail pipe(g/km)	Total (g/km)	tail pipe(g/km)	Evaporative g/test	Equivalent tail pipe(g/km)		Total(g/km)
1 & 2-1	1.87	1.403	25%	1.08	6	0.3	1.4	0.89	2	0.1	0.99	28%
2-2	2.62	1.97		0.92	6	0.3	1.2	0.69	2	0.1	0.79	35%
3	2.62	1.97		0.55	6	0.3	0.9	0.42	2	0.1	0.52	39%

Assumptions:

- Evaporative emission of vehicles in each class at 6 g/test at present.
- Evaporative emission of 4g/test works out to be equivalent of 0.2g/km of HC from tail pipe.
- % reduction will be higher if the current evaporative emission is more than 6 g/test

Two Wheeler Electric Vehicles (future areas)

- **EMC evaluation of electric two-wheelers**
- **Electrical safety requirements**
- **BMS development for Li-Ion batteries**
- **Charging infrastructure**



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TWO-WHEELER SAFETY CAN BE IMPROVED BY ADDRESSING FOLLOWING ISSUES.

INDIA WILL CONSIDER SOME OF THESE AREAS IN FUTURE.

- Formulating Road safety policies with a focus on safety of two-wheeler riders and pillions.**
- Scientific design and maintenance of roads with speed control mechanisms.**
- Separating two-wheelers and other slow moving traffic from heavy and speeding vehicles (on all possible roads).**
- Strict enforcement of traffic regulations and focused speed control mechanisms.**

Summary

- ❑ **Control of drinking and driving.**
- ❑ **Strict driver licensing mechanisms and systems (graduated driver licensing systems are found to give benefits).**
- ❑ **Mandatory helmet legislation and enforcement.**
- ❑ **Design of Safer vehicles, Increasing visibility of two wheeler riders and pillions (bright colored helmets, use of reflective materials, etc.).**
- ❑ **Improved trauma care practices.**
- ❑ **Increasing research to understand situation, circumstances, characteristics and risk factors of two-wheeler crashes.**

**Thank you
for your attention.....**