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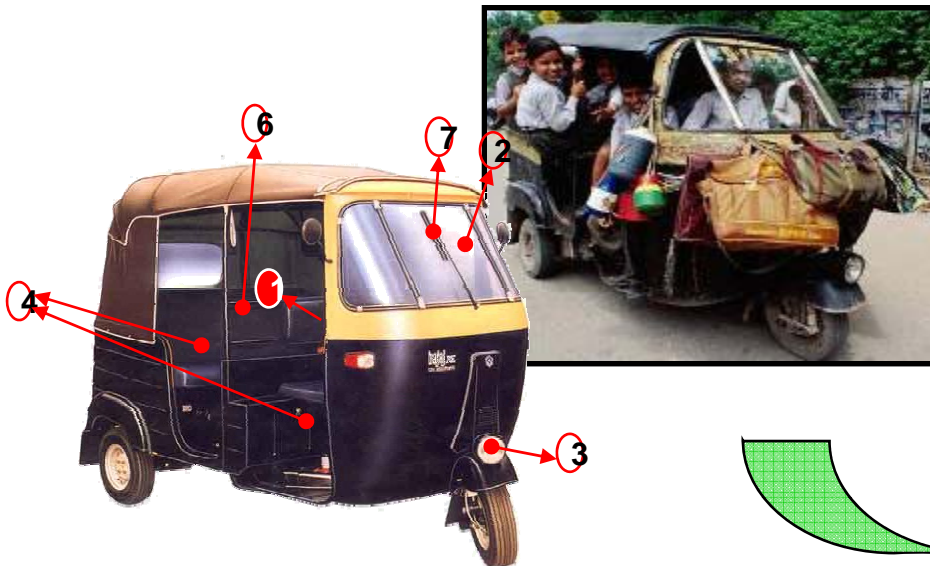
6TH IRF REGIONAL CONFERENCE
5TH OCT 2011, NEW DELHI

Advances in In-Vehicle Safety Devices

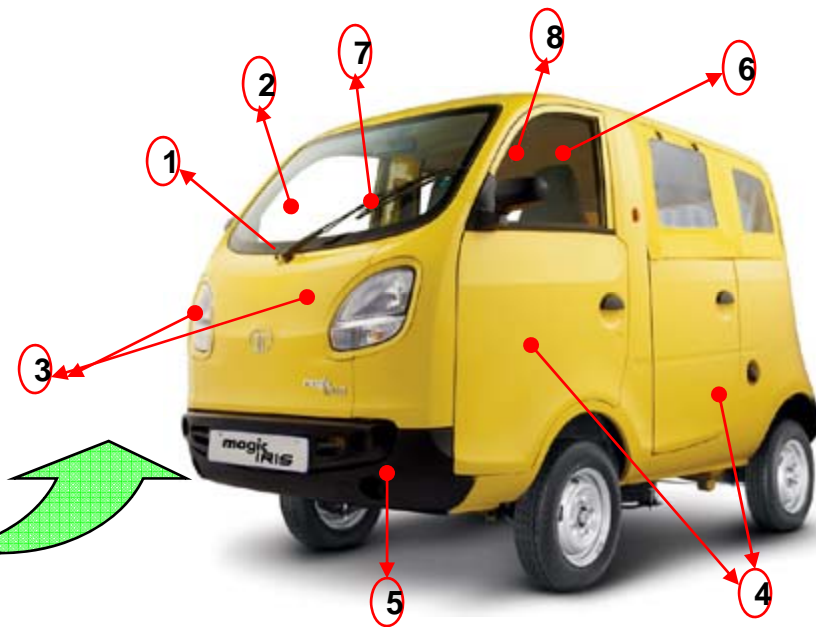
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How Far In-Vehicle Safety Norms Should Go in India???



1	Steering wheel conforming to impact tests (No Steering wheel, Only steering handle)	✗
2	Driver field of Vision	✗
3	Two headlight for night driving (One headlamp)	✗
4	Doors for occupant safety (No doors)	✗
5	Bumper for Pedestrian safety (No bumper)	✗
6	Interior fittings to avoid occupant injury (Not controlled hence dangerous)	✗
7	Stringent wiping requirement for Wet driving (Minimum requirements, Hand operated is OK)	✗
8	Seats & Seat belt conforming to anchorage test	✗



1	Steering wheel conforming to impact tests	✓
2	Driver field of Vision	✓
3	Two headlight for night driving (Better road illumination)	✓
4	Doors for occupant safety	✓
5	Bumper for Pedestrian safety	✓
6	Interior fittings to avoid occupant injury	✓
7	Stringent wiping requirement for Wet driving	✓
8	Seats & Seat belt conforming to anchorage test	✓

Content

- **Current Vehicle Safety Concerns in India**
- **Near Term Vehicle Safety Road Map**
- **Long Term Advances in Vehicle Safety**
- **Conclusion**

European Road Safety 2011-2020

On 1 September 2011, the European Parliament's Committee on Transport & Tourism published the consolidated Koch report on "European Road Safety 2011-2020".

The report endorses the objective of halving EU road deaths by 2020 (in comparison with 2010), and in addition calls for:

- 60% reduction in the number of children under the age of 14 killed in road accidents
- 50% reduction in the number of pedestrians and cyclists killed in road collisions
- 40% reduction in the number of people suffering critical injuries

The report also calls on to "put safer vehicles on the road" through the assessment, development and implementation of a number of safety checks, including: alcolocks, crash management systems, seat-belt reminder systems, fatigue warning systems, integrated accident recorder systems, front-underrun protective devices, and intelligent speed assistance systems.

The human factors

Night-time visibility

Just 5% of the information we see in daylight are caught by the eye at night.

Day

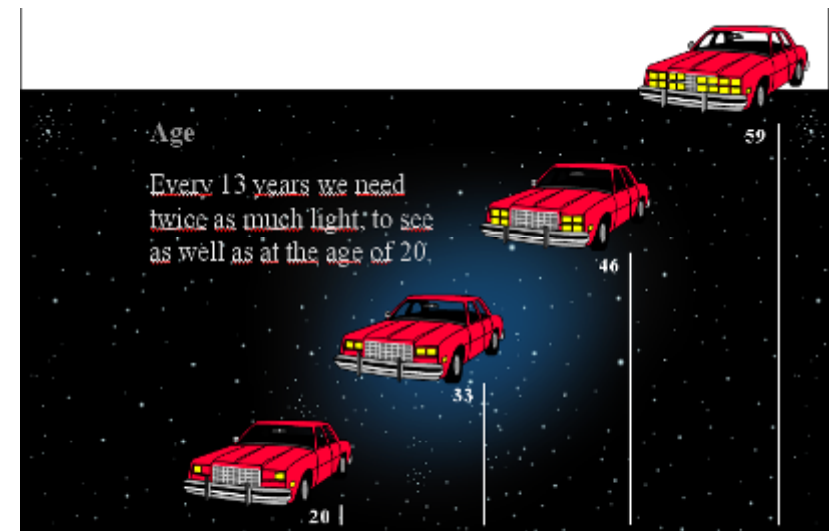


Night



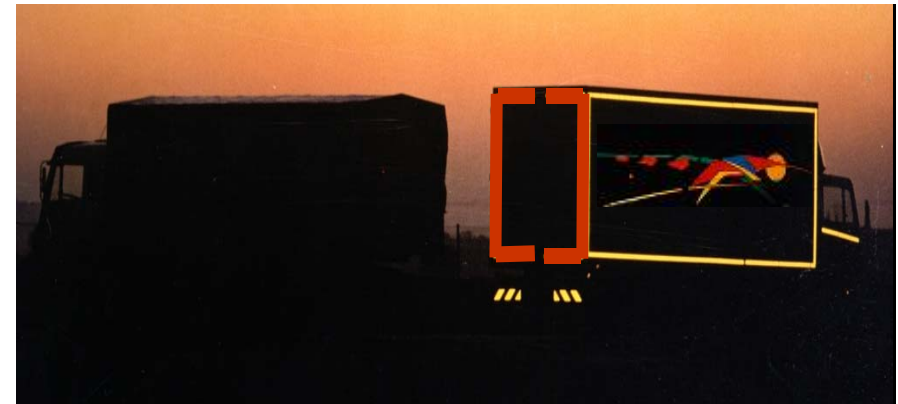
Age Factor

Every 13 years we need twice as much light to see as well as at the age of 20



Colour & Width of Marking

- Side – **Yellow** - 50mm width
- Rear – **Red** - 50mm width



Mandatory Requirements

Rear - RED Full contour markings

Vehicles exceeding 2.1m width

Side – Yellow Partial contour markings

Vehicles exceeding 6000 mm length

Applicable categories

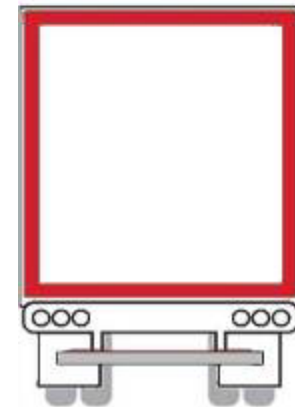
N2>7.5 ton category

N3 Category

T3 Category

T4 Category

International studies show that presence of reflective tapes result in :-
41% fewer rear end collisions
37% fewer side collisions

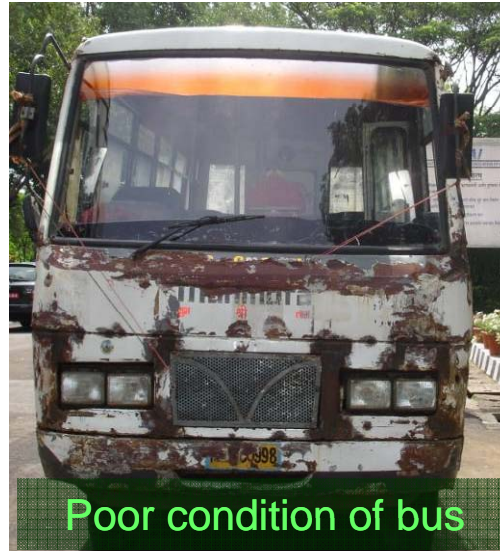


Bus Transport Industry – Existing Scenario

Unsafe practices observed



Unsafe seat designs



Poor condition of bus



Poor condition of bus



Unsafe driver's workplace



No provisions for disabled



Unsafe driver's workplace

AIS:052 - Code of practice for Bus Body Design & Approval

- ❖ Formulated with a view to bring uniformity in the bus body building and to ensure minimum acceptable level of passenger safety and comfort.
- ❖ Also, established a system of Accreditation of Bus Body Builders in the country

Following critical areas addressed in the regulation besides other general aspects -

- 🚌 Various safety related features like entry / exit door , emergency exits, window frames, their locations, dimensions and designs.
- 🚌 Standardization of the gangways and dimensions of the foot steps.
- 🚌 Dimension of seats, seating layout, lighting and illumination.
- 🚌 Driver's workplace requirements.
- 🚌 Provisions for the persons with disabilities.
- 🚌 Stability and strength evaluations of the bus body structure, seat anchorages etc., including the roll over test for the full body.
- 🚌 Requirements related to lighting, illumination, electrical equipment & wiring

All these requirements are followed by OEMs, but, majority of unorganized sector bus body builders do not follow, leading to comprise in vehicular safety.

AIS:031 - Strength of Superstructure of Large Passenger Vehicles (Type II & III Buses with more than 22 Passengers)

The Strength of superstructure of the vehicle shall be verified according to one of the following methods -

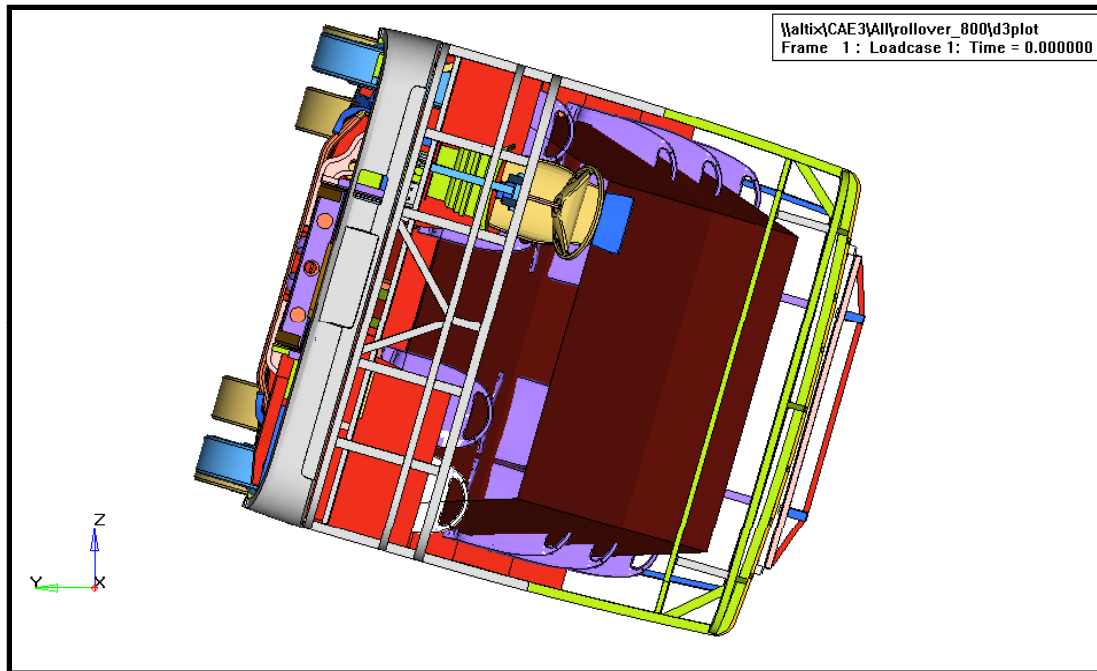
- ❖ A roll-over test on a complete vehicle
- ❖ A roll-over test on a body section or sections representative of a complete vehicle
- ❖ A pendulum test on a body section or sections
- ❖ A verification of strength of superstructure by calculation

A **Roll-over** event is one of the most crucial hazards for the safety of passengers and the crew riding in a bus.

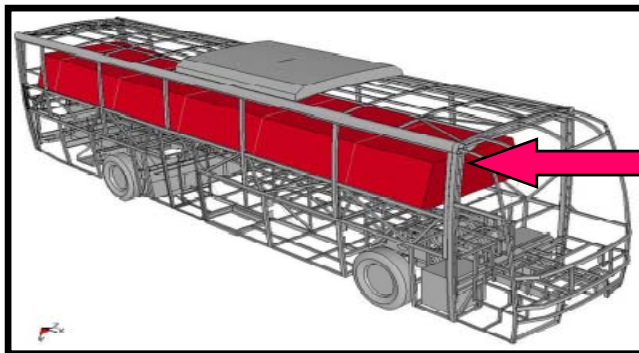
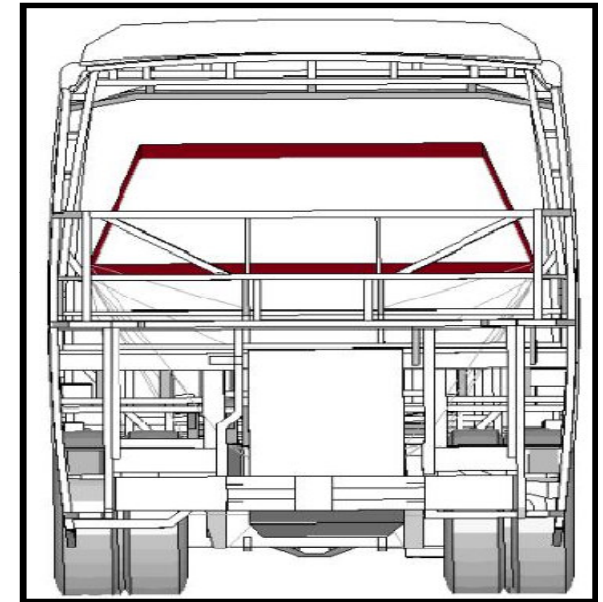


Roll Over requirements are CMVR notified & followed by OEMs. But, not by unorganized sector bus body builders, a big enforcement gap & safety concerns

AIS:031 - Strength of Superstructure of Large Passenger Vehicles

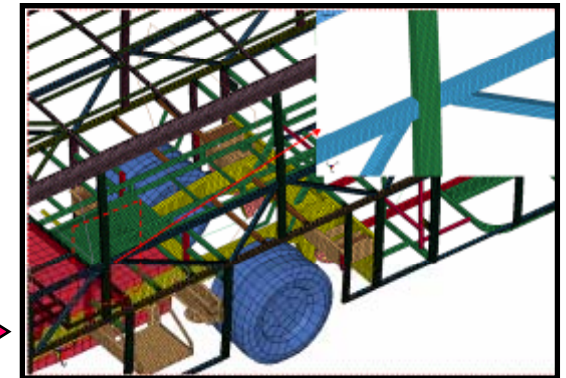


Residual Space Definition



Residual Space

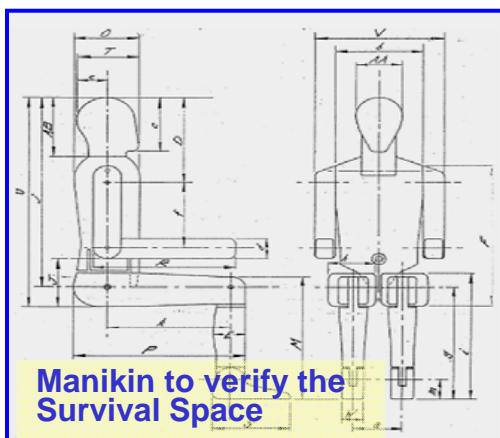
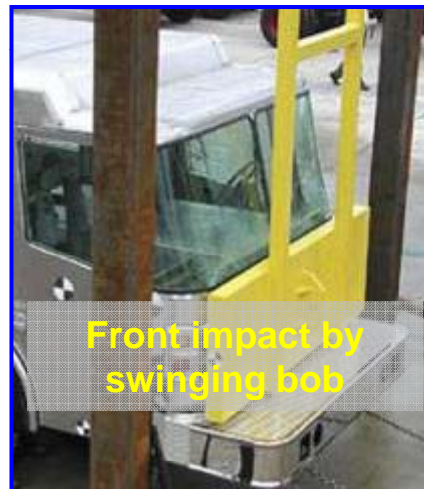
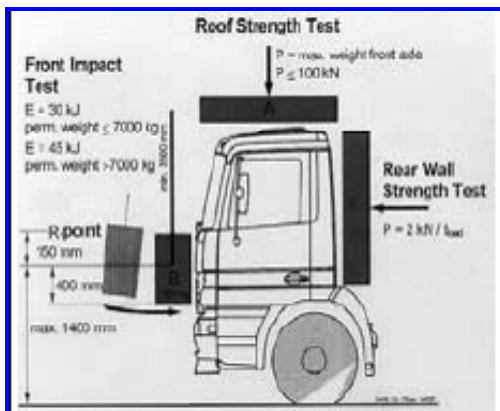
Finite Element Model



AIS:029 - Requirements of Survival Space for the Protection of the Occupants of the Cab of a Commercial Vehicle of N Category.

The **cab of the vehicle** shall be so designed and so attached to the vehicle as to eliminate to the greatest possible extent the risk of injury to the occupants in the event of an accident.

All these requirements are only followed by OEMs & not by unorganized sector Truck body builders, The enforcement need to be stringent in view of safety.



Unauthorized constructions & Unsafe vehicles

Chakda



Popular in Areas of Gujarat

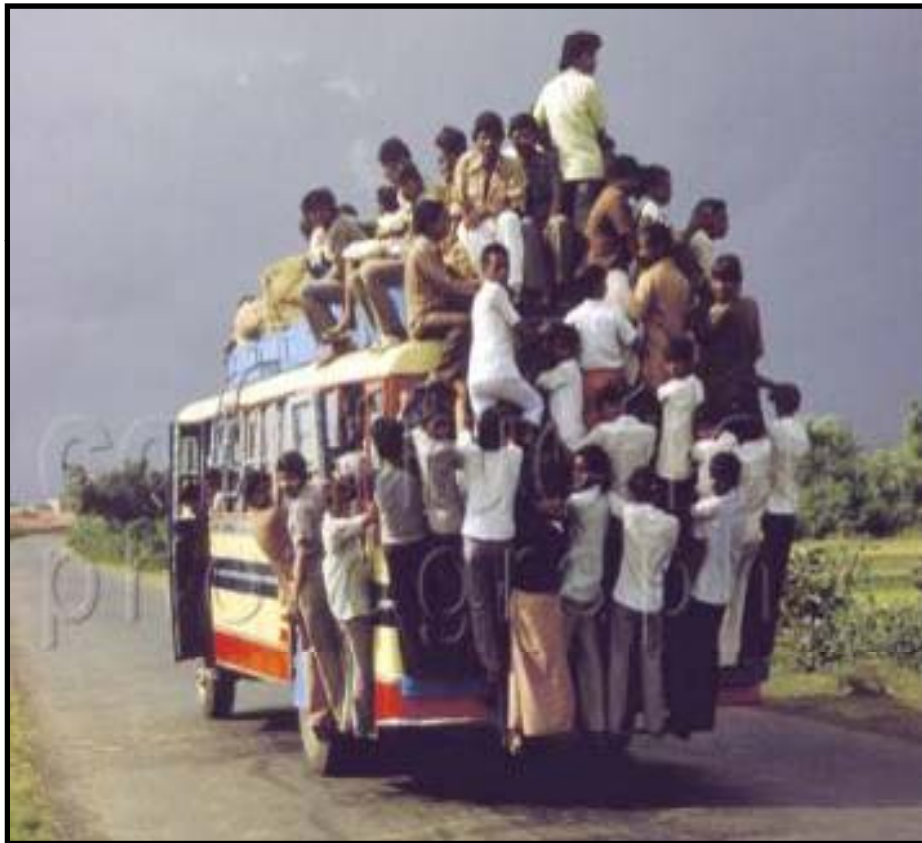
Jugad



Popular in Areas of Punjab

Over loading a major safety issue

Overloading of Bus



Overloading of Truck



Lack of Enforcement

In-service Compliance

- ❖ Validity of Certificate of fitness for transport vehicles -
 - New transport vehicle : 2 years
 - Renewal of Certificate of fitness : 1 year

- ❖ Renewal of a fitness certificate shall be made only after the Inspecting Officer or Authorized testing stations has carried the tests as specified at CMVR Rule No. 62

Strict Implementation is needed

How Relevant is Cost to Safety in India???



Two wheeler are for Two



Towards Safer & Affordable Mobility

Safety Features

1	Steering wheel conforming to impact tests	✓
2	Driver field of Vision	✓
3	Two headlight for night driving (Better road illumination)	✓
4	Doors for occupant safety	✓
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HARMONISATION WITH ECE STANDARDS

Aligned EU Regulations

EU

EU Specific Regulations

India

India Unique Regulations

Groupwise status of alignment with ECE

Group	Partially/fully aligned	Work in progress	Yet to be taken up
GRE	34	1	6
GRRF	10	5	4
GRB	5	0	2
GRSG	19	4	3
GRSP	11	5	2
GRPE	14	0	1

CMVR = Aligned EU regulations + India Unique regulations

Indian Type Approval of Passenger Cars

As per Central Motor Vehicle Rules (CMVR), 1989



ENVIRONMENT

1	Pass by Noise / Silencers: CMV Rule-120, IS:3028
2	Emissions: CMV Rule-115
3	Fuel Consumption: CMV Rule-124-31 Carbon Balance method
4	Exhaust gases: CMV Rule-112
5	Exhaust pipe location: CMV Rule-113

ACTIVE SAFETY

6	Horn Performance: CMV Rule-119, IS:1884
7	Steering Effort & TCD: CMV Rule-98, IS:11048, IS 12222
8	Horn Installation: CMV Rule-119, AIS:014
9	Drivers Field of Vision: CMV Rule 124-34, AIS:021
10	Speedometer: CMV Rule-117, IS:11827
11	Rear View mirror Performance: CMV Rule-125, AIS:001
12	Rear View mirror Installation: CMV Rule-125, AIS:002
13	Tyres Performance: CMV Rule-95, IS:15033
14	Tyres Installation: CMV Rule-95, AIS:051
15	Condition of Tyres: CMV Rule-94
16	Size & ply rating of tyres: CMVR-95
17	Brakes Fitment: CMV Rule-96
18	High Speed Braking Requirements: CMV Rule-96B
19	Brakes Performance: CMV Rule-96, IS:11852
20	Lighting/Signaling Installation: CMV Rule-124-20, AIS:008
21	Lighting/Signaling Performance: CMV Rule-124-20, AIS:012

22	Hydraulic Brake Hose: CMV Rule-124-2, IS:7079
23	Hydraulic Brake Fluid: CMV Rule-124-3, IS:8654
24	Wheel Rims: CMV Rule-124-8, IS:9436
25	Wheel nut, disc & Hub caps: CMV Rule-124-14, IS:13941
26	Hood Latch: CMV Rule-124-17, IS:14226
27	Tell Tale symbols and Controls: CMV Rule-124-19, SS: 12.1
28	Acc. Control system: CMV Rule-124-15, IS:14283
29	Windscreen Wiper: CMV Rule-101 AIS:019
30	Wheel Guards: CMV Rule-124-13, IS:13943
31	Bumpers: CMV Rule-124-41, AIS:006
32	Arrangement of Foot Controls: CMV Rule-124-45, AIS:035
33	Gradeability: CMV Rule-124-23, AIS:003
34	EMI: CMV Rule-124-21, AIS:004

PASSIVE SAFETY

35	Safety Belt: CMV Rule-125, IS:15410
36	Safety Belt, Anchorages: CMV Rule-125, IS:15130
37	Seats, their Anchorages and Head Restraints: CMV Rule-125, IS:15546
38	Exterior Projections: CMV Rule-124-11 IS:13942
39	Fuel Tank- Non Plastic: CMV Rule-124-7, IS:12056
40	Interior Fittings: CMV Rule-124-38, IS:15223
41	Safety Glass: CMV Rule-100, IS:2553
42	Steering Impact GVW upto1.5t: CMV Rule-124-5, IS:11030
43	Side door impact: CMV Rule-124-6, IS:12000
44	Door Locks & retention components: CMV Rule-124-16, IS:14225

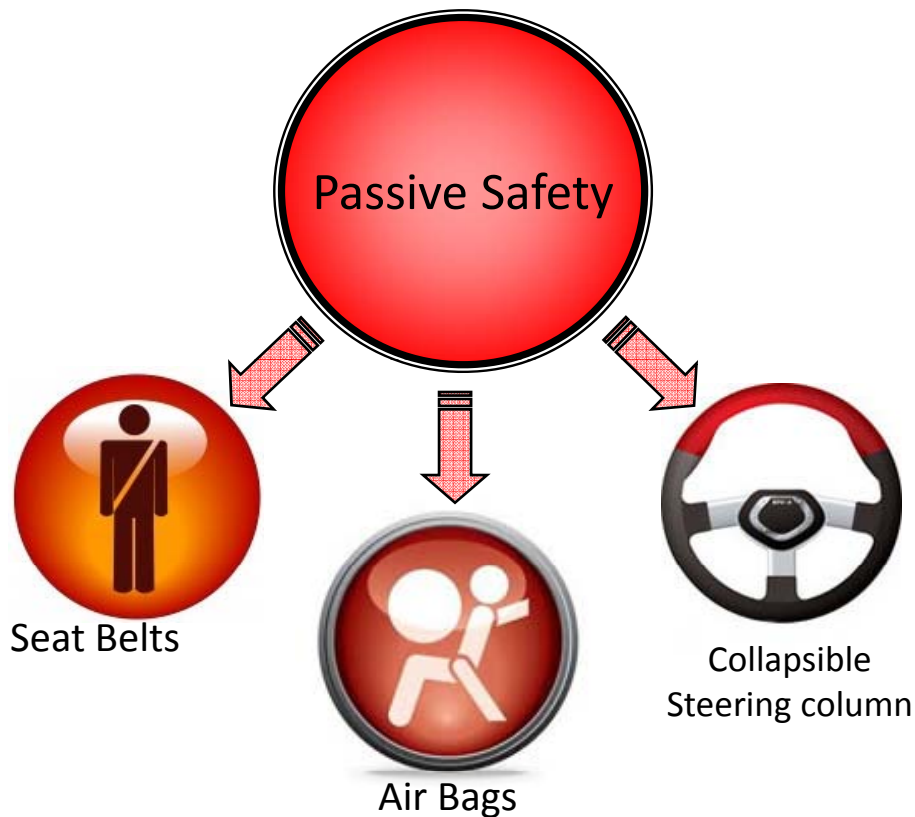
LIGHTING EQUIPMENT

45	Reflectors: CMV Rule-104, AIS:057
46	Automobile Lamps: CMV Rule-124-1 AIS:034
47	Signaling devices, direction indicators & stop lights: CMVR-102
48	Position of the indicator: CMV Rule-103
49	Headlamp height: CMV Rule-105, IS:3415
50	Deflection of lights: CMV Rule-106
51	Use of red or white light: CMVR-108
52	Parking light: CMV Rule-109
53	Prohibition of spotlights: CMV Rule-111

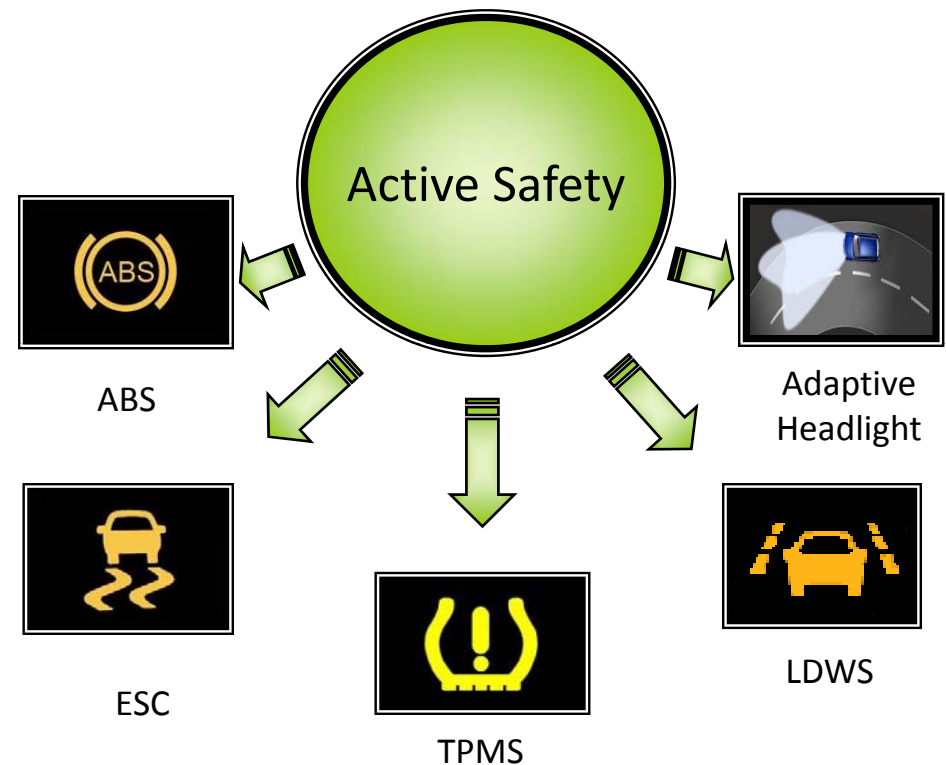
OTHER REQUIREMENTS

54	Warning Triangles: CMV Rule-138, AIS:022
55	Overall Dimensions: CMV Rule-93
56	Forward & Backward Motion: CMV Rule-99
57	Embossment of Chassis & Engine No. & Date of Manufacture (VIN):- CMV Rule-122, AIS:065

In automotive terms, the safety is categorized basically in to two types.



Facilitates the driver to avoid crash by means of the devices provided in the vehicle



Protects the occupants in the event of crash by means of the devices provided in the vehicle

Upcoming Safety Regulations

Sr	Regulation	Standard	Date of introduction
1	Interior Fittings for other than M1	AIS:047	2012 (new)/ 2013 (Existing)
2	Anti-theft Devices	AIS:075	To be notified
3	Offset Frontal Collision	AIS 098	To be notified
4	Lateral Collision	AIS 099	To be notified
5	EMC	AIS:004:Part 3	To be notified

Upcoming Safety Regulations

AIS:047 – Interior Fittings

(Specifications for other than M1 Category Vehicles)

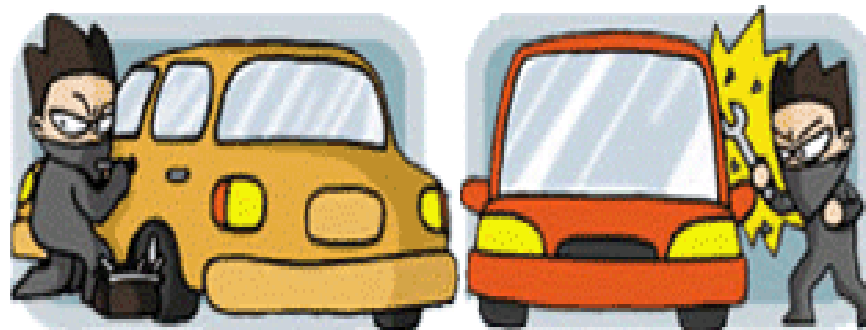
- ❖ In order to specify the **requirements of interior fittings for vehicles other than M1 category** in order **to ensure safety of the traveling passengers**
- ❖ Interior fittings covers –
 - The interior parts (other than rear view mirrors) which are contactable by the seated occupants in the front (First) row of forward facing seats when **likely to be impacted during frontal impacts** only.
 - The protrusions of controls.
- ❖ **Requirements covered are for following areas –**
 - **Forward Interior Parts above the Level of the Instrument Panel** in front of the Front Seat R point, excluding the Side Doors
 - **Forward Interior Parts below the level of the Instrument Panel** in the front of the Front Seat R point, excluding the side Doors and the Pedals



Upcoming Safety Regulations

AIS:075- Protection against unauthorised use (Anti Theft Devices)

- ❖ This standard is applicable to **all M & N** category Vehicles
- ❖ **Intended to provide essential security protection for vehicles and to prevent unauthorized use**
- ❖ **“Device to prevent unauthorized use”** means a system designed to prevent unauthorized normal activation of the engine or other source of main engine power of the vehicle in combination with at least one system which:
 - Locks the steering, or
 - Locks the transmission, or
 - Locks the gearshift control.
- ❖ **Test Requirements :**
 - Wear Producing Test
 - Torque Limiting Test For Key
 - Lock Bolt Strength Test



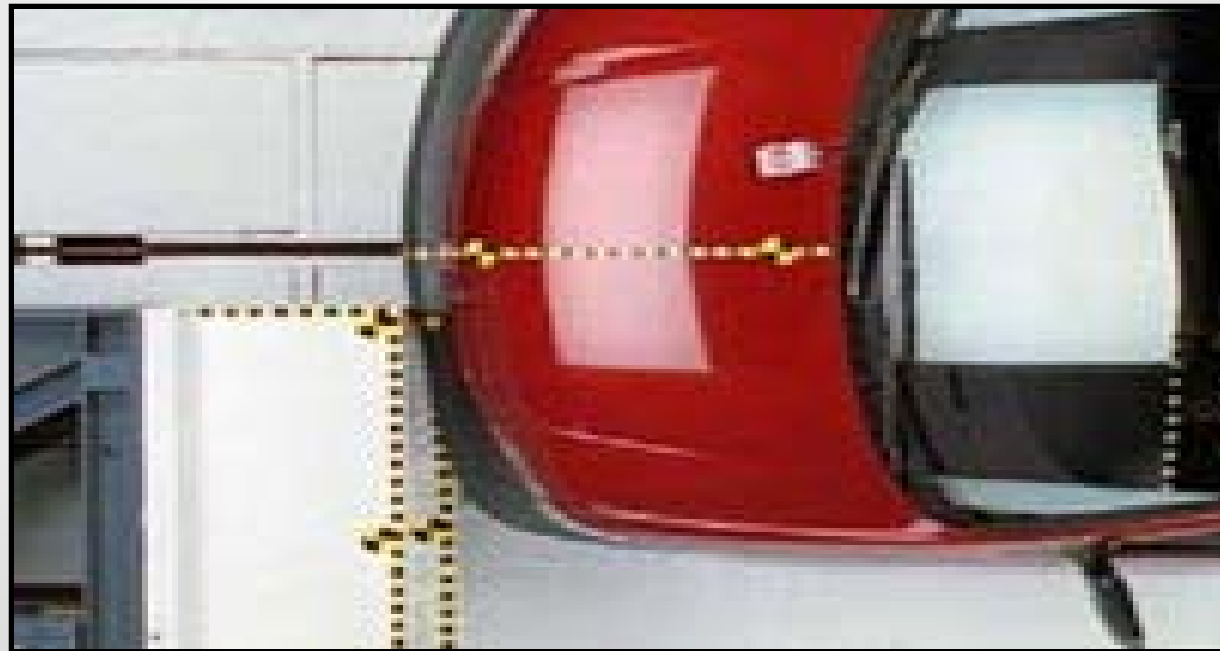
Upcoming Safety Regulations



AIS:098- Offset Frontal Collision

The vehicle shall impact a barrier overlapping face by $40\% \pm 20$ mm, first contact by steering-column side with a speed of 56 kmph.

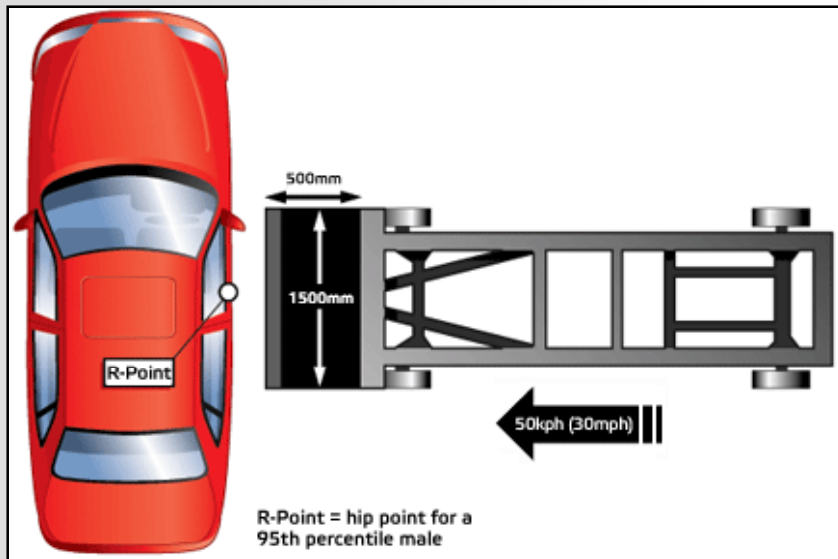
This test measures the ability of vehicle in car to car offset crash which are most common.



AIS:099 - Lateral Collision

Barrier shall impact the vehicle from side with centre line matching with R point with a speed of 50 kmph.

This test evaluates the ability of vehicle to protect occupants from side impact.



AIS-004(Part 3) - Electromagnetic Compatibility (EMC)

- ❖ **Applicable to vehicle categories L, M, N and T with regard to electromagnetic compatibility**
- ❖ **"Electromagnetic compatibility"** means the ability of a vehicle/ component(s)/ separate technical unit(s) to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.



Advance Technologies Long term Vision for India



An **airbag** is a vehicle safety device. It is an occupant restraint consisting of a flexible envelope designed to inflate rapidly during an automobile collision, to prevent occupants from striking interior objects such as the steering wheel or a window. The airbag is designed to only inflate in moderate to severe frontal crashes.

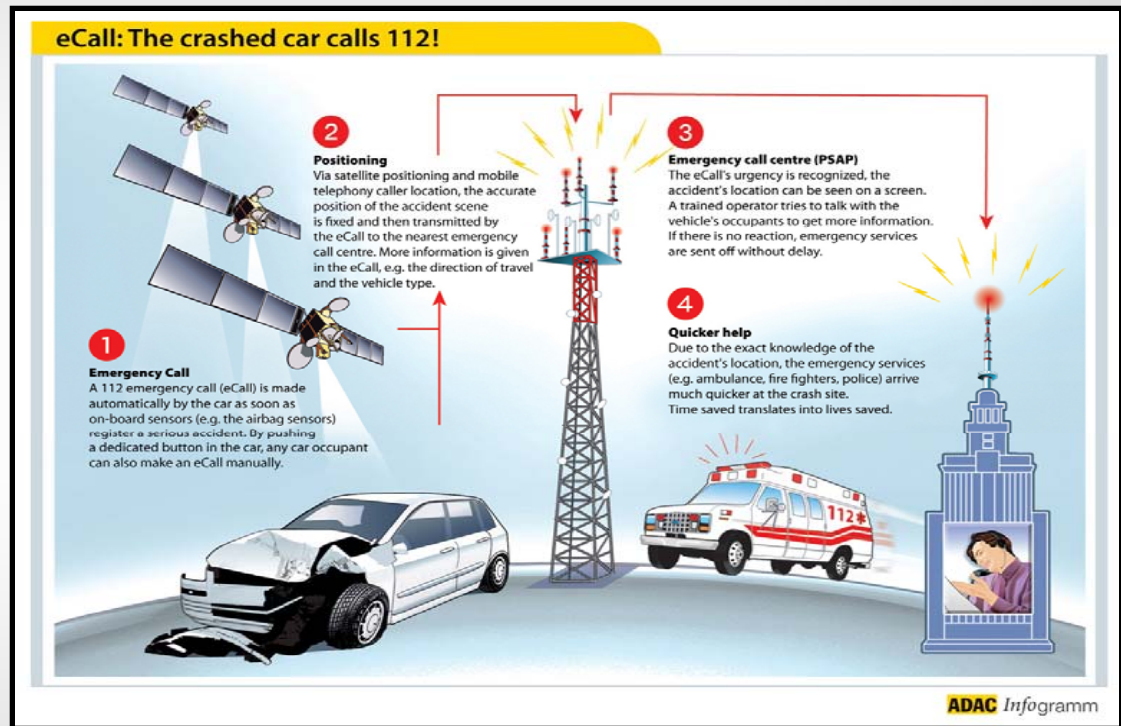
Airbags are normally designed with the intention of supplementing the protection of an occupant who is correctly restrained with a seatbelt. Most designs are inflated through pyrotechnic means and can only be operated once.



Modern vehicles may contain multiple airbags in various side and frontal locations of the passenger seating positions, and sensors may deploy one or more airbags in an impact zone at variable rates based on the type and severity of impact

eCall is a project of the European Commission intended to bring rapid assistance to motorists involved in a collision anywhere in the European Union. The hardware black box installed in vehicles that will wirelessly send airbag deployment and impact sensor information, as well as GPS coordinates to local emergency agencies.

In case of a crash, an eCall-equipped car automatically calls the nearest emergency centre. Even if no passenger is able to speak, e.g. due to injuries, a 'Minimum Set of Data' is sent, which includes the exact location of the crash site.



eCall cuts emergency services response time. It goes down to 50% in the countryside and 60% in built-up areas. The quicker response will save hundreds of lives in the EU every year. You can also make an eCall by pushing a button inside the car.

Active Safety

Antilock braking system (ABS)

Electronic Stability Control (ESC)

Lane Change Assist System (LCA)

Lane Departure Warning System (LDWS)

Adaptive Cruise Control (ACC)

Adaptive headlights

Advanced Emergency Braking System (AEBS)

Reverse Parking Assist System

Tyre Pressure Monitoring System (TPMS)

Night Vision Devices

Child Locks

Alcolocks

Warning triangles & Retro-reflective devices

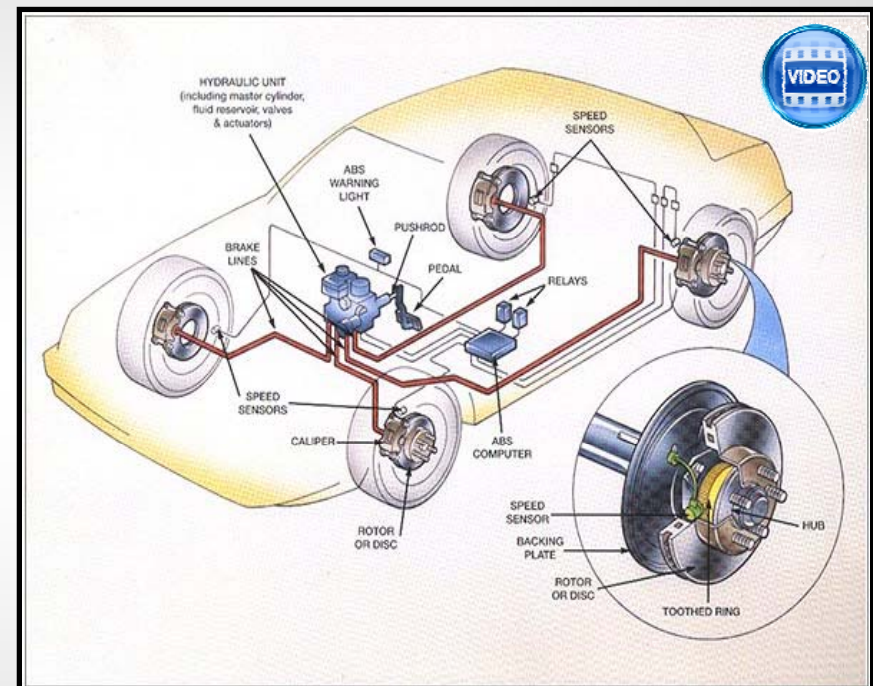
Antilock Braking System (ABS)

An anti-lock braking system (ABS) is a safety system that allows the wheels on a motor vehicle to continue interacting tractively with the road surface as directed by driver steering inputs while braking, preventing the wheels from locking up and therefore avoiding skidding.

A typical ABS includes a central electronic control unit (ECU), four wheel speed sensors, and at least two hydraulic valves within the brake hydraulics.

The ECU constantly monitors the rotational speed of each wheel, if it detects a wheel rotating significantly slower than the others, a condition indicative of impending wheel lock, it actuates the valves to reduce hydraulic pressure to the brake at the affected wheel, thus reducing the braking force on that wheel, the wheel then turns faster.

ABS system are most helpful in snow areas like Europe, where the chances of skid are more. In India due to hot weather the effectiveness of the ABS is not significant.



Electronic Stability Control (ESC/ESP)



Electronic stability control (ESC) is a computerized technology that improves safety of a vehicle's stability by detecting and minimizing skids. When ESC detects loss of steering control, it automatically applies the brakes to help "steer" the vehicle where the driver intends to go.

Braking is automatically applied to wheels individually, such as the outer front wheel to counter over steer or the inner rear wheel to counter under steer.

ESC estimates the direction of the skid, and then applies the brakes to individual wheels asymmetrically in order to create torque about the vehicle's vertical axis, opposing the skid and bringing the vehicle back in line with the driver's commanded direction.

Additionally, the system may reduce engine power or operate the transmission to slow the vehicle down.



Adaptive Cruise Control (ACC)

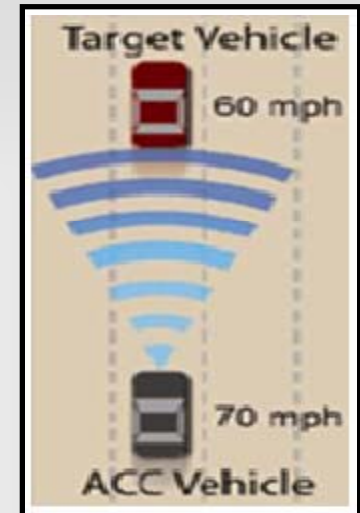


A conventional cruise control system controls the vehicle speed by adjusting throttle position to maintain a speed set by the driver. An Adaptive Cruise Control (ACC) is an extension of conventional system and is designed to maintain a set following distance from the vehicle ahead. The ACC system is designed to assist the driver and is not fully independent system like Advance emergency braking system.

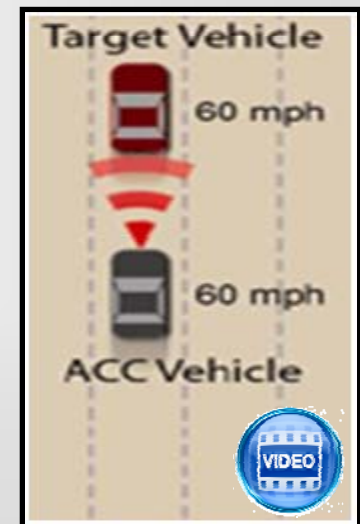
Adaptive Cruise Control (ACC) technology automatically adjust the vehicle speed and distance to that of a target vehicle. ACC uses a long range radar sensor to detect a target vehicle up to 200 meters in front and automatically adjusts the ACC vehicle speed and gap accordingly.

ACC automatically decelerates or accelerates the vehicle according to the desired speed and distance settings established by the driver. As per standard cruise control the driver can override the system at any time.

Initial scenario



Final scenario



Adaptive Headlights

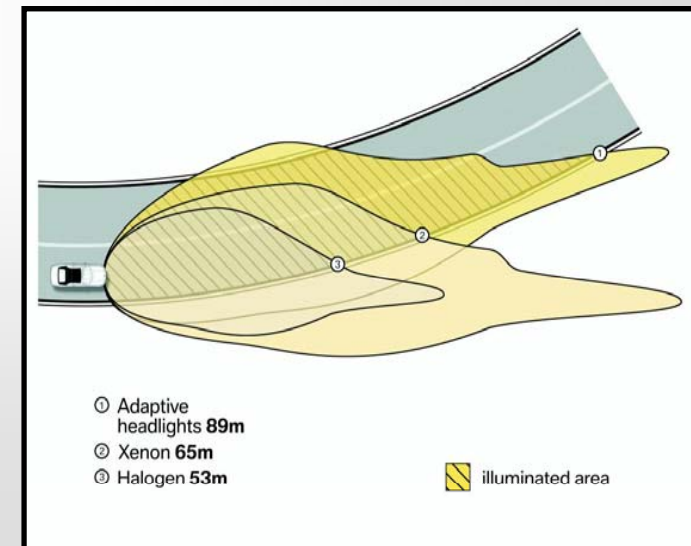
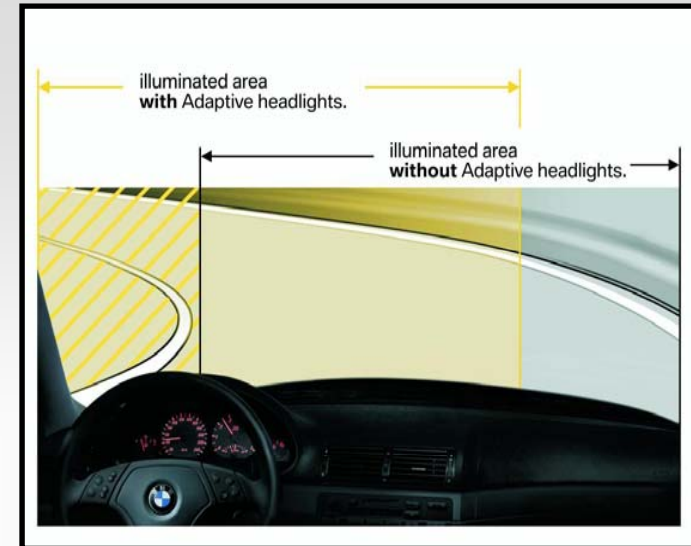


Adaptive Headlights ensure that you have the best possible view of the road ahead, even at night. As you enter a curve, the headlight's beam turns to follow the direction of the road.

Conventional fixed headlights cast their beam straight ahead only. On bends, this means the beam can fall on the oncoming traffic, blinding other drivers while leaving the road ahead in darkness.

In contrast, Adaptive Headlights use swiveling headlights that always point in the direction the vehicle is steering. The road ahead is better illuminated and obstacles become visible sooner.

Based on this information, small electric motors turn the headlights so the beam falls on the road ahead, guiding you into the bend.



Advanced Emergency Braking System (AEBS)

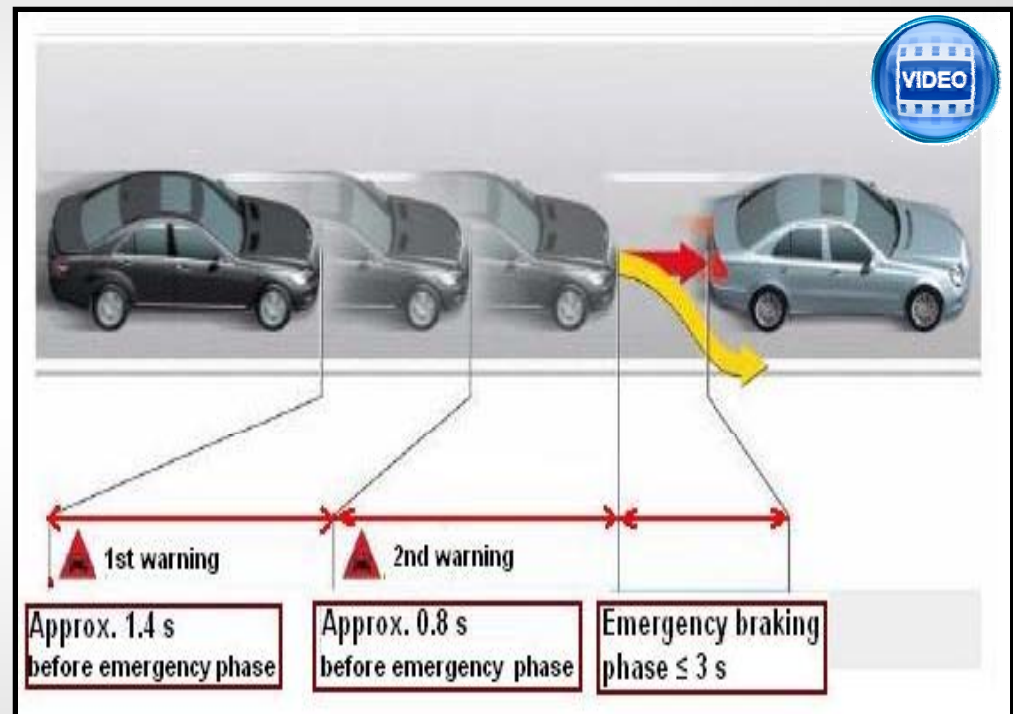


Advanced Emergency Braking system (AEBS) means a system which can automatically detect a potentially forward collision and activate the vehicle braking system to decelerate the vehicle with the purpose of avoiding or mitigating a collision.

AEBS combines the data from forward looking radar and video systems to provide a complete, accurate and real-time picture of the road ahead.

These sensors independently gather data of the road in front of the host vehicle, radar looks forward, while the camera covers a closer, but wider field of view and helps to detect and classify objects in front.

The system recognizes the moving targets (cars, trucks, motor cycles etc) as long as they are moving and even if they come to a complete stop.



Reverse Parking Assist System



A reverse parking-assist system, helps the driver sense when objects are in the vehicle's "blind spot," at rear and help prevent the accidents caused while backing up.

The two common types of systems are.

The audible parking assist system uses ultrasonic technology to determine how close the vehicle is to an object.

An ultrasonic system bounces harmless high-frequency sound waves off objects to the sensors, where they are interpreted to measure the distance of the object from the rear bumper. Warning tones inside the vehicle change pitch or frequency as the proximity to the object changes.

A more advanced parking-assist system utilizes a small camera mounted in a protected area on the rear of the vehicle. A wide-angle view of the vicinity immediately behind the rear bumper is projected on a small display on the instrument panel or dashboard.



Tyre Pressure Monitoring System (TPMS)



The fuel economy of any vehicle is mainly depends on the inflation pressure maintained inside the tyres. If less, it could significantly increase the fuel consumption & CO2 emission. The TPMS warns driver of low inflation so that he can inflate tyres at appropriate time.

A TPMS is an electronic system designed to monitor the air pressure inside all the pneumatic tyres on automobiles.

These systems report real time tyre pressure information to the driver of the vehicle either via a gauge, a pictogram display, or a simple low pressure warning light.



The communication interface is either by direct physical sensors operated with battery or through indirect sensors by monitoring individual wheel rotational speeds, and other signals available outside the tire itself.

Automotive Night Vision Devices.



An automotive night vision system is a system to increase a vehicle driver's perception and seeing distance in darkness or poor weather beyond the reach of the vehicle's headlights. They are currently offered as optional equipment on certain premium vehicles.

There are two types of systems, either passive or active systems.

Active systems use an infrared light source built into the car to illuminate the road ahead with light that is invisible to humans.

The active systems provide high resolution images & effective in warmer conditions but have limitation of short range 150-200m and are not efficient in fog or rain.

Passive systems capture existing thermal radiation emitted by the objects using a thermographic camera. These systems provide greater range above 300 m & works fine in rain or fog conditions but the quality of image is grainy and doesn't work efficiently in warmer weather conditions



Lane Change Assist System (Blind Spot Monitoring System)

The Lane change assist system warns & helps driver to identify the vehicles in the blind spot zone so that he could take timely decision to change line or not.

To avoid distraction due to repetitive warnings, it ignores the Stationary objects, Oncoming vehicles & Vehicles which are more than one lane across.

The lane change assist sensor system consists of two radar units. The devices are mounted in the corners of the rear bumper behind the fascia at a certain mechanical squinting angle.

The field of view is selected to cover most of the blind spot warning zone, and an area containing three lanes (left neighbor, driving and right neighbor lane) 70m back.



It operates on straight roads as well as in curves down to a certain radius. This is achieved by a special antenna design in combination with detection algorithms that exploit intentional side lobes of the beam pattern.

Lane Departure Warning System (LDWS)



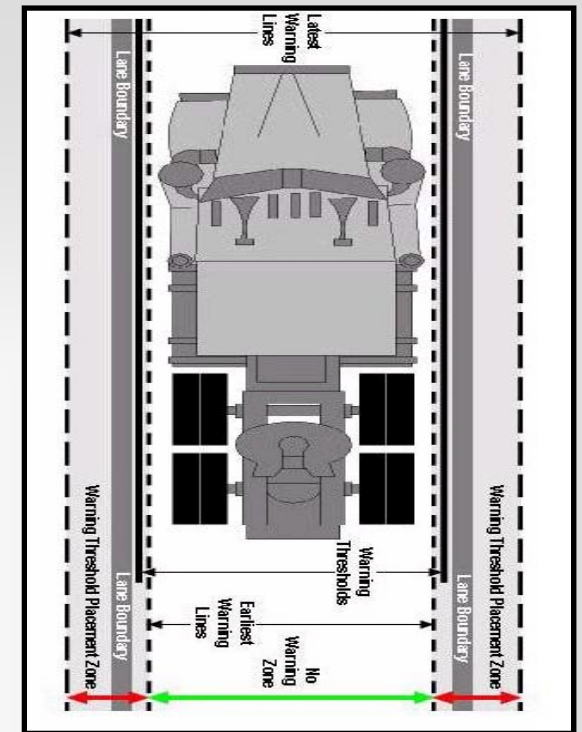
A Lane departure warning system (LDW) is a mechanism designed to warn a driver when the vehicle begins to move out of its lane, unless a turn signal is on.

The driver is warned of unintentional lane departures by an audible rumble strip sound generated on the side of the vehicle drifting out of the lane.

The LDWS calculates an earliest and latest warning line. As shown in Figure above, the "earliest warning line" is inside the lane boundary and the "latest warning line" is outside the lane boundary.

Whenever the vehicle crosses out of the no warning zone into the zone between the earliest warning line and latest warning line, the LDWS issues a lane departure warning.

As the road marking in India are not maintained and many of the roads do not have any marking, these systems are not useful to be implemented.



Thank You