



## Corrosion Performance Survey of Cars Manufactured in India

In the summer of 2015, the IIT Bombay conducted a study to evaluate the corrosion performance of automotive body panels in the challenging climatic environments of India's more than 7,000 km long coastline.

Indian car bodies are typically made of painted cold rolled steel panels. However, steel if not adequately protected will corrode when exposed to the atmosphere. This study will help car manufacturers to improve corrosion protection of their steel panels by providing reliable baseline corrosion data that allow comparison of the corrosion performance of domestic car body panels made of cold rolled steel panels versus those made of galvanized steel. The use of galvanized steel body panels to prevent auto body corrosion is the norm in Europe, North America, Japan and Korea, and in those countries greatly extends vehicle life. Car manufacturers in Europe and North America started to galvanize their steel-based body panels at large in the late 1980s and 1990s. As a result, today they provide corrosion warranties of 10 years or longer. The goal of this study was to determine if the same advantages could be brought to India. The cost of galvanizing is insignificant compared to the cost of premature repair and replacement of cars.

A car is one of the highest expenses an Indian family incurs and hence there is a need to ensure that these automobiles have as long a life as possible and can withstand the aggressive climate conditions of coastal and near coastal areas, where corrosion can be high.

### The Survey

Similar to the corrosion performance survey carried out in North America in the 1990s, IIT Bombay focused on the inspection of major exterior car body panels for corrosion failures. Inner panels and under body panels were excluded from the survey.

The survey was conducted at three sites near the sea in the Mumbai area: Juhu, Gorai and Powai. These areas were chosen for the presence of aggressive chloride ions in combination with significant industrial pollution and the high density of cars.

A total of 455 cars ranging from 5-15 years were inspected. Cars taken into consideration included cars below Rs. 10,000 lakh typically used by an average Indian family. Car models included sedans and hatchbacks from major car manufacturers in India including Maruti, Honda, Hyundai, Tata, Chevrolet, Ford and Mahindra. Cars were found at housing society parking lots. Particular attention was paid to the fact that they came from the region to ensure they were regularly exposed to the aggressive coastal climate.

### Definition of Corrosion Noted:

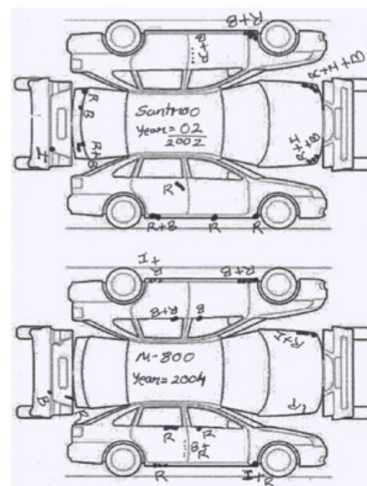
Blister= any bubbling of paint on the surface of the painted car body

Surface rust = any area where the paint has been removed and any underlying steel surface was rusted

Perforation = any complete penetration of the sheet metal that leaves a hole visible to the naked eye

## Field Analysis

Two surveyor teams each consisting of two people examined the cars for corrosion failures on the engine hood, trunk deck, rocker (sill) panel, and door panels around the handles. Schematic diagrams of cars featuring these four panel areas were given to the teams to mark the imperfections on the part. Imperfections with a minimum of 1x1 cm or a group of imperfections corresponding to that size were considered. The teams inspected 30-40 cars per day and recorded also the car model and brand as indicated on the car; and the year of manufacture based on the last two digits of the Vehicle Identification Number (VIN) which is visible through the windshield on all Indian vehicles.



## Findings

- Most cars inspected were 5-9 years old and were built between 2006-2010. The number of inspected cars older than 9 years was insignificant and thus had no statistical relevance.

- Maruti, Hyundai and Honda constituted more than 80% of the inspected cars.

- The results of the survey show the correlation between the level of corrosion failure in the automotive body and the age of the vehicle. The older the car the more serious the level of corrosion.

- Blistering and surface rust represented major corrosion issues while perforation was not yet an issue.

- Out of the four car body parts inspected rocker (sill) panels showed the highest level of corrosion in terms of blisters and surface rust. This can be explained by their location closest to the road.

- The percentage of imperfections recorded in Mumbai is similar to the findings in Michigan, USA in the 1990s. This analogy, despite the high amounts de-icing salts used in Michigan, suggests that Indian coastal areas provide a highly aggressive environment that accelerates the corrosion.

Model Year	Manufacturer						
	Maruti	Hyundai	Honda	Tata	Ford	Chevrolet	Mahindra
2000	0	1	0	0	0	0	0
2001	2	3	0	0	0	0	0
2002	4	1	0	0	0	0	0
2003	8	3	1	2	0	0	0
2004	5	4	3	2	0	0	1
2005	2	7	1	3	0	1	0
2006	16	4	7	5	7	2	0
2007	18	12	7	7	1	1	0
2008	34	22	16	14	4	1	0
2009	31	29	18	10	0	2	1
2010	43	37	24	24	0	3	2

Model Year	Vehicle Age	no. of vehicles inspected	Quantity/Percentage of Imperfection Type					
			Blistering		Surface Rust		Perforation	
			no.	%	no.	%	no.	%
2000	15	1	1	100%	1	100%	0	0%
2001	14	5	4	80%	5	100%	4	80%
2002	13	5	5	100%	5	100%	3	60%
2003	12	14	14	100%	12	86%	6	43%
2004	11	15	13	87%	15	100%	2	15%
2005	10	14	11	79%	12	86%	2	18%
2006	9	41	38	93%	33	92%	4	11%
2007	8	46	37	80%	26	67%	0	0%
2008	7	91	68	75%	56	85%	0	0%
2009	6	91	64	70%	46	79%	1	2%
2010	5	133	79	59%	56	65%	1	1%

## Conclusions

The high level of corrosion failure reported on inspected cars in Mumbai suggests that a conversion from cold rolled steel to galvanized steel will significantly improve corrosion performance thus significantly extending the life of steel-based cars.

Indian coastal areas provide a highly aggressive environment that accelerates the corrosion of car bodies. The percentage of imperfections noted in the Mumbai survey was surprisingly similar to the findings in Michigan, USA survey in the 1990s.

The four worst panels affected by corrosion were the engine hood, trunk deck, rocker (sill) panel, and door panel around handles.

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