

# New investigation of the corrosion resistance of cars

Swerea KIMAB has performed an extensive investigation of the corrosion resistance on crevice surfaces of spot-welded joints and hem flanges of 30 of the most common car models in the Nordic countries. The examined cars of year models 2002–2005 have been in use, for 3–6 years by the time the investigation was performed. Pieces from doors, hoods, trunk lids, rear wings, and rocker panels have been sawn from car bodies and the crevices opened and the surfaces examined with respect to corrosion attack and the effect of different corrosion protection measures i.e. design, surface treatment, adhesives, sealers and anti-corrosion agents. With the method used by sawing pieces of the car body and opening the crevices the corrosion can be detected before it is visible from the exterior.

The examined body parts come from approximately 1000 collision damaged cars collected at car dismantling plants in Sweden, Denmark, Finland, and Norway. The areas in which the investigated cars have been driven belong to one of the most corrosive road environment in the world due to frequent use of de-icing material during the winter period.

The overall corrosion resistance of the cars of 2002–2005 year models has become better compared with 1998–2001 year models studied in a previous investigation. Even though the corrosion resistance has increased among the investigated car models corrosion is still a problem for many car models.

A major difference in corrosion resistance can be observed among the investigated car models. Audi A4, Volvo 70-series, and Volkswagen Golf showed the best corrosion resistance among the 2002/2003 year models. Most degree of corrosion of the 2002/2003 models was observed on Chevrolet Trans Sport, Mazda 6 and Ford Focus. Best corrosion resistance among the 2004/2005 models showed BMW 5-series, Nissan Micra, Renault Megane, and Volvo 40-series but another 10-12 car models also showed a good corrosion resistance after 3–4 years in use. Most degree of corrosion on the 2004/2005 models was observed on Hyundai Santa Fe, Kia Picanto and Ford Focus.

The investigation show that the most important factors to achieve a good corrosion resistance of the car body are:

- Good design to avoid unnecessary joints and to avoid direct splash of road mud into existing joints and hem flanges.
- Metallic surface coating on the steel sheet or body parts of aluminium.
- EC-primer with good adhesion to the metallic surface and good penetration into crevices.
- Proper applied adhesives in hem flanges with good coverage of glue protecting the hem flanges from moisture and road mud.
- Sealer with good adhesion and quality to cover the opening of the hem flange.
- To apply EC-primer before the sealer.
- Treatment with anti-corrosion agents in cavities that penetrates and protects crevice surfaces which are not fully covered with adhesives.

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Swerea KIMAB is a fusion between Swedish Corrosion Institute and Institute of Metals Research and is one of Europe's leading research institute within corrosion and metals research. Swerea KIMAB is a part of the Swerea Group, owned jointly by Swedish industry and the government of Sweden.

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**Investigation of perforation corrosion status of different car models, 2002-2005**

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## Abstract

The corrosion resistance on crevice surfaces of spot-welded joints and hem flanges of 30 of the most common car models in the Nordic countries has been studied in an extensive investigation. The examined cars of year models 2002, 2003, 2004 and 2005 have been in use, for 3-6 years by the time the investigation was performed. Pieces from doors, hoods, trunk lids, rear wings, and rocker panels have been sawn from car bodies and the crevices opened and the surfaces examined with respect to corrosion attack and the effect of different corrosion protection measures i.e. design, surface treatment, adhesives, sealers and anti-corrosion agents. With the method used by sawing pieces of the car body and opening the crevices the corrosion can be detected before it is visible from the exterior. The examined body parts come from approximately 1000 collision damaged cars collected at car dismantling plants in Sweden, Denmark, Finland, and Norway. The areas in which the investigated cars have been driven belong to one of the most corrosive road environment in the world due to frequent use of de-icing material during the winter period.

The performed investigation shows the status of risk of perforation corrosion on 2002-2005 car models after 3-6 years in use. The overall corrosion resistance of the cars of 2002-2005 year models has become better compared with 1998-2001 year models studied in a previous investigation. Even though the corrosion resistance has increased among the investigated car models is corrosion still a problem for many car models.

Audi A4, Volvo 70-series, and Volkswagen Golf showed the best corrosion resistance among the 2002/2003 year models. Most degree of corrosion of the 2002/2003 models was observed on Chevrolet Trans Sport, Mazda 6 and Ford Focus. Best corrosion resistance among the 2004/2005 models showed BMW 5-series, Nissan Micra, Renault Megane, and Volvo 40-series but another 10-12 car models also showed a good corrosion resistance after 3-4 years in use. Most degree of corrosion on the 2004/2005 models was observed on Hyundai Santa Fe, Kia Picanto and Ford Focus.

The investigation show that the most important factors to achieve a good corrosion resistance of the car body are:

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- Sealer with good adhesion and quality to cover the opening of the hem flange.
- To apply EC-primer before the sealer.
- Treatment with anti-corrosion agents in cavities that penetrates and protects crevice surfaces which are not fully covered with adhesives.

Table 5. Ranking and mean score degree of corrosion of the 2002/2003 models.

2002/2003 year models	Mean score	Number of inspected vehicles	Number of inspected surfaces
Audi A4	0,02	12	54
Volvo 70-series	0,04	38	160
VW Golf	0,06	30	126
Mercedes C-class	0,07	9	30
Opel Astra	0,07	34	118
Renault Megane	0,07	61	280
Volvo 40-series	0,08	15	58
VW Passat	0,09	9	34
Mitsubishi Carisma	0,12	10	34
Skoda Octavia	0,17	12	52
Nissan Micra	0,21	13	52
Peugeot 307	0,21	24	110
Citroën C5	0,22	19	50
Saab 9-5	0,22	18	62
Fiat Punto	0,25	21	110
Saab 9-3	0,28	28	112
BMW 3-series	0,34	15	50
Toyota Corolla	0,35	29	120
Mercedes E-class	0,47	8	30
BMW 5-series	0,59	15	52
Ford Mondeo	0,65	29	110
Seat Ibiza	0,70	13	42
Ford Focus	0,88	43	144
Mazda 6	1,24	7	34
Chevrolet Trans Sport	1,64	7	36

Median car

Significant lower corrosion resistance than the median car

Car models excluded in the ranking due to low number of inspected vehicles:

Hyundai Santa Fe

Table 6. Ranking and mean score degree of corrosion of the 2004/2005 models.

2004/2005 year models	Mean score	Number of inspected vehicles	Number of inspected surfaces
BMW 5-series	0,01	16	68
Nissan Micra	0,02	15	60
Renault Megane	0,02	22	94
Volvo 40-series	0,02	23	84
Ford Mondeo	0,03	12	34
Peugeot 307	0,03	22	104
Saab 9-3	0,03	26	94
Fiat Punto	0,04	6	26
Volvo 70-series	0,04	38	112
Opel Astra	0,05	20	88
Saab 9-5	0,05	37	112
Skoda Octavia	0,06	14	64
Citroën C5	0,08	9	24
VW Golf	0,08	19	82
Mercedes A-class	0,11	5	18
VW Passat	0,13	6	18
BMW 3-series	0,21	13	46
Toyota Corolla	0,24	36	136
Hyundai Tucson	0,28	5	18
Ford Focus	0,39	44	202
Kia Picanto	0,43	19	74
Hyundai Santa Fe	0,96	8	34

Median car

Significant lower corrosion resistance than the median car

Car models excluded in the ranking due to low number of inspected vehicles:

Audi A4, Mazda 3, Mazda 6, Mercedes C-class, Mercedes E-class and Seat Ibiza