



Rectification and Analysis of Water Intrusion in the Vehicle

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ABSTRACT

Water intrusion into passenger vehicles is one of the biggest warranty issues and customer dissatisfies facing the automotive industry today. To address this problem, manufacturers have implemented numerous design, engineering, development, test, manufacturing, and auditing facilities and procedures to keep vehicles from leaking and to keep leaky vehicles from getting to the customer. Various problems due to shower leakages are as follows water affects the electronic parts and may cause permanent damage, also leakage inside vehicle takes place due to improper joints which symbolizes the quality of vehicle and it causes discomfort to the consumer. The main aim of this paper is, to collect data of shower leakages, Rectification of leakage problems, Finding the permanent solution.

Key Words: water intrusion, tailgate water leakage, door water leakage.

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INTRODUCTION

Water intrusion into passenger vehicles is one of the biggest warranty issues and customer dissatisfiesfacing the automotive industry today. To address this problem, manufacturers have implemented numerous design, engineering, development, test, manufacturing, and auditing facilities and procedures to keep vehicles from leaking and to keep leaky vehicles from getting to the customer. Some of these efforts work well, and others are not so successful. In addition to traditional body sealing, water management, dynamic airflow, and many other factors are being studied for their effects on water intrusion. More and more, systems engineering approach is being applied to water intrusion issues [1]. Competition in the automotive industry is tougher today than it's ever been, with hundreds of models built by manufacturers worldwide. As a result of the stiff competition, every manufacturer seeks total customer satisfaction, and attention to detail becomes paramount in the fight for market share. Now the customers pay special attention to safety, convenience, opening and closing efforts, sound insulation, fit and finish, and other ergonomic issues. Never before has total vehicle quality been more important [2]. There are so many defects occur in vehicle assembly. These defects can be reduced with the help of following techniques. Ulrich Wolff et al.studied that ToF-SIMS and LAMMA®, two different mass spectroscopic methods with the ability of trace analysis are often used for the investigation of paint defects. Both techniques are similar but their ability of characterization and identification of paint defects however are different [3]. M. Torkar et al. analyses that the hydrogen, which remains dissolved in the steel after galvanic zinc coating, was the reason for the defects in the paint of the bonnet [4]. Helen H. Louet al. suggested that effectiveness of the proactive QC requires the appropriate use of available knowledge and information as much as possible. This suggests the adoption of different process modeling and decision-making techniques. The efficiency of the methodology is demonstrated through illustrating an intelligent hierarchical decision support tool, namely DRACO, for the defect reduction in automotive coating operations. The proactive QC methodology is general and thus is, in principle, applicable to any manufacturing processes [5]. Javad Jassbi et al. said that to improve quality film build and reduce defects, identification variables are essential. Variables influencing the process of painting in a painting hall in a topcoat booth were measured. A neural network model was proposed for the process and was subsequently analyzed through a neural network and regression method[6].

Various problems due to shower leakages are as follows:

a. Water affects the electronic parts and may cause permanent damage.

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- b. Leakages inside the vehicle are due to improper joints which symbolizes the quality of vehicle.
- c. Water leakage inside the vehicle causes discomfort to the consumer. In light of such a competitive, almost hostile, environment, water intrusion into a vehicle can do irreparable damage to a manufacturer's reputation. The main aim of this paper is, to collect data of shower leakages, Rectification of leakage problems, Finding the permanent solution.

It is very important to prevent water leakage because various problems due to shower leakages:

- a. Water affects the electronic parts and may cause permanent damage.
- b. Leakages inside the vehicle are due to improper joints which symbolises the quality of vehicle.
- c. Water leakage inside the vehicle causes discomfort to the consumer.

DATA COLLECTION

Water leaks are hard to pinpoint, but once you find exactly where the water is coming in, then it's a matter of getting to it and repairing it. Body seams are the second major cause water leaking in your car. Seams that have not been properly sealed at the factory, or seams that have been opened from a car accident, will usually cause the mystery water leak, finding the point of entry is half the battle.

The water leakage is of many types. Water leakage may occur at any point. So here is list as shown in table 1 of 1month data, having some water leakage issue observed in some automobile plant with count.

Table 1 water leakage issues with count

| Sr. No. | Defects | Count |
|---------|--------------------------|-------|
| 1 | Tailgate water leakage | 145 |
| 2 | Door water leakage | 95 |
| 3 | Windshield water leakage | 14 |
| 4 | Roof water leakage | 11 |
| 5 | Carpet water leakage | 8 |
| 5 | Headlamp water leakage | 2 |
| | Total | 275 |

EXPERIMENTAL WORK

Definition of water leak: Any water entry to the inside of the vehicle independent of the size or the speed detected during water test.

Vehicles entering the water test have to be in completely finished condition, however, parts that do not influence the test results can be installed later on. Vehicles have to be tested without any changes or special treatments prior to the test. Each water leakage has to be recorded, reported and repaired. All repaired vehicles have to be reprocessed through the water test. An alarm and escalation process has to be in place following Opel/Vauxhall Quality requirements and in line with equivalent processes in the plant. For the purpose of detailed trouble shooting and quick information at each water test facility, an engineering manual including valid drawings has to be available.

A. Preparation of vehicle for shower test:

1. Ensure Door beading is fitted properly and no sealing gap in BIW.
2. Ensure doors and windows are fitted properly.
3. Ensure Sealant application as per specification.

B. Test procedure:

1. Close all the doors, windows and fold carpet in the cabinet.
2. Pull the shower test ON cord and start the shower.
3. Start wipers
4. Enter the vehicle in the shower testing booth.
5. Stop vehicle in the shower for 3 minutes.
6. Visually check for leakages closely.
7. Check whether the wiper blades are over shouting on the windshield.
8. If a leakage is found mark on the history card for rework.
9. If no leakage is found allow vehicle to dry on platform [2].

ANALYSIS AND RESULTS

After shower testing of vehicle, it is found that the water leakage was occurring in tailgate area. It is consider as 20 pointer defect at Quality level i.e. in GCA. Below figure shows the area where the water leakage problem was occurring.



Fig.1. Tailgate water leakage area



Fig. 2. Door water leakage area

Identification of causes by cause and effect diagram:

The cause and effect diagram indicates that there are mainly four resources of causing the defect. Also it indicates all possible causes from the resources. Check each and every parameter to cause defect, and after study we found that the causes in boxes as shown in fig. 3. are the root causes of the defect. The tailgate water leakage is occurred mainly due to flange bend at corner, improper handling of material and improper length of weather strip.

This is how cause effect diagram help us to find out exact root cause of the problem.

Tailgate /door water leakage due to flange bend:

The car body is assembled by thousands of weld points. At tailgate there are two different panels attached with the spot welding. So at corner section if weld points are came inline the flange will remain straight but if the weld points shift from their mean position, then the flange will bend and this causes improper fitment of weather strip. This happens because of wrong process followed by worker. Sometimes worker is not skilled worker, then also the weld points do not come inline. As showed in fig. 3. The door water leakage is also occurred due to uneven body flange where fixed glass is fitted. It is having the same reason as tailgate water leakage due to flange bend. So the run-channel was not properly fitted, and from that point water leakage was coming inside the door area.

A. Verification of probable causes:

a. Standard operation sheet not followed:

- i. Standard operation sequence is studied online.
- ii. Welding of tailgate panel is solely manual process.
- iii. Operator has to do welding in straight line and after that it has to be hammered to make flange straight.
- iv. Operator is new or unskilled; he may not follow his SOS.

b. Weatherstrip length is improper:

- i. 10x profile of the weather strip is drawn and checked with the drawing.
- ii. Actual length of the weather strip is measured and checked with the drawing.
- iii. Actual Length of weather strip is found as 3020mm, 3015mm and 3020mm
- iv. But as per Drawing, it should be 3046 ± 7 mm.
- v. So weather strip length found improper.

c. Improper handling of weather strip:

- i. Studied weather strip storage place i.e. there is no any proper place.
- ii. Weather strips are kept in boxes, due to that they may get damage.

d. No inspection gauge:

- i. No inspection gauge was present online.
- ii. If operator did not follow his SOS, the flange may get bend and it can't be identified.

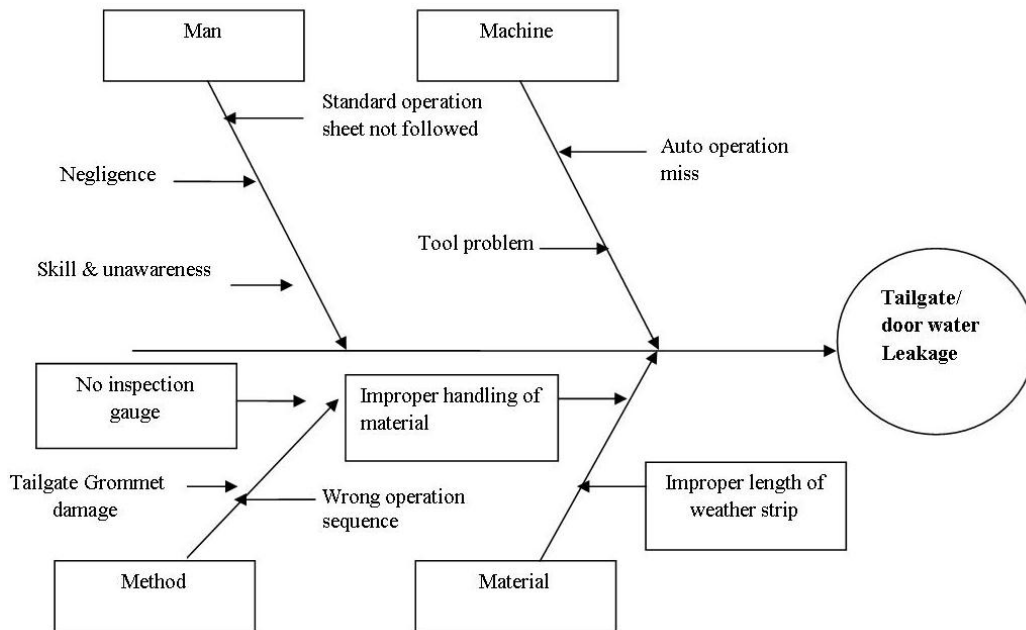


Fig.3. Cause and effects diagram for tailgate / door water leakage

B. Solution:

As this defect is occurred due to process issue and we can't do anything to reduce man to man variation. So to prevent the water intrusion in this case, the flange should be inspected 100% in both cases i.e. tailgate water leakage and door water leakage. For this the special gauge is made. Gauge made from the readings of 50 ok vehicles in shower tester in case of tailgate water leakage. For door leakage, gauge made as per drawing of fixed Glass. 100 % vehicle inspection introduced in GA shop before glass fitment. The inspection gauge is shown in fig. And 100 % vehicle inspection is performed for body flange as shown in fig 5. After inspection if any defected vehicle is found, it has to hammer properly to make flange straight.

C. Validation:

Trials were taken on 10 vehicles with the corrected length found no any water intrusion inside the car. New Weather Strips are provided by Supplier from 17/10/2012.

Tailgate water leakage due to improper length of weather strip:

Another reason for **tailgate water leakage** is **improper length of weather strip**. While finding out the root cause of this problem, it is necessary to perform a 4 diamond process i.e. is correct process followed? Is correct tool used? Is correct part being used? Is part support quality good? So 1st 3 diamonds are ok but part support quality wasn't good. Now, cut the weather strip checked out following parameters.

10x profile of the weather strip is drawn and checked with the drawing. It is necessary to check 10x profile. Because it 10x profile has to match with its actual drawing for proper fitment.

Fig. 4 shows cross section of weather strip and 10x profile of it. In fig. 5 continuous line is master drawing and dotted line is of observed profile. The inspection report is showed in following table. It is seen from table that 10x profile of weather strip is within the tolerance so no issue found in it.

And got results as the 10x profile was as per drawing but length of weather strip was less than specified. 20 samples of weather strip had cut and checked for its length and found average actual length of weather strip was 3020mm. But as per drawing it should be 3046 ±7mm. So after discussion with supplier regarding this issue and we came to know that when weather strip is manufactured, it is cut at specified length while it is in hot condition. But after getting cold it compresses in length slightly, which may lead to improper fitment of weather strip and finally in water intrusion in car as shown in below fig. 6.



Fig.4. Cross section of weather strip

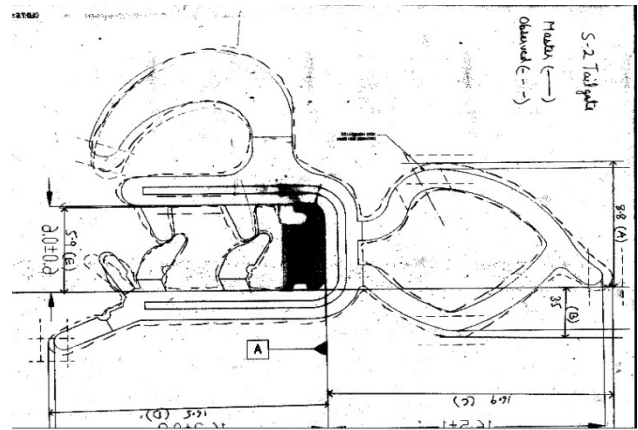


Fig.5. 10x profile of weather strip



Fig.6. Improper fitment of weather strip

A. Solution to the problem:

It is necessary to discuss with supplier and asked him to provide weather Strip length as per the drawing. Insure from him to cut weather strip at 3065mm in hot condition so that after getting colder it will achieve required length.

After finding out the results about 10x profile, now it is necessary to check actual length of weather strip. Actual length of the weather strip is measured and checked with the drawing. As per drawing shown in fig. 7, the length should be 3046 ± 7 mm. But actual length of weather strip is found as 3020mm, 3015mm and 3020mm, which is out of tolerance. So the main problem is found in length of weather strip.

Information about this issue is given to supplier and discussed with him. Then it is found that weather strip manufacturing process was incorrect. Weather strip is manufactured as a single strip. Then it is cut at particular distance when it is in hot condition and then joined it. Supplier was cutting the weather strip at 3048mm and joined it, but after cooling it gets compressed. So length got reduce.

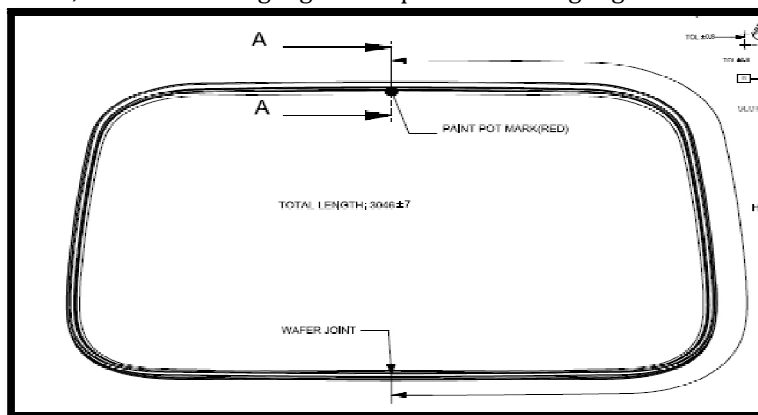


Fig.7. Actual drawing of tailgate flange area

B. Validation :-

Trials were taken on 10 vehicles with the corrected length and no leakage observed in it.



Fig. 8. Implementation of inspection gauge for tailgate water leakage



Fig. 9. Implementation of inspection gauge for door water leakage

CONCLUSION

As discussed above, the reasons for water intrusion are body flange bend and improper length of weather strip. So to avoid the water intrusion, it is necessary to do process control which is really hard job, as it involves man to man variation. Hence the special gauges as shown in fig. 8 &9, were made for 100% inspection and in not ok vehicles, it is important to make flange straight by hammering it.

Also the part like weather strip should be as per drawing. As water leakage is reduced the quality of vehicles increased and the repair activity is also eliminated. This also reduces the repair cost tremendously. It is because more time is required to repair such kind of defects. Hence it is always beneficial to produce defect free car.

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