

## THE EFFECT OF TYPE OF NANO CERAMIC COATING BRAND ON THICKNESS, STICKING POWER, AND CORROSION RATE ON THE VEHICLE BODY

**ADI TRI TYASSMADI<sup>1\*</sup>, RIYADI<sup>2</sup> and MUHAMMAD IQBAL<sup>3</sup>**

<sup>1, 2, 3</sup> Pendidikan Teknik Mesin, Universitas Negeri Jakarta. E-mail: <sup>1</sup>aditriyassmadi@unj.ac.id,  
<sup>2</sup> riyadi.unj@gmail.com, <sup>3</sup> miqbal.unj@gmail.com

### Abstract

Influence of Nano Ceramic Coating Brand Types on Thickness, Sticking Power, and Corrosion Rate on the Vehicle Body. Mechanical Engineering Education Study Program, Automotive Concentration, Faculty of Engineering, Jakarta State University, January 2022. Vehicles in modern times for maintenance not only in the engine sector and legs but if the body of the vehicle does not do a maintenance then the paint will quickly fade and easily beret and it is necessary to take care to extend the life of the vehicle body. To Find out Which Nano Ceramic Coating Brand is best against thickness, sticking power, and corrosion rate. This study uses experimental research methods. In the results of thickness testing in this study specimens without coatings get a result of 164.06  $\mu\text{m}$  and the thickness with the highest coating obtained with 196.02  $\mu\text{m}$ . The application of coating also affects the sticking power. Specimens without coatings in adulation testing get a value with a classification of 2B in the sense of peeling more than 15% but less than 35% and specimens using coatings that produce the highest are found with a classification of 5B which means no one is peeled off. The application of Nano ceramic coatings also affects the rate of corrosion. Specimens without coating gained the most weight loss with a value of 0.0701 grams and specimens using coatings gained the least weight loss with a value of 0.0203 grams.

**Keywords:** Nano Ceramic Coating, Thickness, Adjective, Corrosion Rate

### 1. INTRODUCTION

Developments in vehicles in modern times are not focused on maintaining the engine and its driving parts, but on the body of a vehicle if you don't take care of it, there will be loss or scratches due to natural and human factors on the paint of a vehicle. Because the paint on the vehicle body is the outside of the vehicle as well as a barrier from hot weather, rain, and other conditions, corrosion due to corrosion is one of the problems faced, especially in motorized vehicles. This is because most motor vehicle components are made of low carbon steel [1]. To avoid corrosion, the component is coated with paint as a protector [2]. Kondisi bodi kendaraan yang baik merupakan dimana bodi tersebut tahan terhadap cuaca, korosi, dan usia [3].

Before a car is marketed, there are several ways to keep the vehicle body protected, one of which is by using paint [4]. Paint can be defined as a product in the form of a liquid (liquid) or powder (powder), which contains a pigment and when applied to a base metal will form a layer that has protective, decorative or purposeful properties [4]. Vehicle paint has several layers, namely basic paint, intermediate paint (intermediate coat), final paint (top coat). The thickness of the outermost layer of car paint has a thickness of about 35–50 microns [5].

The paint layer on the vehicle body also requires maintenance so that the paint on the vehicle body can last a long time. Types of paint treatments on vehicle bodies are wax, sealants, PPF,

and ceramics. Nano ceramic is basically liquid silica when applied to the clear coat, this layer will absorb into the clear coat layer and at the same time coat the clear coat itself. [6].

The application or application of nano ceramics to vehicle paint can maintain the authenticity of the paint and can protect the vehicle paint and is able to maintain the glossiness of the paint so that the vehicle looks like new. [6]. The application of nano ceramics can close small pores on a vehicle paint, the effect of the closed pores on a vehicle paint is that dust and water splashes cannot stick so that the paint on the vehicle is easy to clean and the effect of taro leaves on the nano ceramic water coating layer will not imprint on the paint of a vehicle so as to avoid mold or waterspot [7]. Penggunaan nanopartikel untuk melapisi bodi mobil akan memberikan banyak keuntungan, di antaranya ketahanan gores tiga kali lipat dan kecerahan lebih lama [8]. Nanomaterials digunakan untuk mencapai opacity yang lebih tinggi, interaksi yang lebih baik antara coating dan substrat, dan ketahanan coating yang lebih tinggi [9]. In the process of applying nano ceramic coatings, there are two ways, namely: rubbing and spraying.

in research [6] Nano ceramic coating also has an influence on the gloss of a vehicle paint, the gloss value is 85.70 GU to 89.80 GU. Coating also has an influence on the hardness of the paint of a vehicle, and in previous studies it has obtained a hard value of 76.88 shore D to 80.92 shore D. And the highest value at 80.92 was obtained on the coating brand B. In previous studies also conducted heat resistance testing. And it has been obtained that the best heat resistance value is the B coating brand with a temperature of 200°C the specimen has a physical change that is 293.33 to 331.67 minutes. And the color change is 98.33 to 120 minutes.

So from the description above, it is necessary to study the effect of the type of nano ceramic coating brand on the thickness, adhesion, and corrosion rate of vehicle paint. And the author took the title because of encouragement from people who complain about the paint on their vehicles often causing scratches or paint loss. In this study, the method used is rubbing and using nano ceramic coating types with brands A, B, and C which can be found in online shops and with well-known brands. It is expected which type of coating brand is the best based on the results of research conducted.

## 2. RESEARCH METHODOLOGY

### a. Research time and place

The research was conducted at the Automotive Laboratory and the Fire and Safety Laboratory of Mechanical Engineering, State University of Jakarta.

### b. Flow diagram

Start – study of literature – preparation of tools and materials – manufacture of specimens – process of coating – testing: thickness, adhesion, and corrosion rate – results and discussion – finished.

### c. Preparation of tools and materials

- 1). Prepare plates with sizes 20x20cm and 10x10cm

- 2). Prepare the compressor and spray gun
- 3). Prepare epoxy, hardener, sandpaper, color paint, thinner, 3.5% NaCl solution and nano ceramic coating brands A, B, and C

**d. Specimen making process**

1. Prepare plates with a size of 20 x 20 cm and 10 x 10 cm.
2. Perform the sanding process on the plate to smooth the surface.
3. Perform the process of mixing epoxy, hardener, and thinner with a ratio of 1: 4
4. Clean the plate that has been sanded earlier to clean it from dust.
5. Perform the process of painting epoxy as much as 2 layers evenly.
6. Then dry the epoxy paint for 1 day / 24 hours
7. After the epoxy is dry, sand it with a 1000 sandpaper grid to smooth the surface on the epoxy paint.
8. Perform the process of mixing paint and thinner with a ratio of 1: 1
9. Clean the plate that has been in epoxy with a clean cloth to avoid dust
10. Carry out the painting process with 2 coats evenly
11. Dry in the sun for 7 days for a completely dry result

**e. Coating process**

1. After the plate is completely dry completely, then the nano ceramic coating process is carried out.
2. First, clean the surface to be coated so that it is clean from dust attached
3. Drop 3-5 drops of nano ceramic coating on the applicator pad that has been lined with suede cloth
4. Rubbing the applicator that has been dripped with nano ceramic coating liquid and rubbing vertically or horizontally
5. After being applied, within a few minutes the nano ceramic will begin to harden and will harden completely within 24 hours [10].

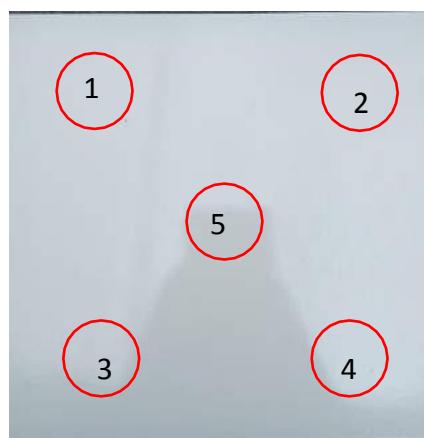
**f. Test**

**1) Thickness (Thickness)**

The result of the perfect painting and coating process can be seen from its thickness. The thicker the paint and coating it will be resistant to corrosion rates, erratic weather, scratches from sharp objects. To determine the thickness of the paint and its coating, a special measuring tool is needed. The tool is a thicknees gauge, where this tool can measure and detect the thickness of the paint on the surface of the object being painted. Thickness gauge is able to measure quickly and accurately [11].

- a). Prepare the thickness gauge and carry out the calibration process by turning on the thickness gauge, entering the settings menu, then selecting calibration, and selecting the metal and size that has been determined for calibration. Then put the size on the metal and attach the thickness gauge to the metal until the number on the thickness gauge is the same as the predetermined size.
- b). after the thickness gauge is calibrated, then place the specimen to be tested on a flat surface so that the specimen does not move during the testing process.
- c). Determine the point for the measurement process.

**Figure 3: Determination of Points for Cross Cut Testing**



- d). Attach the thickness gauge at the specified point by slightly pressing it.
- e). Observe and record the results of measurements at each point.

### 1) Adhesion (Cross cut)

Adhesion test is a measurement to determine the strength of the coating layer attached to the media coated by paint. Adhesion criteria are very important and affect the overall paint quality. To get a good adhesion between the paint layer and the surface, pretreatment on the surface must be considered [12]. The method used for testing the adhesive power is cross cut with a crosscutter. The level of adhesion will be tested at levels 0-5, where 0 means more than 65% of the area lifted by the tape, and 5 means the area lifted by the tape is 0% [13].

- a) Prepare cross cut testing tools.

**Figure 4: Cross Cut Adension Test**



- a) Then prepare the scales to equalize the pressure that will be given during the test
- b) Prepare specimens to be tested.
- c) This test is carried out by making a scratch using a cross cut tool on the specimen with a cross stroke with pressure when scratching 10 kg, then masking tape is applied to the intersection of the cross and then pulled or removed to get results.
- d) After the tape is pulled or removed, observe visually using a magnifying glass and see if any paint is lifted or not.
- e) Then grade the classification according to the ASTM - D3359 reference and record the results.

## 2) Corrosion Rate (weight loss)

Corrosion rate testing is used to determine the strength of the paint that has been coated against the corrosion rate. In this test, the author uses the method of weight loss or weight loss from immersing the specimen using a corrosive solution for 168 hours. The tools and materials used are digital scales with a scale of 0.0001 grams and 3.5% NaCl solution. Where the scales are useful for measuring the weight of the specimen before and after soaking for 168 hours using NaCl solution.

- a) Prepare a scale with an accuracy of 0.0001 gram
- b) Perform calibration by pressing the cal button on the scale.
- c) After the scales are calibrated and ready to use, enter the specimens that have been coated
- d) After the specimen is inserted into the scale, wait a few seconds until the number on the scale is stable.
- e) Record weighing results.
- f) After recording the weighing of the specimen without being immersed in 3.5% NaCl, prepare a container and pour the solution into the prepared container.

Put the weighed specimen into a container containing 3.5% NaCl and soak for 168 hours or 1 week.

**Figure 6: Immersion of the Specimen**



- a) After the specimen has been soaked for 168 hours, rinse the soaked specimen with clean water and dry it with a clean cloth.
- b) Weigh the specimens that have been immersed in 3.5% NaCl liquid.
- c) Record the weighing results after soaking.

#### **g. Data collection technique**

In this data collection technique, the outline in the steps of data analysis is:

- 1) Collecting and obtaining data using the observation method carried out by researchers in the laboratory or work shop
- 2) Calculate the average test results on the A, B, and C coating specimens as well as the uncoated specimens as standardization.

#### **h. Data analysis technique**

The research data were analyzed by looking for the average, here's how to find the average value, the formula used:

$$\sum \frac{f}{n}$$

Information :

$\bar{x}$  = Average value

$\Sigma$  = Number of data values

$n$  = Lots of data

The average value obtained is the result of the third study of nano ceramic coatings by testing thickness, cross-cut, and corrosion rate using the weight loss method.

## **RESEARCH RESULTS AND DISCUSSION**

### **Thickness Test Results**

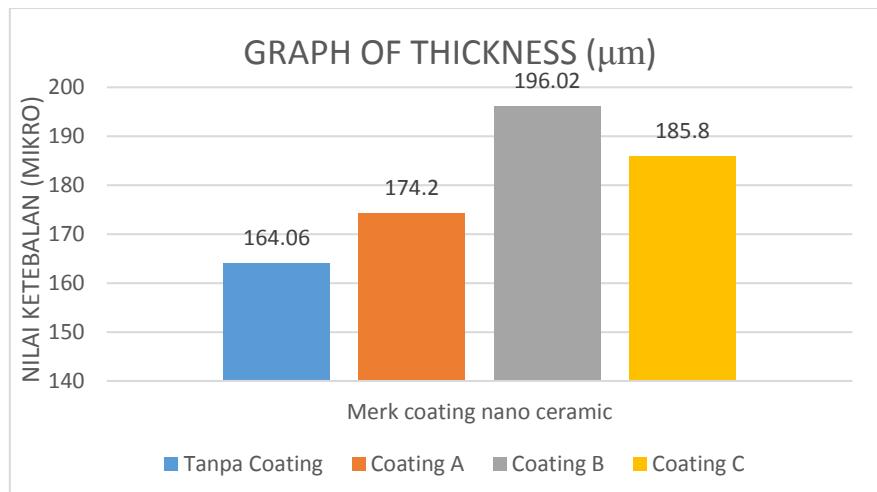
The thickness test in this study is to determine the effect of which type of nano ceramic coating brand has the best thickness among the three types of coating brands.

**Table 1 Thickness Test Results**

Specimen	Thickness Test					Average	Average amount
	1	2	3	4	5		
No coating 1	164,66	166,33	165	164,66	163,33	164,8	164,06 µm
No coating 2	166,33	164	163,66	162,66	162	163,93	
No coating 3	163,33	164	164	161,66	164,33	163,46	
Coating A 1	174,66	175,33	173,33	172,33	177	174,53	174,42 µm
Coating A 1	175,66	174	171,66	174	175,33	174,13	
Coating A 1	174,66	174,33	175	174,66	174,33	174,6	
Coating B 1	197,33	195,66	195,66	195,66	196,33	196,13	196,02 µm
Coating B 2	195	196	197	196	196,33	196,06	
Coating B 3	196	196,33	196,66	194,33	196	195,86	
Coating C 1	183,66	186	182,33	186,66	183,66	184,46	184,44 µm
Coating C 2	183	186	183,66	185	184	184,33	
Coating C 3	187	185	186,33	181,66	182,66	184,53	

From the measurement results according to the table above, it is explained that the highest thickness value is obtained on the type of nano ceramic coating brand B with an average value of 196.2 µm. And the one with the lowest thickness is the type of nano ceramic coating brand A with an average value of 174.2 µm. When testing the thickness of the data, the results obtained are the result of three repetitions at five predetermined points on each specimen. The effect of the thickness of the A, B, and C nano ceramic coating brands used is shown in the following figure:

**Diagram 1 Thickness Test Results**



It can be seen in the graph above that the thickness test with brand B nano ceramic coating obtained the highest thickness with an average value of 196.2 µm and the second position was

occupied by brand C nano ceramic coating with an average value of 185.8  $\mu\text{m}$ . And the lowest position is occupied by nano ceramic coating brand A with an average value of 174.2  $\mu\text{m}$ . And as a standard reference, specimens are made without using a nano ceramic coating, from this thickness test it has an average number

—average 163.5  $\mu\text{m}$ . According to [13] the thickness of the paint from the base to the top layer has different layers, this is because the paint painting process is still done manually so that the ideal distance at a distance of 15-25 cm is not achieved. Therefore, this test has different thicknesses. The result of paint thickness is also affected by the drying temperature, the higher the drying temperature causes the paint layer to be thinner, because the drying process with too high a temperature can experience excessive evaporation of the paint layer and cause the layer thickness to decrease [14]. In the study [15] the drying temperature at 40°C and 60°C had an average thickness of 118  $\mu\text{m}$  and at 80°C it had an average of 117  $\mu\text{m}$ , from the study it was stated that the thickness was affected by the drying temperature.

### Adhesive Test Results

The adhesion test in this study aims to find out which type of nano ceramic coating brand is the best among coating A, coating B, and coating C. The following are the results of the adhesion test on the specimens made as shown in the table below:

**Table 2: Results of Adhesion Test**

Cross cut adhesion tape test ASTM D3359			
Specimen	Test result	Class classification	test conclusion
No coating 1	18 % peeled off	<b>2B</b>	Exfoliate More than 15% but less than 35%
No coating 2	13 % peeled off	<b>3B</b>	Exfoliate more than 5% but less than 15%
No coating 3	16 % peeled off	<b>2B</b>	Exfoliate More than 15% but less than 35%
Coating A 1	11% peeled off	<b>3B</b>	Exfoliate more than 5% but less than 15%
Coating A 2	8% peeled off	<b>3B</b>	Exfoliate more than 5% but less than 15%
Coating A 3	4% peeled off	<b>4B</b>	Exfoliate less than 5%
Coating B 1	0% peeled off	<b>5B</b>	Nothing is missing
Coating B 2	0% peeled off	<b>5B</b>	Nothing peeled off
Coating B 3	0% peeled off	<b>5B</b>	Nothing peeled off
Coating C 1	4% peeled off	<b>4B</b>	Exfoliate less than 5%
Coating C 2	3% peeled off	<b>4B</b>	Exfoliate less than 5%
Coating C 3	3% peeled off	<b>4B</b>	Exfoliate less than 5%

The test results according to table 2. above, the average results of specimens without coating are 2 B with a conclusion peeling off more than 15% but less than 35%, coating with brand A gets an average result of 4 B with a conclusion peeling off less than 5%, then coating with brand B gets an average result of 5 B with the conclusion that nothing is peeling off and coating with brand C gets an average result of 4 B with a conclusion that peels off less than 5%.

From the data above, the coating that has the best or best adhesive power is found in the type of mek B coating with an average result of 5 B with the conclusion that nothing is peeling off, the second position is occupied by brand C coating with an average result of 4 B testing with the peeling conclusion is less than 5%, and the last place is occupied by the nano ceramic coating brand A with an average test result of 4 B with a peeling conclusion of less than 5%. According to [16] the thickness of the paint layer and the temperature that is too high can cause a lack of adhesion of the paint to the substrate or the media covered by the paint. In research [12] the thicker the paint applied, the stronger the protection provided, therefore weather and natural conditions are difficult to predict, that's why the painting process is carried out twice back and forth or more. In research [13] the results of painting with a drying temperature method of 1400c can produce a paint thickness of 92  $\mu\text{m}$  and adhesion to a level of 2B (exfoliated more than 15% but less than 35%). Therefore, the lack of thickness and the high temperature of drying the specimen can cause the paint layer to peel off a lot.

### Corrosion Rate Test Results

The weight loss test in this study aims to determine the effect of which type of nano ceramic coating is the best. The following are the results of testing the weight loss on the specimens made as shown in the table below:

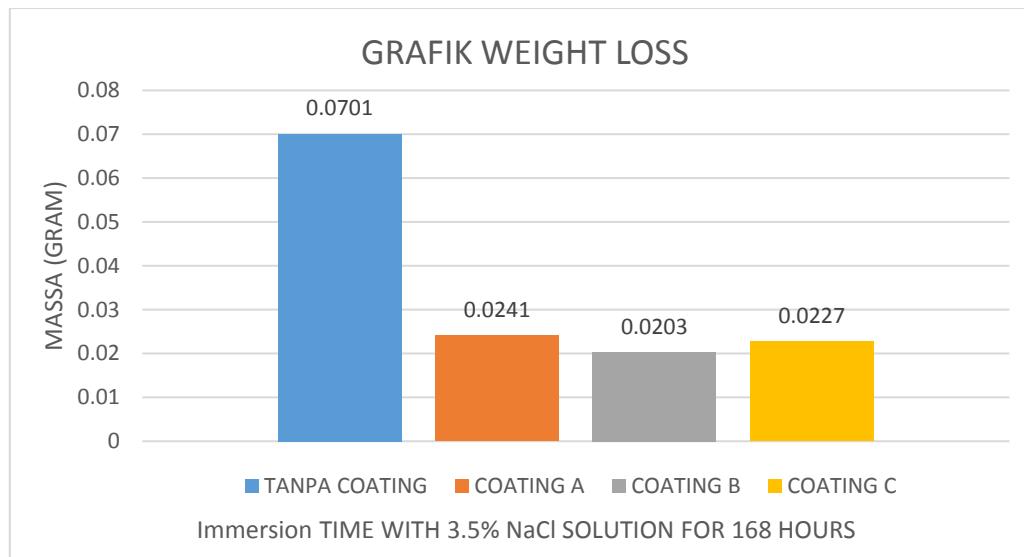
**Table 3: Corrosion Rate Test Results with Weight Loss Method**

Corrosion Rate Test Results With the Weight Loss Method						
No	Specimen	W0 (gram)	W1 (gram)	Time (hour)	$\Delta$ massa (gram)	Average
1	No coating 1	72,6274	72,5481	168	0,0793	0,0701 Gram
2	No coating 2	73,2825	73,2158	168	0,0667	
3	No coating 3	73,2803	73,2159	168	0,0644	
4	Coating A 1	74	74,0916	168	0,0201	0,0241 Gram
5	Coating A 2	73,8555	73,8295	168	0,0260	
6	Coating A 3	74,2040	74,1778	168	0,0262	
s	Coating B 1	75,4858	75,4671	168	0,0187	0,0203 Gram
8	Coating B 2	75,2544	75,254	168	0,0200	
9	Coating B 3	74,7320	74,7097	168	0,0223	
10	Coating C 1	74,8253	74,8013	168	0,0240	0,0227 Gram
11	Coating C 2	74,8446	74,8226	168	0,0220	
12	Coating C 3	74,2218	74,1998	168	0,0220	

From the measurement results according to the table above, it is explained that the corrosion rate with a good weight loss method is found in the type of nano ceramic coating brand B with

an average yield of 0.0203 grams, and the second position is occupied by type C nano ceramic coating with an average result of 0.0227 grams, and the third position is occupied by nano ceramic coating brand A with an average measurement result of 0.0241 grams. The effect of corrosion rate using the weight loss method with the type of nano ceramic coating brands A, B, and C used is shown in the following figure:

**Diagram 2: Corrosion Rate Test Results**



According to the graph above, the specimen without using nano ceramic coating got a weight loss value of 0.0701 gram. The specimen that got the best corrosion rate results was the specimen coated with brand B nano ceramic coating with a weight loss of 0.0203 grams by immersion using a 3.5% NaCl solution for 168 hours or 1 week. And then the specimens were coated with a nano ceramic coating of brand C with a weight loss of 0.0227 grams and the last specimen was occupied by a specimen coated with a nano ceramic coating of brand A with a weight loss of 0.0241 grams. The best corrosion rate is influenced by the thickness of the paint and good paint adhesion, because the thicker the paint layer and the more sticky the paint, the 3.5% NaCl solution is difficult to enter the layer and difficult to penetrate into the media or substrate so that specimens with a thickness of and good adhesion also has a good corrosion rate.

## CONCLUSION

Based on the results of testing, data collection and experiments that have been carried out starting from the process of making specimens, testing of each specimen and the discussion that has been described in previous chapters. then this research can be concluded as follows:

1. The application of nano ceramic coatings on vehicle paints has the effect of increasing thickness from before being coated with a coating and after being coated with a coating as a protection for vehicle body paint. According to the test results, it was found that the

thickness without coating was 164.02  $\mu\text{m}$ , and the best thickness was obtained by specimens coated with nano ceramic coating brand B with a thickness of 196.02  $\mu\text{m}$ , second place was followed by specimens coated with nano ceramic coating brand C. with a thickness of 184.44  $\mu\text{m}$  and the last place was followed by specimens coated with nano ceramic coating brand A with a thickness of 174.42  $\mu\text{m}$ .

2. The application of nano ceramic coating also affects the adhesion because of the thickness given to the specimen, and the thicker the nano ceramic coating, the better the adhesion. According to the test results, it was found that the specimens without nano ceramic coating had 2B adhesion, which means peeling off more than 15% but less than 35%. And the best adhesion was obtained by specimens coated with brand B nano ceramic coating with an adhesion value of 5 B, which means (0% does not peel off) does not peel off. and the second place was followed by specimens coated with brand C nano ceramic coating with an adhesion value of 4 B, which means that it peeled off less than 5%. And the last place is occupied by specimens coated with brand A nano ceramic coating with an adhesion value of 4 B, which means that it peels off less than 5% but there is 1 specimen that gets 3 B results, which means that it peels off more than 5% but less than 15%.
3. The application of nano ceramic coatings also affects the corrosion rate because nano ceramic particles are able to cover the pores in the paint, thereby reducing the corrosion rate. According to the test results, it was found that the specimen without being coated with a nano ceramic coating lost 0.701 grams of weight with an immersion time of 168 hours or one week using a 3.5% NaCl solution. And the best corrosion rate was on specimens coated with brand B nano ceramic coating with a weight loss of 0.0203 grams with the same treatment. And the second place was followed by specimens coated with nano ceramic coating brand C with a weight loss of 0.0227 grams with the same treatment. and place the last specimen was coated with nano ceramic coating brand A with a weight loss of 0.0241 grams and with the same treatment.
4. Based on the results of three tests of the type of nano ceramic coating brand, the best type is brand B because the thickness is much better than its competitors and the thickness is getting better, the adhesion is good too, if the adhesion is good, the corrosion rate is also good because of the pores – the pores in the paint are tightly closed.

#### Acknowledgments

In this research, the researcher got a lot of help from several parties, therefore I as a researcher would like to thank:  
1) Head of Mechanical Engineering Laboratory UNJ, 2) Head of UNJ Fire Laboratory, 3.) Mechanical Engineering Student UNJ

#### References

1. Horvath, C. D. (2004). The Future Revolution in Automotive
2. Soegijono, B., Susetyo, F. B., & Notonegoro, H. A. (2019). Perilaku Ketahanan Korosi Komposit Coating Poliuretan/Silika/. Flywheel: Jurnal Teknik Mesin Untirta Vol. V.
3. Syarifudin, a. (2005). fleksibilitas, kekerasan dan daya lekat cat untuk pengecatan bodi kendaraan.

4. Tyassmadi, A. T. (2017). Teknologi Pengecatan. Jakarta: Universitas Negeri Jakarta.
5. Auto bild & nas moco (img). (2021, februari 16). Waspada Terhadap Ketebalan Cat Mobil Anda. Retrieved from Waspada Terhadap Ketebalan Cat Mobil Anda: <https://www.alatuj.com/article/detail/195/waspada-terhadap-ketebalan-cat-mobil-anda>
6. Tyassmadi, Adi Tri, Basori, Imam, & Ramadhan, D. D. (2021). [skripsi] Pengaruh Jenis Merk Coating Nano Ceramic Terhadap Daya Kilap, Kekerasan, Dan Ketahanan Panas Pada Cat Kendaraan. Jakarta: Universitas Negeri Jakarta.
7. Wahyu, D. (2018, oktober 3). GridOto.com. Retrieved from perbedaan wax, sealent, dan coating dalam melindungi cat mobil: <https://www.gridoto.com/read/221037541/perbedaan-wax-sealant-dan-coating-dalam-melindungi-cat-mobil?page=3>
8. Dwandaru, W. S. (2012). Nanoteknologi. Aplikasi Nanosains Dalam Berbagai Bidang Kehidupan.
9. Dubbert, W., Schwirn, K., Volker, D., & Apel, P. (2014). Use of nanomaterials in coatings. Germany : Federal Environment Agency.
10. Liu, Y.-H., Xu, J.-B., Zhang, J.-T., & Hu, J.-M. (2017). Electrodeposited silica film interlayer for active corrosion protection. <http://dx.doi.org/doi:10.1016/j.corsci.2017.01.017>.
11. Ardyanto, M. W., & Utama, F. Y. (2018). Rekayasa Komposisi Mixing Solvent Dan Varnish Terhadap Kualitas Hasil Pengecatan Menggunakan Gloss Meter. JPTM. 07, 26-33.
12. Noor, R. A., & Tarmedi, E. (2007). Pengaruh Ketebalan Lapisan Terhadap Daya Lekat Cat.
13. Supriyono, Mulyanto, T., & Miftahuddin, M. (2019). Analisis Pengaruh Suhu Pengovenan Terhadap Daya Rekat Dan Kekuatan Lapisan Pada Pengecatan Serbuk. jurnal teknik mesin, 21(2), 77-87
14. Hutama, T. S., Darsin, M., & Mulyadi, S. (2019). Optimasi Variasi Diameter Nozzle, Tekanan Udara dan Suhu Pengeringan Pada Pelapisan Baja St37 Menggunakan Metode Response Surface.Jurnal SIMETRIS, Vol. 10 No. 2.
15. Iqbal. (2021). Pengaruh Variasi Suhu Pengeringan Terhadap Daya Kilap Pada Bodi Kendaraan Bermotor.