

Method of Testing Paint Film Properties

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1. Scope of Application

This standard defines the test method of paint film painted for the purpose of an anticorrosive and decoration of a vehicle.

(Quality standard is based on KES B R R001 (paint film of a vehicle))

2. Definition of a Terminology

(1) Manufacturer : paints manufacturer

(2) The terminology used in this standard is based on KS M 5001 (paints terminology) without special directions.

3. General Condition of a Test

3.1 Standard state of a testing place

It is desirable to choose the indoor place there is no direct sunlight and gas, steam, and dirt to effect disadvantageously on a test, also wind without special directions.

But, if it is not sure, test on the standard state of temperature $23 \pm 3^{\circ}\text{C}$, humidity $50 \pm 10\%$ based on KS A 0006

3.2 Condition of a test sample

The condition of a test satisfies following condition

(1) Collect the test sample among parts and a finished product manufactured based on prescribed specification and use the test sample manufactured based on same material as a finished product and painting specification according to the contract between a inspection department and cooperative companies.

(2) Leave a test sample used for 24hr after hardening drying and test it

4. Appearance

The appearance of a paint film is as followings

(1) Purpose

Observe the paint film appearance is normal and or not with the naked eye

(2) Test method

The glass transmitted light and a diffusion daylight except fluorescent paint is sed as a

background color of an achromatic color. Inspect on a foundation exposition, swelling, peeling off, breaking, whitening, cratering, pinhole, stain, extension, flowing, lack of paint, dirt, and groove with the naked eye by at intervals of 0.5m setting uniform intensity of illumination of more than 300Lux on effective surface.

Note1. A diffusion daylight is at the time from 3hr after sunrise to 3hr before sunset and escape direct sunlight and shed light from a north window.

(3) Decision

If the paint film appearance of a test sample is fitted to the standard defined on the paint film, it is decided to “ a chip appearance is normal “

5. Luster

Luster test is as followings

5.1 Purpose

Observe the luster of a paint film is normal or not

5.2 Classes

Test methods are two kinds on table 1

Table 1

Classes	Test method
Class 1	Test with the naked eye
Class 2	Test by a gauge

5.2.1 Test with the naked eye

(1) Test method

Shed intensity of illumination by 1000Lux on effective surface and compare a test sample with a standard sample using a standard source of light of color, C by KS A

0061 (color indication method by 2° vision X,Y,Z system) for ones not emitting fluorescent color, and using Xenon standard white source of light by KS A 0073 (Xenon standard white source of light) for ones emitting fluorescent color.
a background color of an achromatic color (gray about N5).

(2) Decision

If paint film luster of a test sample is fitted to the standard defined on the paint film, it is decided to “ the luster is normal “

5.2.2 Test by a gauge

(1) Test method

Measure the 60° slope side luster of a test sample and a standard sample by KS 0069 (measurement method of luster degree) and calculate luster maintenance rate in the following equation

$$\text{Luster Maintenance Rate} = \frac{(\text{60}^\circ \text{ slope side luster of a test sample})}{(\text{60}^\circ \text{ slope side luster of a standard sample})} \times 100$$

(2) Decision

If luster maintenance rate of paint film is fitted to the standard defined on paint film, it is decided to “ the luster is normal “

6. Color

Color test is as followings

6.1 Purpose

Observe the color of a paint film is normal or not with the naked eye

6.2 Test method

Shed intensity of illumination by 1000Lux on effective surface, compare a test sample with a standard sample by KES K 0911 (standard gray color table for discoloration) shown on the table 2, and finally measure a color tone difference and grade using a standard source of light of color, C by KS A 0061 for ones not emitting fluorescent color,

and using Xenon standard white source of light by KS A 0073 (Xenon standard white source of light) for ones emitting fluorescent color with a background color of an achromatic color (with brightness less than a test sample by 1).

Table 2

Grade	Standard of Decision
1	A color tone difference is gray scale number 1 or more than
2	A color tone difference is gray scale about number 2
3	A color tone difference is gray scale about number 3
4	A color tone difference is gray scale about number 4
5	A color tone difference is gray scale about number 5

6.3 Decision

If the color tone difference grade of the paint film of a test sample is fitted to the standard defined on the paint film, it is decided to “ the color is normal “

7. Discoloration

Discoloration test is as followings

7.1 Purpose

Presume discoloration by paints spread on the surface of a paint film.

7.2 Test method

Put a test sample on the test board of rubbing tester shown on fig 1. And put the gauze of dimension of 1cm × 4cm , stack of two sheets, and settled in water to be up water surface on a rubbing board.

Carry out reciprocal rubbing test 5 times on the condition shown in the table 3.

Measure the grade of discoloration for a test sample by decision condition shown in the table 4.

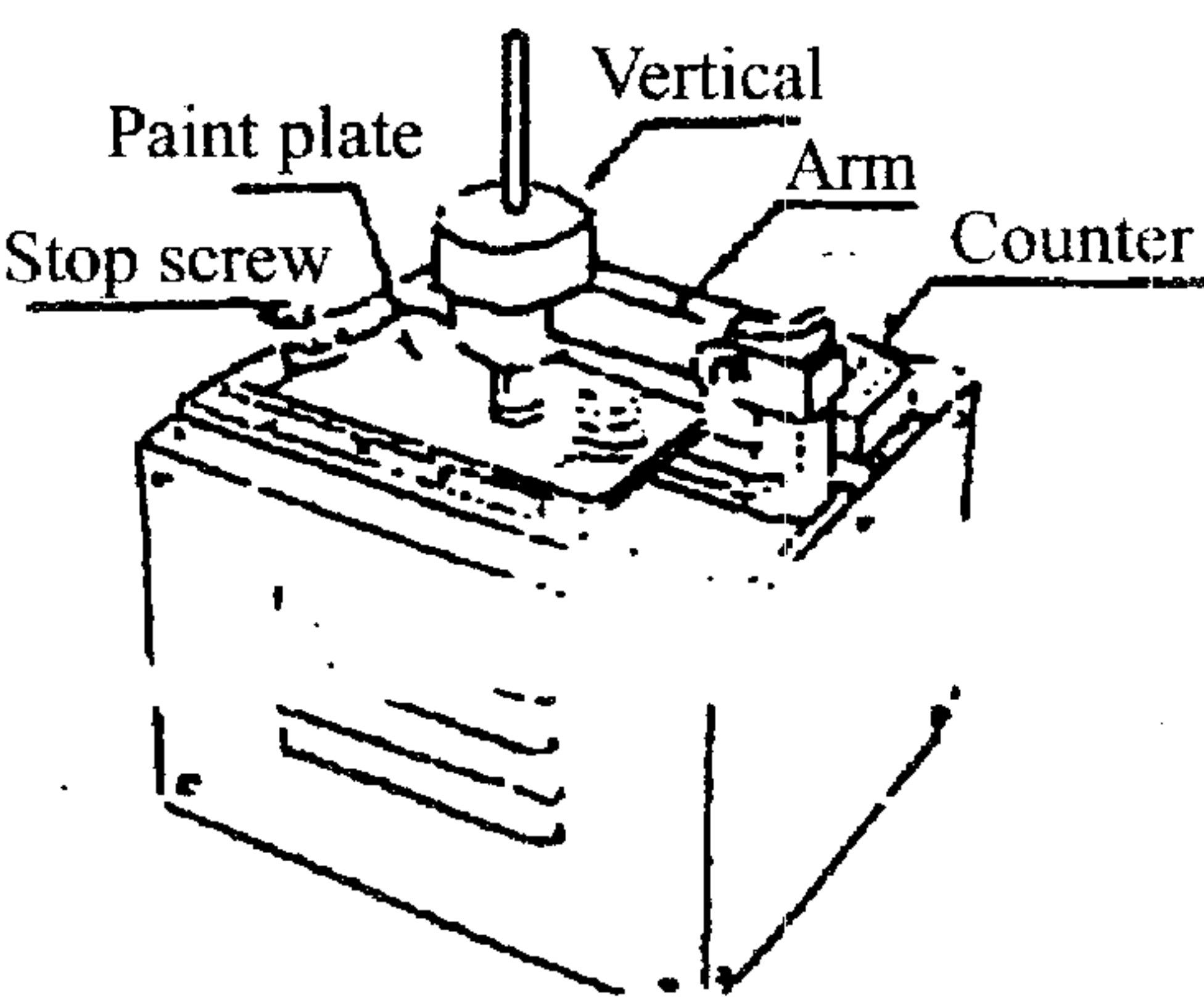


Fig 1

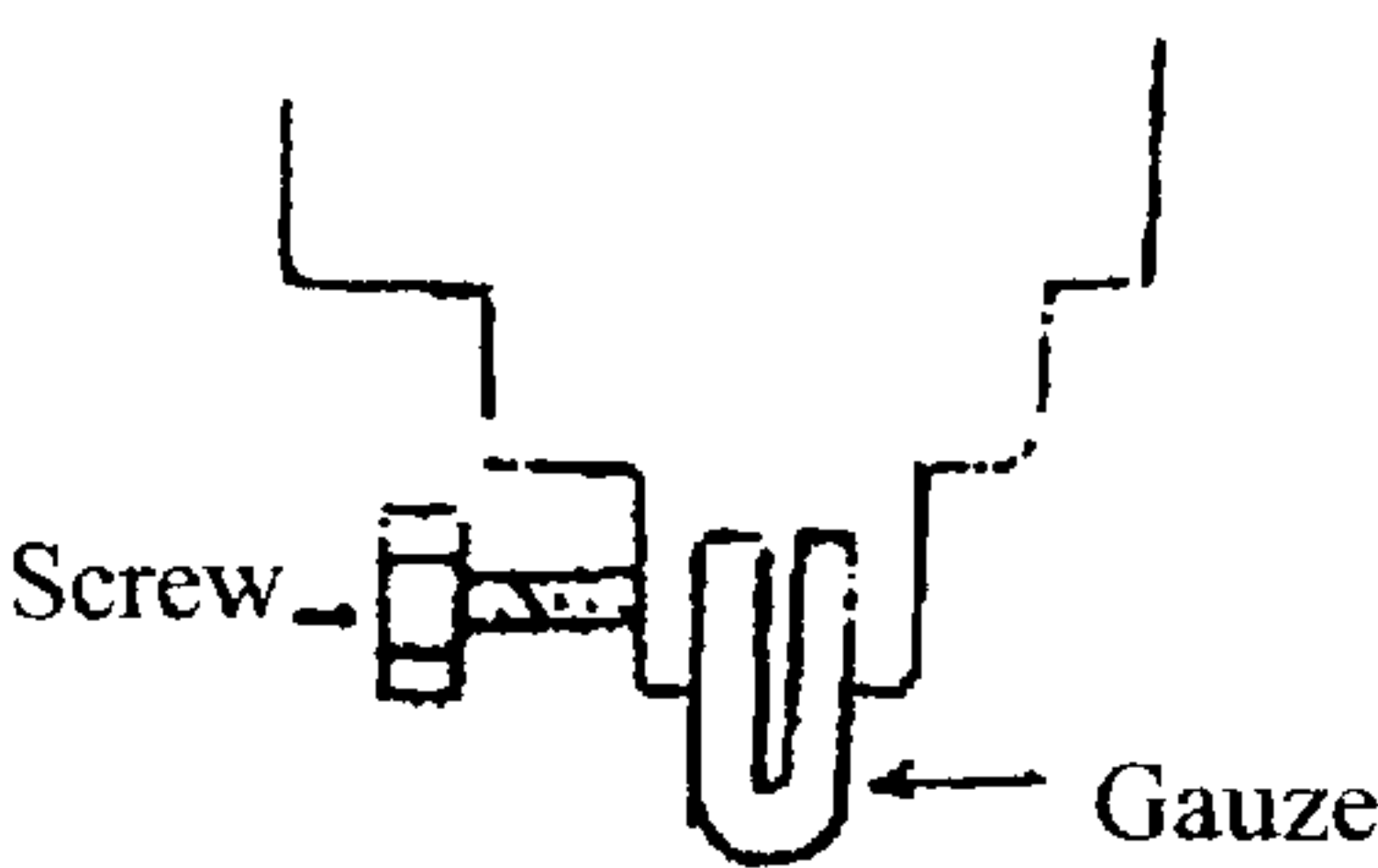


Fig 2

Table 3

Item	Condition
Contact area	2
Load	3.4 ± 0.1 (33.3 ± 1.0)
Moving distance	2.5
Reciprocation velocity (times/sec)	1

Table 4

Grade	Decision Condition
1	Remarkable discoloration
2	A little remarkable discoloration
3	Conspicuous discoloration
4	A little discoloration
5	Scarcely discoloration

7.3 Decision

If the discoloration of the paint film of a test sample is fitted to the standard defined on the paint film, it is decided to “ the discoloration - proof is normal “

8. Adherence

Adherence test is as followings

8.1 Purpose

Measure the adherence of a paint film foundation, the adherence for the gap of paint film stacks, and the strength and weakness of a paint film breakage.

8.2 Classes

Test method is classified to 3 classes in the table 5

Table 5

Classes	Test method
Class 1	Checkers test of 2mm
Class 2	Checkers test of 4mm
Class 3	Scratch test

8.2.1 Checkers test of 2mm

(1) Test method

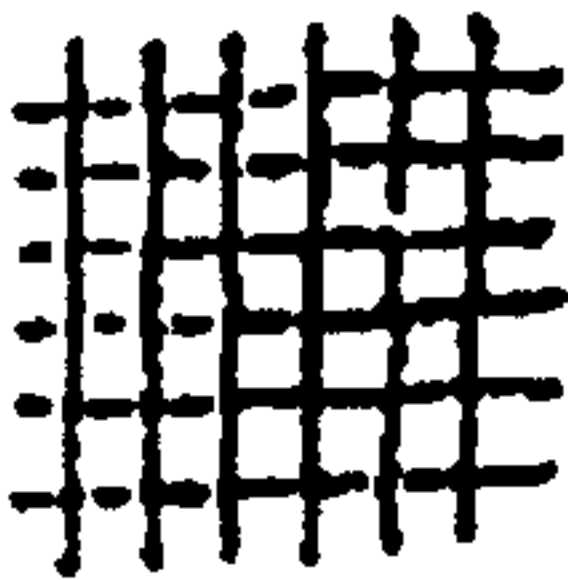
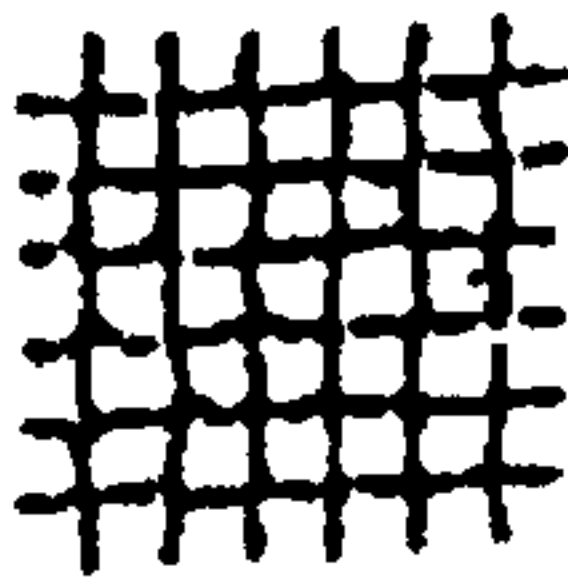
Maintain the cutter (3) of cutter - knife (a small size) (2) on a vertical plane about 30° for a effective surface, make 10 (number 10 × 10) checkers of 2mm, and adhere closely cellophane adhesive tape (KS A 1528) (4) of width 24mm to a checkers without bubbles rubbing strongly 3 times with more than 2kgf (19.6N) by a nail. And, maintain one edge of a tape vertical to a effective surface, remove it at the fast speed more than 0.5m / sec in a moment, and measure the exfoliation rating grade of a test sample comparing the exfoliation state and grade of paint film shown in the table 6.

Note ⁽²⁾ Use NT Cutter of type S and type A as Cutter knife(a small size) and something equivalent to them.

Note ⁽³⁾ Use the new point of a knife after making 100 checkers. But, if a knife is broken, make checkers on other effective surface with a new point of a knife.

Note ⁽⁴⁾ Use the cellophane adhesive tape made by Daeil Chemical

Table 6

Grade	Exfoliation area(%)	A limit sample(example of cutting 6 samples)
5	0	None
4	From 0 to less than 5	a limit sample of 5% 
3	From 5 to less than 12	a limit sample of 15% 
2	From 15 to less than 30	a limit sample of 35% 
1	more than 35	

(2) Decision

If the exfoliation rate grade of the paint film of a test sample is fitted to the condition defined on the paint film, it is decided to “ the adhesion is normal “

8.2.2 Checkers test of 4mm

(1) Test method

Maintain the knife ⁽⁵⁾ on a vertical plane about 90° for a effective surface shown on fig 3, make ⁽⁶⁾ 25 checkers of 4mm near a foundation, and adhere closely cloth adhesive tape (KS A 1526) ⁽⁷⁾ of width 25mm on scratch without bubbles rubbing strongly with more than 2kgf (19.6N) by a nail. And, maintain one edge of a tape

vertical to a effective surface, remove it at the fast speed more than 0.5m / sec in a moment. Adhere closely it on the other direction vertical using a new tape and remove it one more time and measure the exfoliation rating grade of a test sample comparing the exfoliation state and grade of paint film shown in the table 6.

Note ⁽⁵⁾ If the cutting surface of a knife get wear and defect as time passes, maintain a shape shown on fig 3 grinding it with a whetstone.

Note ⁽⁶⁾ If paint film separates finely after cutting it with a knife, remove fine paint film separated pushing down with more than 2kgf (19.6N) by a nail before adhering a tape. Also, refer to the exfoliation of paint film occurred in this operation for rating exfoliation.

(2) Decision

If the exfoliation rate grade of the paint film of a test sample is fitted to the condition defined on the paint film, it is decided to “ the adhesion is normal ”

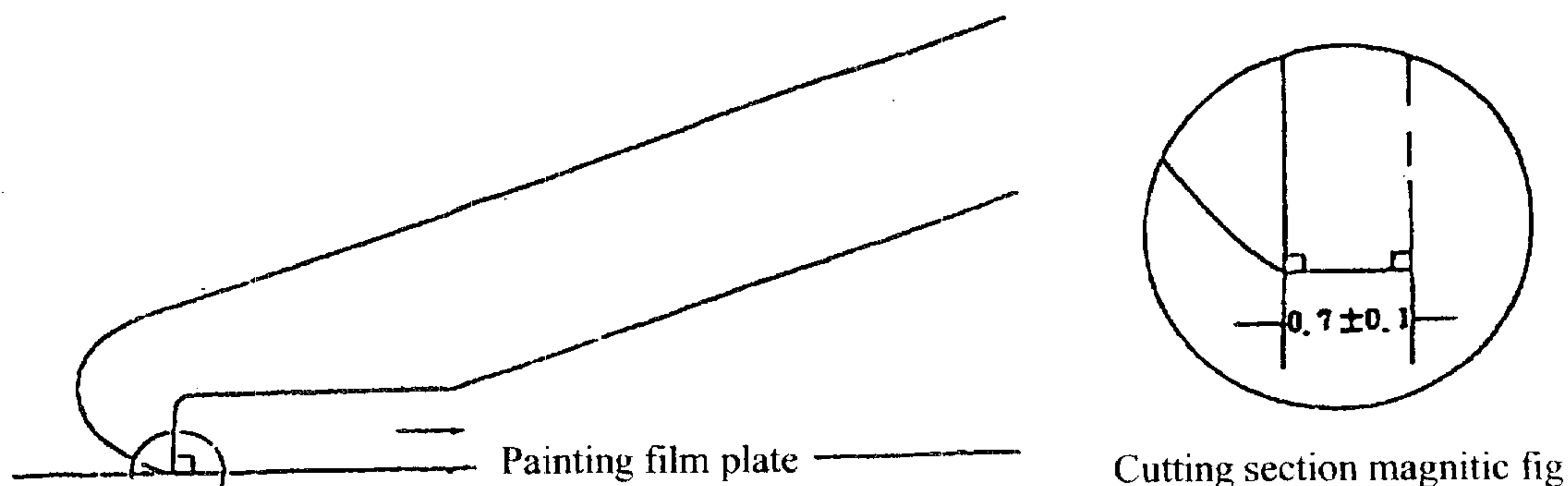


Fig 3

8.2.3 Scratch test

(1) Test method

Maintain the cutter, note ⁽³⁾ of a cutter knife (a small size), note ⁽²⁾ on a vertical plane about 30° for a effective surface shown on fig 4, make the cross cut near a foundation, and adhere closely cellophane adhesive tape (KS A 1526), note ⁽⁴⁾ of width 24mm on scratch without bubbles rubbing strongly with more than 2kgf (19.6N) by a nail. And, maintain one edge of a tape vertical to a effective surface, remove it at

the fast speed more than 0.5m/sec in a moment, and measure the exfoliation rating grade of a test sample comparing the exfoliation state and grade of paint film shown in the table 7.

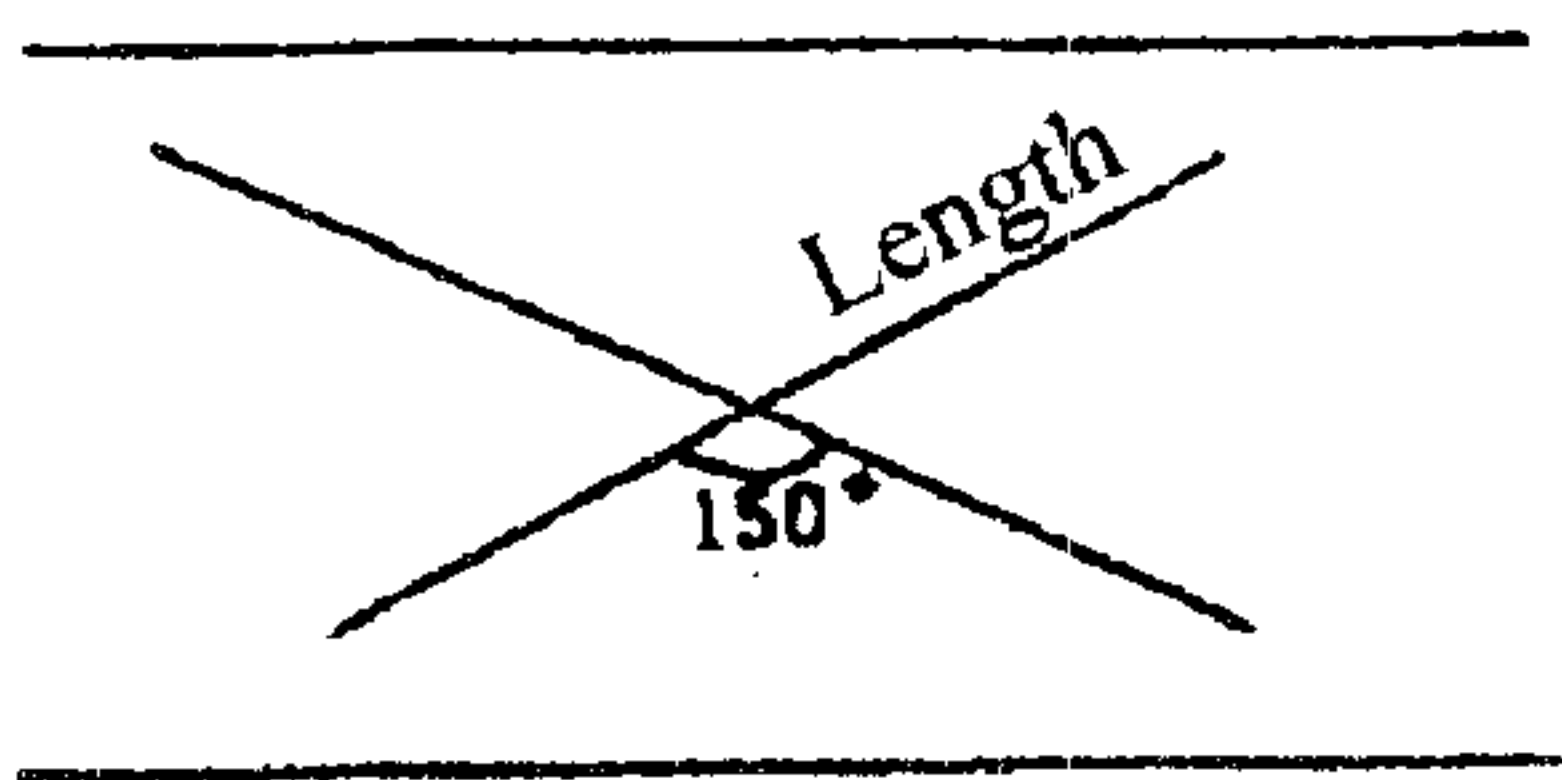
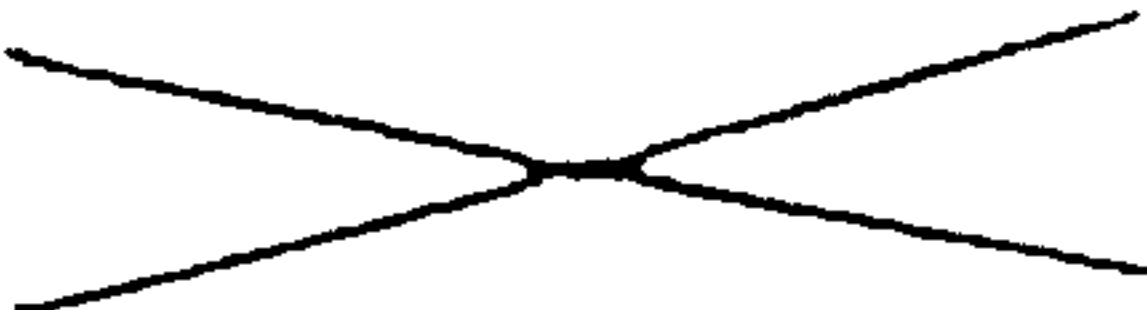


Fig 4

(2) Decision
If the exfoliation rate grade of the paint film of a test sample is fitted to the condition defined on the paint film, it is decided to “ the adhesion is normal “

Table 7

Grade	A limit sample
5	None
4	
3	
2	
1	Exfoliation area : 100%

9. Hardness

Hardness test is as followings

9.1 Purpose

Measure the hardness of a paint film is normal and or not.

9.2 Classes

Test method is divided to two classes shown on table 8

Table 8

Classes	Test method
Class 1	Pencil hardness 1
Class 2	Pencil hardness 2

9.2.1 Pencil hardness 1

(1) Purpose

Measure the hardness of a paint film, and which is normal and or not.

(2) Test method

Draw 50mm at the speed of about 3mm/sec in the direction of a pencil lead holding a pencil ⁽⁸⁾ at an angle of about 45 and pushing down a pencil lead on a paint film with the force of 1.0 ± 0.5kgf (9.8 ± 5N)and measure the existence of groove.

Test 5 times changing position. If there is grooves more than 2 times, change the hardness of a pencil lead to the lower by 1 degree and retest like above.

Take the symbol of a pencil strength with groove less than 2 times as the hardness of a paint film.

Note ⁽⁸⁾ Use Mitsubishi Uni as a pencil and sharpen it with a pencil sharpener (KS G 2620).

Expose a pencil lead by 3mm, contact it on the even waterproof sandpaper (KS L 6004) number 400 vertically, grind it smoothly drawing a circle. Use the pencil edge ground newly whenever draw it.

Note ⁽⁹⁾ Remove the crush by a pencil lead

(3) If the hardness of the paint film of a test sample is fitted to the condition defined on the paint film, it is decided to “ the hardness is normal “

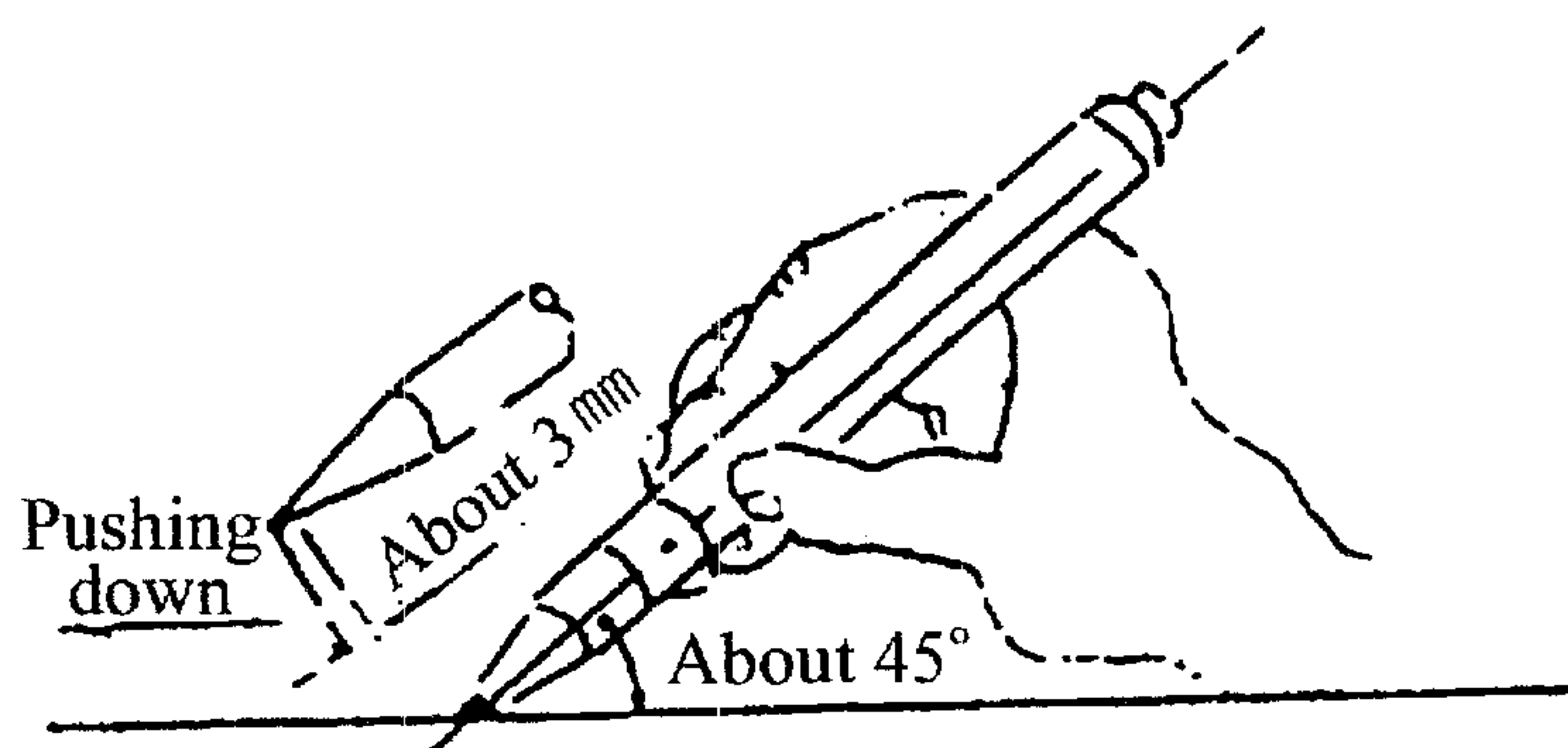


Fig 5

9.2.2 Pencil hardness 2

(1) Test method

Draw 50mm at the speed of about 3mm / sec in the direction of a pencil lead holding a Pencil ⁽⁸⁾ at an angle of about 45 shown on fig 5 and pushing down a pencil lead on a paint film with the force of $1.0 \pm 0.5\text{kgf}$ ($9.8 \pm 5\text{N}$) and measure the existence of groove ⁽¹⁰⁾. Test 5 times changing position. If there is grooves more than 2 times, change the hardness of a pencil lead to the lower by 1 degree and retest by same method. Take the symbol of a pencil strength with scratch less than 2 times as the hardness of a paint film.

Note ⁽¹⁰⁾ A groove means the state that a pencil lead reach the bottom scratching a paint film with a pencil lead and it is impossible to push down more.

(2) Decision

If the hardness of the paint film of a test sample is fitted to the condition defined on the paint film, it is decided to " the hardness is normal "

10. A tack - free

A tack - free test is as followings

10.1 Purpose

Measure the tendency of a paint film adheres at high temperature according to the adhesion of pressed gauge and the standard of gauge appearance.

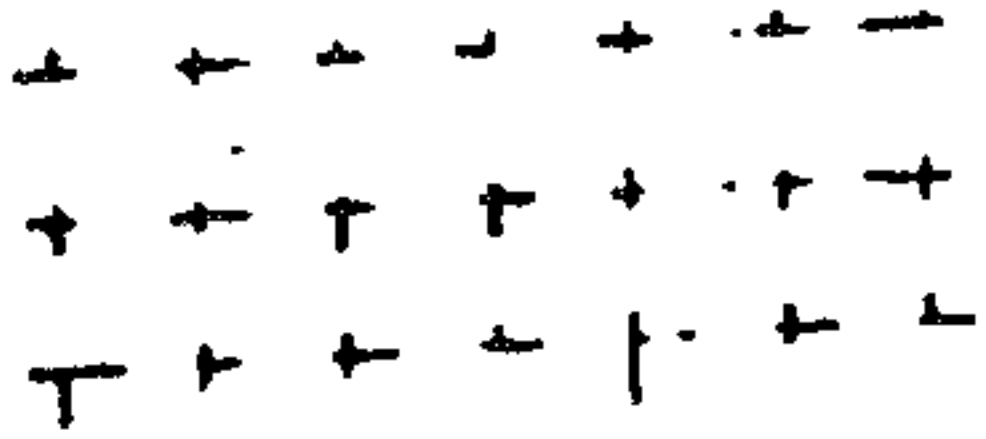
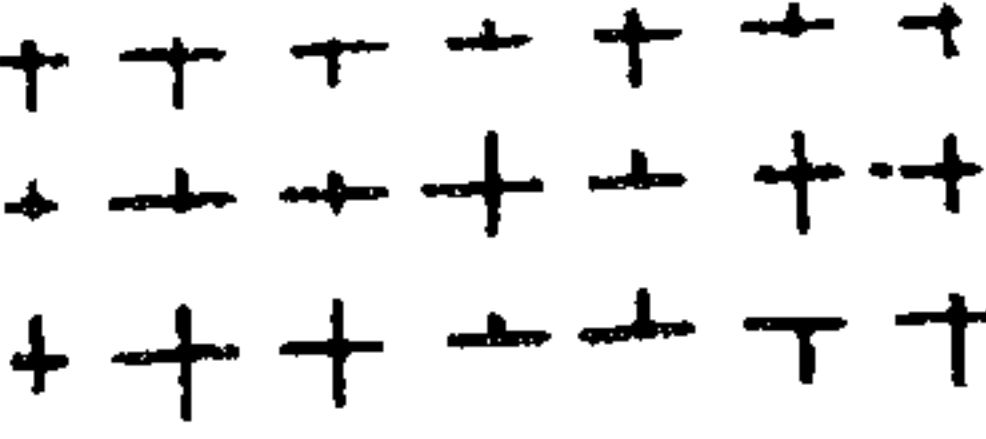
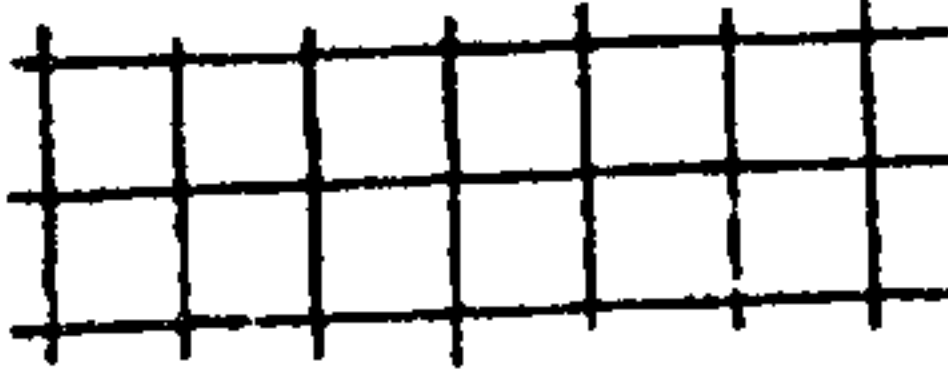
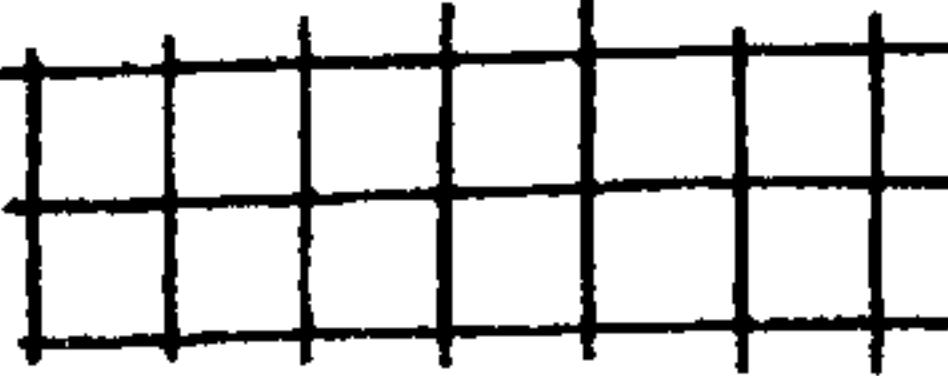
10.2 Test method

Put the effective surface of a test sample upward in the thermostat to maintain the paint film at defined temperature, ant put the conical weight (¹¹) with even bottom of a diameter of 40 ± 1mm, and mass of 0.5 ± 0.003kgf (4.9 ± 0.03) at the center of gauge (used at a pharmacy) of 5 stacks with the dimension of 50mm square set on the center of a effective surface.

Maintain the weight set for defined time, hold it up, remove gauge from a paint film. Measure the tack-free grade of a test sample comparing the standard between gauge and a paint film and the marks of gauge surface covered with a paint film with the grade in the table 9

Note (¹¹) Put a weight in a thermostat beforehand for more than 1hr and set it at defined temperature.

Table 9

Grade	A tack-free	Marks of gauge	
5	There is no a tack-free	There is no marks of gauge	
4	“	T here is point marks	
3	“	There is a little marks of gauge	
2	“	There is clear marks of gauge	
1	There is a tack-free	“	

10.3 Decision

If the standard between a paint film and gauge and the marks of gauge for a paint film is fitted to the condition defined on the paint film, it is decided to " the tack - free is normal "

11. Thermal resistance

Thermal resistance test is as followings

11.1 Purpose

The purpose is to measure the standard of discoloration and cohesion change of a paint film by the heat aging of a test sample.

11.2 Test method

Put the effective surface upward in the thermostat to maintain the paint film of a test ample at defined temperature and maintain it for defined time. Take it out and estimate luster, color and adhesion after leaving it at the room temperature for 1hr.

11.3 Estimation method

(1) Estimating luster

Estimating luster is carried out by test method by a gauge in 5.2.2 luster for measuring luster maintenance property.

(2) Estimating color

Estimating color is carried out by color test method in 6 for measuring the grade of discoloration.

(3) Estimating adherence

Estimating adherence is carried out by adherence test method.

11.4 Decision

If the luster, color, and adherence for the paint film of a test sample is fitted to the condition defined on the paint film, it is decided to " the thermal resistance is normal "

12. Cooling and heating repetition

The test for cooling and heating repetition is carried out as followings.

12.1 Purpose

The purpose of to measure the characteristic of a paint film by the repetition of cooling and heating for a test sample under the setting state (¹²) according to the standard of braking, wear, wrinkle, and swelling

12.2 Test method

Carry out soft chip test (¹³) in 29.2.1 (angle of 45° , temperature of $23 \pm 3^\circ\text{C}$) for a test sample beforehand. Put the test sample under setting state in the thermostat maintaining temperature of $30 \pm 2^\circ\text{C}$, and leave it for 1 hr. Also, take it out and leave it at the room temperature for 30 minutes.

And, put the test sample under setting state in the thermostat maintaining temperature of $80 \pm 2^\circ\text{C}$, and leave it for 1 hr. Also, take it out and leave it at the room temperature for 30 minutes. This is 1 cycle. And measure the state of braking, wear, wrinkle, and swelling on the effective surface by appearance test method in chapter 4, carrying out the test as many as the number of cycle defined on the paint film of a test film. Soft chip test is carried out for the first cycle.

12.3 Decision

If the state of braking, wear, wrinkle, and swelling of a test sample is fitted to the condition defined on the paint film, it is decided to " the cooling and heating repetition is normal "

Note (¹²) The setting state of a test sample means the state of associating a test sample on a mounting plate on the equivalent fitting condition of assembling parts to a vehicle. The thickness of a mounting plate, shape of curve surface, material, and fitting condition is determined by the discussion with the design department in a concern company.

(¹³) Corrosion resistance test is not needed before and after

13. Water - proofing

Water - proofing test is carried out as followings.

13.1 Purpose

The purpose is to deposit a paint film in the water and measure water - proofing.

13.2 Test method

Put ion removal water or distilled water in a thermostat, maintain it at the temperature defined on the paint film of a test sample, and deposit a test sample in it.

Deposit it for the defined time, and estimate appearance, luster, and color. Leave it for 1hr in the case of checkers test of 2mm, for 5hr in the case of checkers test of 4mm at the room temperature and estimate adherence.

13.3 Test method

(1) Estimating appearance

Measure the state of braking, wrinkle, wear, and swelling on a effective surface by appearance test method in chapter 4.

And, compare the state of swelling with No 9 - MD in fig.6

Note 1 The swelling in fig.6 what makes the size smaller being equal to the density of swelling for NO. 8 - MD defined on ASTM D 714.

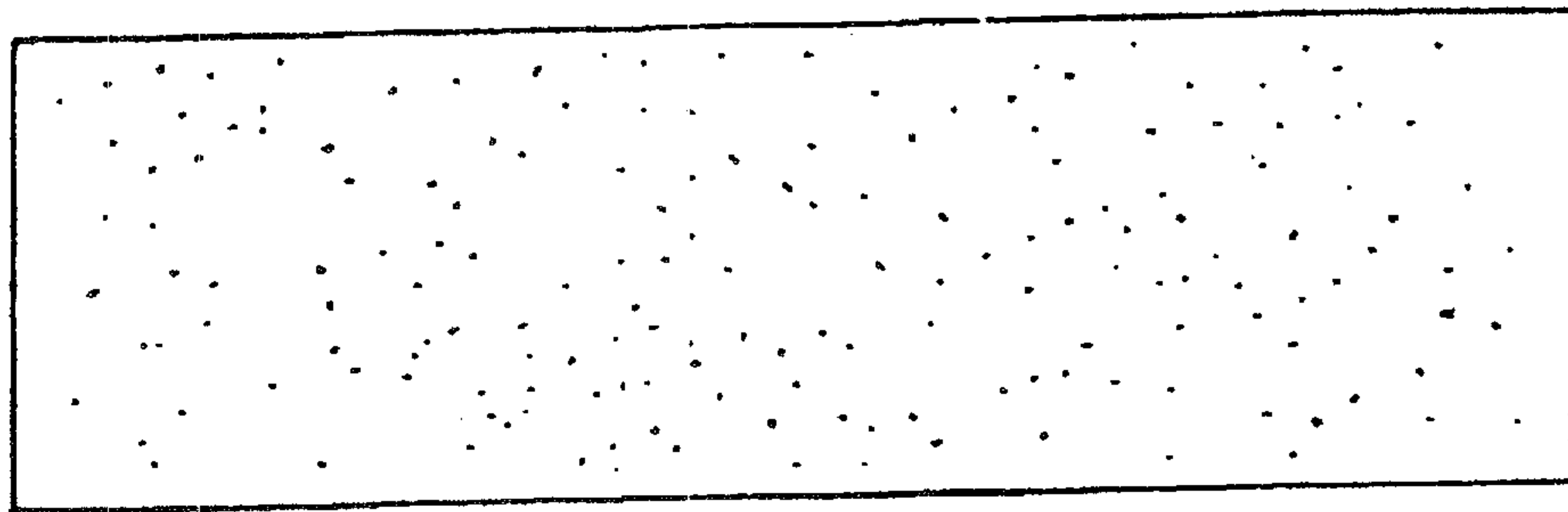


Fig 6

(2) Estimating luster

Estimating luster is for measuring luster maintenance property by luster test method by a gauge in 5.2.2

(3) Estimating color

Estimating color is for measuring the grade of discoloration by color test method in chapter 6.

(4) Estimating adherence

Estimating adherence is carried out by adherence test method in chapter 8.

13.4 Decision

If the appearance, luster, color, and adherence of a test sample is fitted to the condition defined on the paint film, it is decided to “water-proofing is normal”

14. Wet - proofing

Wet - proofing test is as followings.

14.1 Purpose

The purpose is to measure the wet - proofing of a paint film under high humidity.

14.2 Test method

Put a test sample with the effective surface upward in the thermostat to maintain the paint film of a test sample at defined temperature, and humidity and maintain it for defined time. Take it out and estimate appearance, luster, color and adhesion after leaving it at the room temperature for 1hr.

14.3 Estimating method**(1) Estimating appearance**

Measure the state of braking, wrinkle, wear, and swelling on a effective surface by appearance test method in chapter 4.

(2) Estimating luster

Estimating luster is for measuring luster maintenance property by luster test method by a gauge in 5.2.2

(3) Estimating color

Estimating color is for measuring the grade of discoloration by color test method in chapter 6.