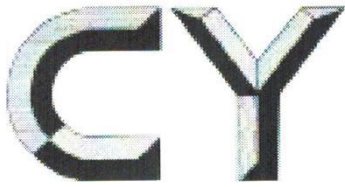


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CY/T 144-2015

**Screen printing — Performance requirement and test method for
photoemulsion**

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**Issued by State Administration of Press, Publication, Radio, Film and Television of The People's
Republic of China**

Foreword

The standard is drafted based on GB/T 1.1-2009.

The standard is presented by State Administration of Press, Publication, Radio, Film, and Television of The People's Republic of China Issue.

The standard is managed by national printing standardization technical committee screen printing sub-committee unified management.

The standard draft main department: Denbishi Fine Chemical (Kunshan) Co., Ltd., Beijing
Taipingqiao Printing Material Co., Ltd., Jiangshan Ying Te Chemical Co., Ltd, Kunshan Product
Quality Supervision and Inspection institute, Wenzhou Huasheng Screen Printing Material Co.,
Ltd., Shenzhen Polytechnic, Tianjin Zhonghua Hi-tech Co., Ltd.

The standard main drafters: Zheng Junming, Cheng Shuang, Zhang Jiwen, Zhan Zhiqiang, Mao Weilin, Jin Shengce, Wang Lijie, Hu Baorui.

Screen printing—Performance requirement and test method for photoemulsion

1 Scope

This standard stipulate screen printing photo emulsion general terms and definition, classify, performance requirement and testing method.

This standard is suitable for screen printing emulsion using and testing.

2 Normative reference document

Below documents are essential for application of this standard. If there is date on the reference document, only this version suitable for the standard. If there is no date on the reference document, the newest version (including revised version) suitable for the standard.

GB/T 6062 GPS, surface structure, outlining, nominal characteristic of contact
(contact pilotage) instruments

GB/T 8170-2008 Expression way and judgment method of numerical rounding rule
and value limit

GB/T 26555-2011 Printing machine, Aluminum frame of screen printing

JB/T 8393 Magnetic and eddy measuring instrument for coating thickness

JB/T 9108 printing machine, prefabricated exposure machine

JB/T 9124.1 Printing machine for flat screen

JB/T 11118-2010 Printing machine, coating machine

JB/T 20033 Hot air circulating oven

3 General terms and definition

Below general terms and definition are suitable for this standard.

3.1 Coating property

The emulsion coating on the screen mesh forming surface smooth and thickness uniformity film.

3.2 Exposure property

The emulsion film has the properties of photochemical reaction under UV light illumination.

3.2.1 Sensitivity

The emulsions are sensitive for UV light. General showed by exposure time. The exposure time longer, the sensitivity is lower. Exposure time shorter, the sensitivity is higher.

3.2.2 Optimum exposure

During exposing, the shooting amount which make the emulsion film get the best image-text.

Notice: Exposure light amount (mJ/cm²) = Exposure time (s) × Illuminance (mW/cm²)

3.3 Developing performance

After exposing screen, on image-text area the emulsion film dissolve by water, washing and show image-text ability. The time shorter, the developing faster. The time longer, the developing slower.

3.4 Resolution power

The ability of emulsion film record image-text reappearing.

Notice: Revise GB/T 9851.2-2008 No.2.13

3.5 Bridging ability

The film edge of image-text span or suspend mesh (mesh hole) opening, keep the image-text copy complete, edge clearly.

3.6 Adhesive force

The ability of fixation between emulsion film and mesh bonding.

3.7 Storage stability of pre-sensitive stencil

Under certain condition, during the screen placed which not exposure, the emulsion film keep its property the same. Placed time longer, the stability is better. Placed time shorter, the stability is worse.

3.8 Swelling ratio

The quality change rate which is the emulsion film soak into the regent for a certain time, it showed by percentage. The percentage smaller, the swelling ratio is lower, the percentage bigger, the swelling ratio higher.

4 Classify

According to emulsion performance which after expose, the emulsion can be classified water resistant emulsion, solvent resistant emulsion and dual cure emulsion.

5 Performance requirement

5.1 Endurance

5.1.1 Swelling ratio

The swelling ratio should meet form 1 requirement, after emulsion film soak into pure water and analytical reagent.

Form 1 Swelling ratio requirement

Emulsion	Water resist emulsion	Solvent resist emulsion					Dual cure emulsion Water and solvent resistance emulsion				
		Pure water	Ethyl acetate	Toluene	Acetone	Ethyl alcohol	Pure water	Ethyl acetate	Toluene	Acetone	Ethyl alcohol
Swelling ratio	≤30%	≤110%	≤20%	≤35%	≤30%	≤15%	≤35%	≤15%	≤10%	≤20%	≤10%

5.1.2 Screen film thickness loss

Wipe the screen surface by pure water or mixture reagent, the film not fall off besides character, line, symbol and image-text, it can keep complete, clearly and identifiable. The film thickness loss should meet form 2 requirement.

Form 2 The requirement of screen film thickness loss

Emulsion	Water resist emulsion		Solvent resist emulsion		Dual cure emulsion	
	Wipe directly by water	After coating hardener, wipe by pure water	Pure water	Mixture reagent	Pure water	Mixture reagent
Screen film thickness loss	≤5μm	≤2μm	≤5μm	≤2μm	≤10μm	≤2μm

^a: The hardener is 5% concentrated hydrochloric acid solution + 10% glutaral mix water solution
^b: Mixture reagent is ethyl acetate, toluene, acetone and ethyl alcohol each with 25% analytical reagent.

5.2 Coating property

5.2.1 Coating smoothness

The emulsion film layer which the printing side RZ value less or equal 1μm

5.2.2 Film thickness uniformity

The screen film thickness which on 9 position the max difference less or equal 1μm

5.3 Exposure property

5.3.1 Sensitivity

Sensitivity is showed by exposure time, generally is 30s-360s.

Notice: If exposure time less or equal 180s, the sensitivity is high. If exposure time above or equal 360s, the sensitivity is low.

5.3.2 Optimum exposure lux

Optimum exposure lux is $60\text{mJ}/\text{cm}^2 \sim 100\text{mJ}/\text{cm}^2$

5.4 Developing

The emulsion film developing time should less than 60s.

5.5 Resolution

The emulsion film should reappear 0.1mm width line, the line edge no sawtooth.

5.6 Bridging

Less or equal 50% adjustable dot (Dia.0.2mm) or more or equal 0.1mm line suspend or span the mesh opening(mesh hole), not fall off, shrink and out of shape.

Suspend refer to image 1 A and B, span refer to image 1 C and D

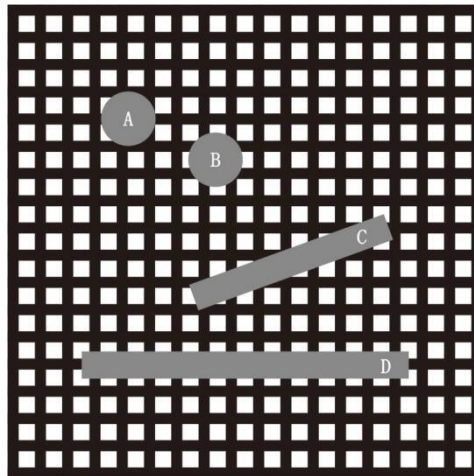


Image 1 Suspend and span sketch map

5.7 Resistance to print

Print 3000 times continuous, 70% adjustable dot not fall off on the emulsion film.

5.8 Adhesive force

The adjustable dot of dot ruler lost quantity not more than 50 pcs.

5.9 storage stability of pre-sensitive stencil

Under a certain storage condition, after placed 27 hours, it can meet 5.5 requirement.

6 Test

6.1 Test condition

6.1.1 Environment

6.1.1.1 Temperature and humidity

Temperature is $23^{\circ}\text{C}\pm 2^{\circ}\text{C}$; Relative humidity is $50\%\pm 5\%$.

6.1.1.2 illumination condition

The operating environment light is yellow when developing or before developing.

6.1.2 Adjust test sample status

After emulsion adopt pure water mix diazo, placed above two hours under 6.1.1 terms.

6.1.3 Numerical value rounding of test result

The test result as GB/T 8170-2008 No.3.2 rules, get each test item efficient numerical.

6.1.4 Screen condition

6.1.4.1 Frame

Size is $880\text{mm}\times 880\text{mm}$, basic parameter meet GB/T 26555-2011 form 1 P4 model requirement.

6.1.4.2 Mesh

Yellow polyester monofilament plain weave mesh, Mesh count 100 per cm, diameter $40\mu\text{m}$, thickness $59\mu\text{m}\pm 2\mu\text{m}$, aperture ratio $37\%\pm 2\%$.

6.1.4.3 Screen tension

The tension is $22\text{N}/\text{cm}^2\pm 2\text{N}/\text{cm}^2$

6.1.4.4 Screen stretching angle

22.5°

6.1.4.5 Screen film thickness

$15\mu\text{m}\pm 1\mu\text{m}$.

6.1.5 Instrument and equipment

6.1.5.1 Drying oven

Conform to JB/T 20033 principle, temperature is 40°C , the device with heated air circulation.

6.1.5.2 Thickness gauge

Conform JB/T 8393 requirement, the measurement precision accurate to $0.5\mu\text{m}$

6.1.5.3 Magnifying lens

Enlarge 100 times, ocular lens with ruler, division is 0.02mm.

6.1.5.4 Test slip

The test slip is composed of round dot stair ruler color lump which screen line is 24cm^{-1} , dot angle is 75° and a group lines. Test slip sketch map refer to image 2

The stair ruler including 0%、10%、20%、30%、40%、50%、60%、70%、80%、90%、100% total 11 color lump, each color lump size is $10\text{mm}\times 10\text{mm}$; The line including width 0.025mm, 0.050 mm, 0.075 mm, 0.100mm, 0.125mm, 0.150mm, 0.175mm, 0.200mm, 0.225mm, 0.250m, total 10 lines.

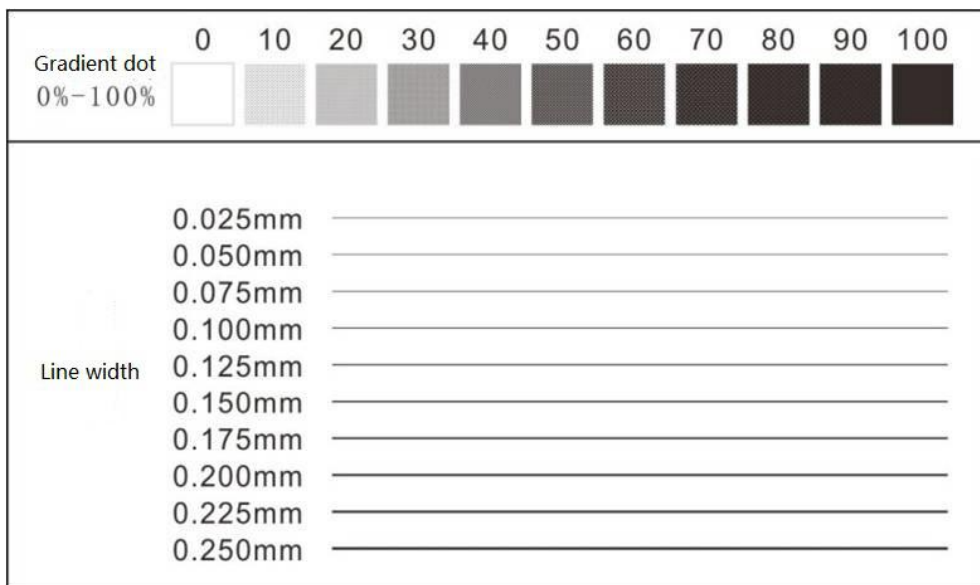


Image 2 test slip sketch map

6.1.5.5 Automatic coating machine

Conform to JB/T11118 requirement, testing parameter meet form 3 requirement.

Form3 Automatic coating machine testing parameter

Parameter	Coating Speed mm/s	Front scraper pressure MPa	Back coater pressure MPa	Coater tilt angle	Tilt time s	Coater mouth thickness mm
Numerical value	60	0.2	0.2	30°	3	0.6

6.2 Testing method

6.2.1 Swelling ratio

6.2.1.1 Analytical balance

Measurement accuracy is 0.0001g.

6.2.1.2 Testing procedure

Step 1: Use analytical balance to weight 30mm×30mm mesh to meet 6.1.4.2 requirement, the weight record C.

Step 2: Make the stencil which meet 6.1.4 requirement, use the optimum exposure lux to exposing, developing, dry then cut the emulsion film to

30mm×30mm sample. Put into 40°C dry oven for 24 hours. Take it out for weight, record weight A.

Step 3: The sample soak into the agent after weighting, take it out from agent after 24 hours. Use the dust-free sample to absorb residual agent on the sample surface then weight, record weight B.

Step 4: Please calculate swelling ratio as formula 1

$$P = \left(\frac{B-C}{A-C} - 1 \right) \times 100\% \quad \dots\dots\dots (1)$$

A— The sample weight before soak into the agent, unit is g.

B— The sample weight after soak into the agent, unit is g.

C— The weight of mesh, unit is g.

P— The emulsion film swelling ratio.(%)

6.2.2 Screen film thickness loss

6.2.2.1 Weight

Cylinder standard weight 500g.

6.2.2.2 Testing procedure

Step 1: Make the stencil which meet 6.1.4 requirement, first measure emulsion film thickness, thickness record H.

Step 2: Spread a piece new dust- free cloth on the flat side of cylinder standard weight 500g , the agent (pure water, esters, arene, ethyl acetate, alcohol) humidify different dust-free. Put the weight on the testing emulsion film, donot increase extra pressure, please reciprocating to wipe 100 times at speed of one time a second, back and forth as one time.

Step 3: After dry in the air, thickness gauge measure emulsion film thickness, the thickness record Hb.

Step 4: Please calculate screen film thickness loss ΔH as formula 2, the calculate result keep one effective digit after decimal point.

$$\Delta H = H_a - H_b \quad \dots\dots\dots (2)$$

In the formula:

ΔH ——Screen film thickness loss, the unit is μm .

H_a ——The emulsion film layer thickness before testing, the unit is μm ;

H_b ——The emulsion film layer thickness after testing, the unit is μm .

6.2.3 Surface smoothness

6.2.3.1 Surface smooth instrument

Conform GB/T 6062 requirement, measure value accurate to $0.1\mu\text{m}$.

6.2.3.2 Testing procedure

Step 1: Adopt automatic coating machine to make the stencil which meet 6.1.4 requirements.

Step 2: The screen squeegee side cling the plain glass, the printing side film upwards waiting to test.

Step 3: Put the surface smooth instrument on the film layer of the printing side. Set the sample length 24mm, press the testing key. The sensor slide on the film surface. When the slide stop, read sum of average of 5pcs max contourlet peak and 5 pcs max contourlet lowest value.

6.2.4 Thickness uniformity

Step 1: Use automatic coating machine make the stencil which meet 6.1.4 requirements.

Step 2: Confirm 9 testing points as image 3.

Step 3: Testing and record emulsion film thickness of 9 testing points.

Step 4: Calculate the difference between max and min. film thickness.

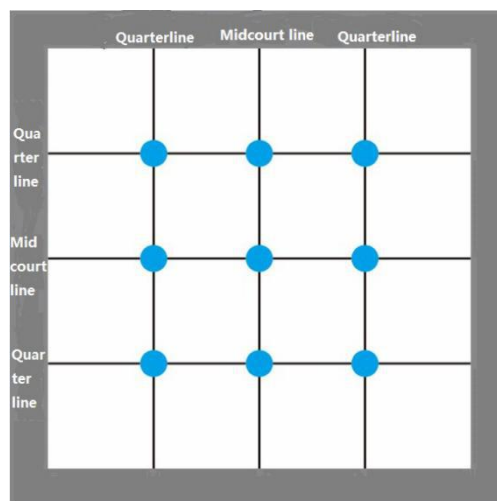


Image 3 The 9 testing points for screen film thickness testing

6.2.5 Sensitivity and optimum exposure lux

6.2.5.1 Exposure machine

Conform to JB/9108 rules, use high pressure halogen lamp of power 3KW, its UV light illumination is 15mW/cm². Its wave of UV light is 300nm-450nm. (Diazo type emulsion optimum wave is 365nm-385nm), light distance is 1m.

6.2.5.2 Testing procedure

Step 1: Make the stencil meet 6.1.4 requirement.

Step 2: Use 6.2.5.1 exposure machine to expose testing slide which conform to 6.1.5.4, exposure lux is among the range of 40mJ/cm²~140mJ/cm².

Exposure 6 times, each time increase 20mJ/cm². Mark light amount and time units for each exposure.

Step 3: After dry developing, use magnifying lens to observe 50% dot film layer. Find out the film layer without developing unqualified, dot film damage, time units and exposure lux.

Step 4: Get the time unit from step 3 is sensitivity

Step 5: Get the exposure lux from step 3 is the optimum exposure lux.

6.2.7 Developing

Step 1: Make the stencil which meet 6.1.4 requirement, expose testing slide which meet 6.1.5.4 requirement. The amount of light setting to the emulsion optimum exposure lux.

Step 2: After exposure, use the water gun to wash off emulsion on printing side of screen, and record the time. The distance is 20cm from water outlet to printing side of screen. The water gun parameter meet form 4 requirement.

Form 4 Water gun parameter

Parameter	Nozzle Dia. mm	Pressure MPa	Water yield ml/min
Numerical Value	1	0.35	95

Step 3: The emulsion which not exposure dissolve into the water completely falling off, the developing finalized, stop the time.

Step 4: The time of the emulsion dissolve into the water completely is developing.

6.2.8 Resolution

Step 1: Make the stencil which meet 6.1.4 requirement, expose the testing slide which

meet 6.1.5.4 requirement. The amount of light setting to optimum exposure lux.

Step 2: After dry developing, use 100 times magnifying lens to observe all lines of screen printing side reappear quality. Find out the thinnest line which the edge flat, no sawtooth, no falling off. And record the line width data.

Step 3: Record the line width is emulsion resolution.

6.2.9 Bridging

Step 1: Make the stencil which meet 6.1.4 requirement, expose the testing slide which meet 6.1.5.4 requirement. The amount of light setting to optimum exposure lux.

Step 2: After dry developing, use 100 times magnifying lens to observe all dots and line of printing side opening under span and suspend status. Find out the smallest dot and thinnest line which not fall off, shrinkage and out of shape. And record dot adjustable vale and line width data.

Step 3: The record dot adjustable value and line width data is emulsion bridging.

6.2.10 Resistance to print

6.2.10.1 Horizontal type screen printing machine

Meet JB/T 9124.1 requirement, parameter meet form 5 requirement.

Form 5 Horizontal type screen printing machine parameter

Parameter	Print speed mm/s	Squeegee pressure MPa	Distance between plates mm	Scraper angle	Squeegee hardness HS
Value	220	0.4	3	75°	70°

6.2.10.2 Testing procedure

Step 1: Make the stencil which meet 6.1.4 requirement, expose the testing slide which meet 6.1.5.4 requirement. The amount of light setting to optimum exposure lux

Step 2: Choose suitable ink, printing by form 5 horizontal type screen printing machine,

recording the printing times.

Step 3: During printing, use 100 times magnifying lens to observe reappear situation of 70% adjustable dot. Record the printing times when the 70% adjustable dot start to fall off.

Step 4: Record the printing times to show emulsion and ink resistance to print.

6.2.11 Storage stability of pre-sensitive stencil

Step 1: Make the stencil meet the 6.1.4 requirement.

Step 2: Put the emulsion on the dark room, take out after 72 hours, testing as 6.2.8 method.

Step 3: Judge storage stability of pre-sensitive stencil as 5.5 requirement.

6.2.12 Adhesive force

Step 1: Make the stencil which meet 6.1.4 requirement, expose the testing slide which meet 6.1.5.4 requirement. The amount of light setting to optimum exposure lux

Step 2: Finalized dry developing screen, after placed 30 minutes under normal temperature. Use adhesive force 10N/25mm±1N/25mm tape stick on the emulsion of 50% adjustable dot, compaction by hand.

Step 3: During 90s±30s, hold one side of the overhanding tape, try to close the 180°angle, tear off the tape quickly.

Step 4: Use 100 times magnifying lens to observe the dot on the tap and record the quantity.

References

- [1] GB/T 9851.2-2008 Terminology of printing technology part 2 Terminology of before printing
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Standardized instructional technical documents for the press and publishing industry
Screen printing—Performance requirement and test method for photoemulsion
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China Screenprinting & Graphic Imaging Association
Subcommittee 2 on Screen Printing of National Technical Committee 170 on Printing of
Standardization Administration of China published
705 room, Shangdu International Center, No.8, Dongdaqiao Road, Chaoyang District,
Beijing
Zip code: 100020
Tel:0086-10-58700601 /58700602

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