COSMETIC SPECIFICATIONS OF INJECTION MOLDED PARTS

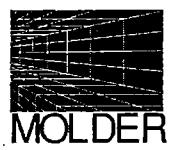
Specifications for Molders and their customers

1994 Edition

UNIFORM VIEWING CONDITIONS AND ACCEPTANCE CRITERIA

KEYS TO COSMETIC INSPECTION OF PLASTIC MOLDED PARTS

GLOSSARY OF TERMS FOR TYPICAL COSMETIC DEFECTS



Sponsored by the Molders Division of The Society of the Plastics Industry, Inc.

The Society of the Plastics Industry Cosmetic Specifications of Injection Molded Parts

This specification has been prepared by the Molders Division of The Society of the Plastics Industry, Inc. as a service to its members and their customers. The specification provides recommendations only. It is up to the molder and customer to determine particular contractual arrangements.

Acknowledgement

The SPI Molders Division is indebted to Carl Kern, Director of Quality, BACE Manufacturing, Inc., for his dedication to the development of this guide as its principal author and layout-designer. The division also wishes to thank Mike Noggle, CEO, BACE Manufacturing, Inc. (and Molders Division Director-at-Large) for BACE's generosity in providing the contents of the original draft. We also acknowledge Mr. Noggle's leadership towards achieving the published document.

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Version A
Date of Issue: March , 1994

The Society of the Plastics Industry
Cosmetic Specifications
of Injection Molded Parts

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The Society of the Plastics Industry
Cosmetic Specifications
of Injection Molded Parts

TITLE:

Cosmetic Specification of Injection Molded Parts

PURPOSE

The purpose of this standard is to provide quantitative definitions, and recommended methods of inspection and measurement of the cosmetic quality attributes in the absence of customer provided specifications.

The definitions, descriptions and classifications contained in the specification are based on typical terms used in the injection molding process and, where applicable, also relate to post molding activities.

SCOPE

This specification addresses the cosmetic quality of molded plastic parts and related post molding activities.

I. DEFECT DEFINITIONS

BLEEDING (paint or decoration)

Evidence of one color overlaping or altering another color (painting). Speading of pigment beyond the intended boudries (silk screen, printing).

BLUSH

Discoloration or change in gloss. Generally occurring at gate locations or abrupt changes in wall thickness.

BROKEN

General damage. For example bent and/or broken tabs or ribs.

BUBBLES

Void pockets, typically seen only in transparent parts. May appear as a bulge or protrusion in an opaque part.

BURNS

Brown marks or streaks. (Also see gas marks.)

COLD SLUG

First material to enter mold during injection. Solid or semi-solid, this material leaves a distinct border with adjacent melted material similar in appearence to weldlines.

CONTAMINATION

Large areas of discoloration from foreign matter or foreign material embedded in the surface of a part.

CRACKING

Stress induced splitting or fissures causing separation of material.

CRAZING

Multiple tiny cracks due to stress exerted on the part.

DELAMINATION

Separation (peeling) of layers of plastic

DISCOLORATION

Any change from the original color standard. Unintended, inconsistent color.

DRAG MARKS

Clusters of scratches from plastic dragging against mold details when a part is ejected from a mold.

FILL-INS (print or silk screen)

An excessive use of ink that alters the form of screened or printed feature. Placement of ink where no ink should be.

FLASH

Excess plastic at parting line or mating surface of the mold. Normally very thin and flat protrusion of plastic along an edge of a part. Can also appear as a very thin string or thread of plastic away from the edge of a part (string flash). Often found at vents, knock outs and other shut-off areas.

FLOW MARKS (paint or silk screen)

Waviness of edge or excessive linear junction between two surfaces of ink or paint.

GAS MARKS

Dark discolored streaks caused by incomplete venting of gases generated during the molding cycle.

GOUGE

Surface imperfection due to abrasion that removes small amounts of material. Depth is measurable.

GREASE

Any type of machine lubrication on the surface of a part.

HAZE

Cloudiness on an otherwise transparent part.

INSERT PROBLEMS (Not a true "cosmetic" defect. More functional than cosmetic)

Errors related to the installation of inserts into plastic parts. Inserts can be set too high or too low in a socket or boss. They can also be damaged or misaligned and may even be missing.

JETTING

See splay.

LINT (paint)

Any unintended foreign substance in the coating or on the surface.

MARBLING

Colored streaks caused by incomplete mixing of 2 different colored plastics. Also referred to as streaking.

NICKS

Like gouges but of short length. Cause by impact rather than abrasion.

NON-ADHESION (painted or decorated))

Lack of adequate sticking of paint, print or any coating to the plastic surface.

ORANGE PEEL

Rippled or mottled appearance view able as concentric lines. Caused by under-pressurizing. Orange peel is often the first sign of possible sink or shorting.

PIN PUSH

Protrusion or distortion caused by an ejector pin pushing into part more than normal. The protrusion is most evident on the surface opposite the ejector pin.

PITTING

Crater-like imperfections on the surface of the part.

PULLING

Part distortion caused from plastic catching in the mold when the part is ejected.

RUNS (painting or printing)

Dripping or sagging of paint or ink. Movement of ink beyond intended surfaces. Usually caused by too much or too thick paint or ink.

SCRATCH

Surface imperfection due to abrasion that removes small amounts of material. Depth is not measurable. Differs from scratch in mold which leaves a consistent mark.

SHINE

Glossy or shiny areas on textured surface. Usually caused by a dirty or worn mold. Can also be caused by lack of sufficient pressure to properly replicate texture in the mold.

SHORTS (Short shot, non-fill)

Missing plastic due to incomplete filling of the mold cavity. Parts are not completely formed. Can usually be identified by smooth, shiny and rounded surfaces.

SINK

Surface depression caused by non uniform material solidification and shrinkage. Most often noted at interface between differing wall thicknesses.

SMEARING (paint or ink)

Similar to bleeding. Excess ink or paint in areas that should be free of ink or paint. Smearing is due to rubbing of surface before adequately dried.

SPECKS

Small discolored points of matter embedded in the surface. Typically black, caused by material contamination or material degradation.

SPLAY

Off colored streaking. Usually appears silver-like. Splay is caused by moisture in the material or thermal degradation of the resin during processing. A similar look can be caused by cold material skipping across the surface during a fast fill. This is commonly called "jetting".

WELDLINES

Witness line where 2 or more fronts of molten plastic converge. Also called knitlines or flowlines.

II. SURFACE IDENTIFICATION AND CLASSIFICATION OF SURFACE FINISH

A. SURFACE FINISH

GRADE 1 -

- Highly polished: (e.g. SPI - B1 or lower).
- Clear transparent.
- Fluid contact - (primarily applies to medical parts)

GRADE 2 -

- Low grade polish, non-textured: (e.g. SPI - B2 or higher.)
- Textured.
- Clear translucent.

GRADE 3 -

- Painted parts

GRADE 4 -

- Ink stamped, printed, silk screened
- Other decorative processes.

B. SURFACE IDENTIFICATION

"A" surface - The top or front, most often viewed surface.

"B" surface - Generally the front edge and sides of a part. Not viewed as often as an "A" surface but easily seen by user.

"C" surface - Most often, the back and bottom surface.

"D" surface - internal surfaces. Normally D surfaces are not inspected for cosmetic attributes. Where, necessary, D surface inspection will be specified as an exception.

III. STANDARD VIEWING CONDITION

A. LIGHTING INTENSITY

All quality decisions of cosmetic acceptability will be made under normal lighting conditions (80-120 footcandles) in white fluorescent light.

B. VIEWING ANGLE

All viewing will take place with direct overhead lighting. Viewing angle is dependent on surface classification.

In every case, parts will be held such that the light is NOT REFLECTED directly to the viewer.

"A" surface - Hold part 30° from the horizontal plane.
Part is in direct line with your eyes.

ROTATE part 30° to the right and to the left about the vertical axis.

"B" surface - Hold part 90° from the horizontal plane.
Part is in direct line with your eyes.
DO NOT rotate the part.

"C" surface - Hold part 90° from the horizontal plane.
Part is NOT in direct line with your eyes. Part is held 45° below the plane of your eyes.
DO NOT rotate the part.

C. VIEWING DISTANCE

"A" surface - 18 inches
"B" surface - 24 inches
"C" surface - 30 inches

III. STANDARD VIEWING CONDITION (continued)

D. INSPECTION INTERVAL (time)

Inspection interval is a function of surface area.

SURFACE AREA		"A" Surfaces	non-"A" Surfaces
≤ 4 in^2	(2" x 2")	2 sec.	1 sec.
4-16 in^2	(4" x 4")	4 sec.	2 sec.
16-64 in^2	(8" x 8")	6 sec.	3 sec.
64-144 in^2	(12" x 12")	8 sec.	4 sec.
$>$ 144 in^2	(12" x 12")	10 sec.	5 sec.

IV. COLOR MATCHING

Decisions regarding color matching are made by comparison to known standards using a spectrophotometer, color meter or suitable color matching light booth.

Color standards and tolerances shall be provided by the customer. In the absence of a customer supplied color standard, standards shall be developed based upon the material manufacturer's color chip set and tolerances shall be set using a Delta E (ΔE) limit of 1.00, unless otherwise stated by the customer.

V. GLOSS.

Determination of gloss is to be made using a suitable glossmeter (e.g. BYK Gardener Glossgard® 60° glossmeter). When gloss cannot be measured by glossmeter, judgement shall be made by eye against gloss standards provided by or approved by the customer. All evaluations by eye shall be under standard viewing conditions .

VI. SURFACE FINISH and TEXTURE MATCHING.

Judgement as to the conformance of surface finish is to be made by comparing a part to an SPI Mold Finish Guide plaque. Comparison is by eye unless otherwise specified by the customer.

Judgement as to the conformance of surface texture is to be made by comparing a part to a Mold-Tech texture plaque. Comparison is by eye unless otherwise specified by the customer.

VII. ADHESION

Adhesion requirements pertain to printed, painted or other decorative finishes applied to the surface of a plastic part.

The applied finish must withstand a tape test, whereby a piece of pressure sensitive tape (Scotch Number 610 or equivalent adhesive strength) is applied across the finished surface. The tape is then removed by rapidly pulling the tape at a 90 degree angle to the part surface. The tape is examined for evidence of finish coat removal. There should be no evidence of finish coat on the tape.

COSMETIC QUALITY SUMMARY SHEETS

The following four pages are summary sheets outlining the cosmetic requirements by grade.

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GRADE 1 (Highly polished, clear transparent, fluid contact)

SURFACE		A	B	C
WELDLINES & BLUSH		Limits for BLUSH and WELDLINES are established in agreement with customer and held based upon limit samples		
SINK		None allowed.	.003" max.	.010" max.
SPECKS & BUBBLES	ACCEPT IF -	Less than or equal to .010". No closer than 1 inch.	Less than or equal to .010". No closer than 1 inch	Less than or equal to .012". No closer than 1 inch.
	ALLOWABLE RANGE	.010" - .025". Allow 1 per 16 inch^2 (4" x 4").	.010" - .025". Allow 2 per 16 inch^2 (4" x 4"). No closer than 2 inches.	.012" - .030". Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inches.
	REJECT IF -	Greater than .025".	Greater than .025".	Greater than .030".
SCRATCHES				
	ACCEPT IF -	.100" or less in length. Allow 1 per 16 inch^2 (4" x 4").	.150" or less in length. Allow 1 per 16 inch^2 (4" x 4").	.300" or less in length. Allow 2 per 16 inch^2 (4" x 4"). No closer than 1 inch.
	REJECT IF -	Greater than .100"	Greater than .150"	Greater than .300"
SPLAY		None Allowed	None Allowed	Refer to limit samples
BURNS		"	"	or note exceptions in
GAS MARKS		"	"	Quality Plan.
MARBLING		"	"	"
ORANGE PEEL		"	"	"
NON-UNIFORM TEXTURE		"	"	"
PITTING		"	"	"
CRACKING		"	"	"
CRAZING		"	"	"
DELAMINATION		"	"	"
COLD SLUGS		"	"	"

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GRADE 2 - (Low grade polish, textured, clear translucent)

SURFACE	A	B	C
WELDLINES & BLUSH	Limits for BLUSH and WELDLINES are established in agreement with customer and held based upon limit samples		
SINK	None allowed.	.005" max.	.015" max.
SPECKS & BUBBLES ACCEPT IF -	Less than or equal to .010". No closer than 1 inch.	Less than or equal to .010". No closer than 1 inch	Less than or equal to .015". No closer than 1 inch.
ALLOWABLE RANGE	.010" - .030". Allow 1 per 16 inch^2 (4" x 4").	.010" - .030". Allow 2 per 16 inch^2 (4" x 4"). No closer than 2 inches.	.015" - .040". Allow 3 per 16 inch^2 (4" x 4"). No closer than 1 inch.
REJECT IF -	Greater than .030".	Greater than .030".	Greater than .040".
SCRATCHES ACCEPT IF -	.150" or less in length. Allow 1 per 16 inch^2 (4" x 4").	.200" or less in length. Allow 1 per 16 inch^2 (4" x 4").	.300" or less in length. Allow 3 per 16 inch^2 (4" x 4"). No closer than 1 inch.
REJECT IF -	Greater than .150"	Greater than .200"	Greater than .300"
SPLAY	None Allowed	None Allowed	Refer to limit samples
BURNS	"	"	or note exceptions in
GAS MARKS	"	"	Quality Plan.
MARBLING	"	"	"
ORANGE PEEL	"	"	"
NON-UNIFORM TEXTURE	"	"	"
PITTING	"	"	"
CRACKING	"	"	"
CRAZING	"	"	"
DELAMINATION	"	"	"
COLD SLUGS	"	"	"

GRADE 3 - (Painted / Finished parts)

SURFACE	A	B	C
SPECKS, DISCOLORATION, & GLOSSINESS			
ACCEPT IF -	Less than or equal to .010". No closer than 1 inch.	Less than or equal to .015". No closer than 1 inch.	Less than or equal to .015".
ALLOWABLE RANGE	.010" - .020". Allow 2 per 16 inch^2 (4" x 4").	.015" - .040". Allow 4 per 16 inch^2 (4" x 4"). No closer than 2 inches.	.015" - .050". Allow 6 per 16 inch^2 (4" x 4"). No closer than 1 inches.
REJECT IF -	Greater than .020".	Greater than .040".	Greater than .050".
SCRATCHES & LINT			
ACCEPT IF -	.010" x .030" or less. Allow 2 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.020" x .050" or less. Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.020' x .500" or less. Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inch.
REJECT IF -	Greater than .010" x .030"	Greater than .020" x .050"	Greater than .020' x .500".
MARKS & RUNS			
ACCEPT IF -	none.	.020" x .050" or less. Allow 2 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.020' x .500" or less. Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inch.
REJECT IF -	any found	Greater than .020" x .050"	Greater than .020' x .500".
NON-ADHESION OR NON-UNIFORM COVERAGE			
ACCEPT IF -	none.	.125" or less. Allow 2 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.250" or less. Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inch.
REJECT IF -	any found	Greater than .125"	Greater than .250".

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GRADE 4 - (Decorated Parts - stamped, printed, silk screened, in-mold,... etc.))

SURFACE	A	B	C
SPECKS, VOIDS & FILLINGS			
ACCEPT IF -	Less than or equal to .010". No closer than 1 inch.	Less than or equal to .015". No closer than 1 inch.	Less than or equal to .025".
ALLOWABLE RANGE	.010" - .020". Allow 2 per 16 inch^2 (4" x 4"). No closer. than 2 inches.	.015" - .030". Allow 3 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.025" - .050". Allow 5 per 16 inch^2 (4" x 4"). No closer than 1 inch.
REJECT IF -	Greater than .020".	Greater than .030".	Greater than .050".
FLOWMARKS & INCONSISTENCIES			
ACCEPT IF -	none allowed	.020" or less. Allow 2 per surface No closer than 1 inch.	.050" or less. Allow 4 per surface No closer than 1 inch.
REJECT IF -	any found	Greater than .020"	Greater than .050".
SMEARING, BLEEDING & HAZE			
ACCEPT IF -	none allowed	.020" or less. Allow 1 per surface No closer than 1 inch.	.050" or less. Allow 2 per surface No closer than 1 inch.
REJECT IF -	any found	Greater than .020"	Greater than .050".

APPENDIX

The following four pages are work sheets outlining the cosmetic requirements by grade and are intended to be used as work instructions *at the job site*.

Their use is optional and the sheets are provided merely as a tool in the implementation and integration of cosmetic evaluation during the manufacturing process (as opposed to *after* the process).

The pages of the appendix may be photocopied.

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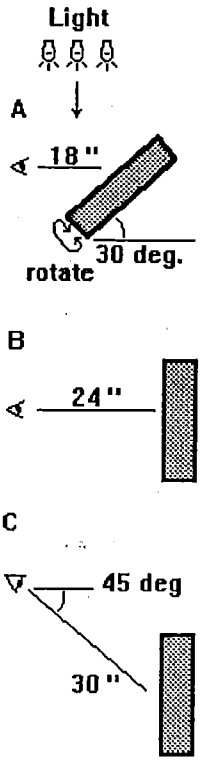
Cosmetic Specifications

Cutomer:_____
Part Name: _____ Part Number:_____
Authorized by:_____

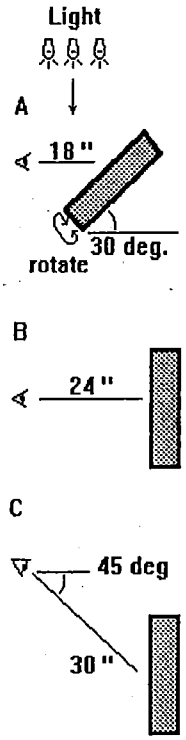


GRADE 1 (Highly polished, clear transparent, fluid contact)

SURFACE		A	B	C
WELDLINES & BLUSH		Limits for BLUSH and WELDLINES are established in agreement with customer and held based upon limit samples		
SINK		None allowed.	.003" max.	.010" max.
SPECKS & BUBBLES	ACCEPT IF -	Less than or equal to .010". No closer than 1 inch.	Less than or equal to .010". No closer than 1 inch	Less than or equal to .012". No closer than 1 inch.
	ALLOWABLE RANGE	.010" - .025". Allow 1 per 16 inch^2 (4" x 4").	.010" - .025". Allow 2 per 16 inch^2 (4" x 4"). No closer than 2 inches.	.012" - .030". Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inches.
	REJECT IF -	Greater than .025".	Greater than .025".	Greater than .030".
SCRATCHES				
	ACCEPT IF	.100" or less in length. Allow 1 per 16 inch^2 (4" x 4").	.150" or less in length. Allow 1 per 16 inch^2 (4" x 4").	.300" or less in length. Allow 2 per 16 inch^2 (4" x 4"). No closer than 1 inch.
	REJECT IF -	Greater than .100"	Greater than .150"	Greater than .300"
SPLAY		None Allowed	None Allowed	Refer to limit samples or note exceptions in Quality Plan.
BURNS		"	"	
GAS MARKS		"	"	
MARBLING		"	"	"
ORANGE PEEL		"	"	"
NON-UNIFORM TEXTURE		"	"	"
PITTING		"	"	"
CRACKING		"	"	"
CRAZING		"	"	"
DELAMINATION		"	"	"
COLD SLUGS		"	"	"

The Society of the Plastics Industry
Cosmetic Specifications

Cutomer:_____
Part Name: _____ Part Number:_____
Authorized by:_____

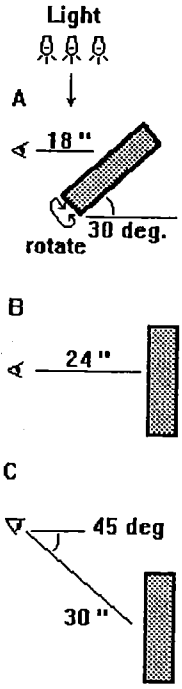


GRADE 2 - (Low grade polish, textured, clear translucent)

SURFACE		A	B	C
WELDLINES & BLUSH		Limits for BLUSH and WELDLINES are established in agreement with customer and held based upon limit samples		
SINK		None allowed.	.005" max.	.015" max.
SPECKS & BUBBLES	ACCEPT IF -	Less than or equal to .010". No closer than 1 inch.	Less than or equal to .010". No closer than 1 inch	Less than or equal to .015". No closer than 1 inch.
	ALLOWABLE RANGE	.010" - .030". Allow 1 per 16 inch^2 (4" x 4").	.010" - .030". Allow 2 per 16 inch^2 (4" x 4"). No closer than 2 inches.	.015" - .040". Allow 3 per 16 inch^2 (4" x 4"). No closer than 1 inch.
	REJECT IF -	Greater than .030".	Greater than .030".	Greater than .040".
SCRATCHES				
	ACCEPT IF -	.150" or less in length. Allow 1 per 16 inch^2 (4" x 4").	.200" or less in length. Allow 1 per 16 inch^2 (4" x 4").	.300" or less in length. Allow 3 per 16 inch^2 (4" x 4"). No closer than 1 inch.
	REJECT IF -	Greater than .150"	Greater than .200"	Greater than .300"
SPLAY		None Allowed	None Allowed	Refer to limit samples or note exceptions in Quality Plan.
BURNS		"	"	
GAS MARKS		"	"	
MARBLING		"	"	"
ORANGE PEEL		"	"	"
NON-UNIFORM TEXTURE		"	"	"
PITTING		"	"	"
CRACKING		"	"	"
CRAZING		"	"	"
DELAMINATION		"	"	"
COLD SLUGS		"	"	"

The Society of the Plastics Industry
Cosmetic Specifications

Cutomer:_____
Part Name: _____ Part Number:_____
Authorized by:_____



GRADE 3 - (Painted / Finished parts)

SURFACE	A	B	C
SPECKS, DISCOLORATION, & GLOSSINESS			
ACCEPT IF -	Less than or equal to .010". No closer than 1 inch.	Less than or equal to .015". No closer than 1 inch.	Less than or equal to .015".
ALLOWABLE RANGE	.010" - .020". Allow 2 per 16 inch^2 (4" x 4").	.015" - .040". Allow 4 per 16 inch^2 (4" x 4"). No closer than 2 inches.	.015" - .050". Allow 6 per 16 inch^2 (4" x 4"). No closer than 1 inches.
REJECT IF -	Greater than .020".	Greater than .040".	Greater than .050".
SCRATCHES & LINT			
ACCEPT IF -	.010" x .030" or less. Allow 2 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.020" x .050" or less. Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.020' x .500" or less. Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inch.
REJECT IF -	Greater than .010" x .030"	Greater than .020" x .050"	Greater than .020' x .500".
MARKS & RUNS			
ACCEPT IF -	none.	.020" x .050" or less. Allow 2 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.020' x .500" or less. Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inch.
REJECT IF -	any found	Greater than .020" x .050"	Greater than .020' x .500".
NON-ADHESION OR NON-UNIFORM COVERAGE			
ACCEPT IF -	none.	.125" or less. Allow 2 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.250" or less. Allow 4 per 16 inch^2 (4" x 4"). No closer than 1 inch.
REJECT IF -	any found	Greater than .125"	Greater than .250".

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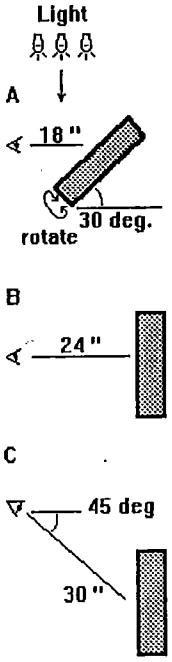
Cosmetic Specifications

Cutomer:_____
Part Name: _____ Part Number:_____
Authorized by:_____



GRADE 4 - (Decorated Parts - stamped, printed, silk screened, in-mold,... etc.))

SURFACE		A	B	C
SPECKS, VOIDS & FILLINGS				
	ACCEPT IF -	Less than or equal to .010". No closer than 1 inch.	Less than or equal to .015". No closer than 1 inch.	Less than or equal to .025".
	ALLOWABLE RANGE	.010" - .020". Allow 2 per 16 inch^2 (4" x 4"). No closer. than 2 inches.	.015" - .030". Allow 3 per 16 inch^2 (4" x 4"). No closer than 1 inch.	.025" - .050". Allow 5 per 16 inch^2 (4" x 4"). No closer than 1 inch.
	REJECT IF -	Greater than .020".	Greater than .030".	Greater than .050".
FLOWMARKS & INCONSISTENCIES				
	ACCEPT IF -	none allowed	.020" or less. Allow 2 per surface No closer than 1 inch.	.050" or less. Allow 4 per surface No closer than 1 inch.
	REJECT IF -	any found	Greater than .020"	Greater than .050".
SMEARING, BLEEDING & HAZE				
	ACCEPT IF -	none allowed	.020" or less. Allow 1 per surface No closer than 1 inch.	.050" or less. Allow 2 per surface No closer than 1 inch.
	REJECT IF -	any found	Greater than .020"	Greater than .050".

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