Ultra Matte Lipstick Gloss Values vs MAC Matte 19/07/2022

Objective

The objective of this test was to assess the gloss value of Ultra Matte Lipstick vs MAC Matte Lipstick on an *in vitro* substrate.

This test utilized a glossmeter and an established procedure to ensure a standardized and reproducible evaluation of gloss values for Ultra Matte lipstick and key competitor matte lipsticks.

Principle

This assessment followed Avon's Cosmetic Product Shine test protocol, PSM-11-2, where a drawdown of each sample was prepared and measured. All angles of illumination (geometries 20°, 60°, and 85°) were captured for each measurement. To standardize the evaluation, each draw down was completed with a film layer of 3 MIL thickness and the temperature of the heated blanket was set at 35 °C.

Glossmeters such as those produced by BYK Instruments "provide a quantifiable way of measuring gloss intensity ensuring consistency of measurement by defining the precise illumination and viewing conditions" (1). They are routinely used in industries where it is important to know or evaluate gloss intensity including paints and coatings, plastics, cosmetics, and textiles. The three measurement angles (geometries 20°, 60°, and 85°) are specified to cover the majority of industrial coatings applications. Several international technical standards define the method of use and specifications for different types of glossmeters used on various types of materials and Avon's Cosmetic Product Shine test protocol PSM-11-2 is a modification of these standards to optimize the protocol for cosmetic materials.

(1) Hunter, R.S. "Methods of Determining Gloss" NBS Research Paper RP 958 via https://archive.org/stream/jresv18n1p19/jresv18n1p19_A1b_djvu.txt

Experimental Materials

1) Clear Polyester Sheet (Leneta)
2) 3 MIL thickness slot draw-down bar
3) Glossmeter (Micro-Tri-Gloss, Model 4520; BYK Gardner)
4) Heating blanket (BriskHeat Model SRL 1224, Thermo Scientific)
5) Black Leneta Card (Leneta)
6) Test Lipstick Samples

Experimental Protocol

- See attached PSM-11-2 for Avon methodology for Cosmetic Product Shine Test

Conclusion

Though there were gaps between Avon's and the competitor's shade palette, the initial analysis indicated that sixteen MAC Matte shades were identified to be similar to sixteen Ultra Matte shades. Of the tested corresponding MAC Matte shades, the gloss values ranged from 9.6.to 20.1, while the shades in the Ultra Matte palette had a gloss value range from 2.5 – 9.0.

Gloss measurements were also conducted on six core shade families of MAC Matte lipstick (Reds, Berry, Pinks, Brown/Nude, Plum & Orange) and compared against Ultra Matte lipstick, for all shade families. The gloss data for each of the six shade families of Ultra Matte lipstick is significantly lower (more matte) than the six shade families of MAC

Matte lipstick. Each shade family of Ultra Matte exhibit average gloss values significantly below 10, while each shade family of MAC Matte, average gloss values are above 10.

- See attached presentation Gloss Values Avon v MAC 18-07-22

Avon Ultra Matte lipstick & MAC Matte Lipstick: Gloss measurements were taken between 20/06/22 – 18/07/22

Typically, gloss values are evaluated at a specific geometry based on the value reported at the 60° geometry. For very matte values (<10 at 60°) it is recommended that the value at the 85° geometry is reported per PSM-11-2. However, in order to compare gloss values that range from 1-25 at 60° (which was the case for the Ultra Matte and MAC Matte sample set), the values must be reported for the same geometry and in this case the 60° geometry was selected.

- See attached Gloss values at 60°
- See attached Principles of Specular Gloss Measurement

Rationale to support 'Most Matte finish' has a low gloss value range

Published literature reports validate that subjects can differentiate as little as 5 gloss values especially in the matte range, indicating consumers will be able to clearly differentiate visually between Ultra Matte (average gloss value of 4.6) and MAC Matte (average gloss value of 13.1 across 40 shades).

- See attached literature Portable Gloss Measurements from Cole-Parmer (www.coleparmer.com/TechLibraryArticle/573)
- See attached literature An Introduction to Gloss Measurement (www.imbotec.com/products/306d)

Separately, PCRC conducted an Exploratory Study with 400 consumers in the US, Brazil, Russia and China to explore consumer language (matte, shiny, satin) as it relates to technical gloss measurements.

When shown pictures, in a randomized order, women were able to distinguish between various finishes.

- Women selected the (UC Matte HER with Gloss Value **0-10**) image as "matte" most often.
- Women selected the (Color Precise with gloss value **60-70**) image as "satin" most often.
- Women selected the Image (UCMatte + Lip Gloss **80+**) image as "shiny" most often.
    - See attached See attached summary from PS Lip Touchpoint Study#68325-106

The gloss value data indicates that the Ultra Matte values correspond to the consumer identification of 'matte' very closely, whereas the MAC Matte shade values are above this range. As the attached file indicates Ultra Matte shade family that correspond to a similar MAC Matte shade family have a significantly lower gloss reading to an extent that the perception of 'matte' would be achieved.

Gloss Measurements of Similar Shades of Ultra Matte & MAC Matte Lipstick

Company	Shade	60° Gloss Reading	Company	Shade	60° Gloss Reading
Avon	RED SUPREME	4.4 ± 0.88	MAC	RUSSIAN RED	18.8 ± 4.26
Avon	WISTFUL WINE	3.8 ± 0.70	MAC	SOAR	16.1 ± 3.93
Avon	SUPERB WINE	3.3 ± 0.46	MAC	DIVA	20.1 ± 2.65
Avon	VIOLETTA	2.5 ± 0.64	MAC	GET THE HINT?	13.5 ± 4.17
Avon	WILD CHERRY	3.1 ± 0.35	MAC	D FOR DANGER	11.6 ± 1.06
Avon	ELECTRIC PINK	9.0 ± 0.74	MAC	CANY YUM-YUM	11.1 ± 3.14
Avon	PURE PINK	5.7 ± 0.69	MAC	PLEASE ME	14.2 ± 3.67
Avon	PINK TRUFFLE	5.4 ± 0.89	MAC	YOU WOULDN'T GET IT	15.9 ± 3.36
Avon	CRIMSON TIDE	3.9 ± 0.49	MAC	MARRAKESH	9.9 ± 2.19
Avon	MARVELOUS MOCHA	4.7 ± 0.69	MAC	TAUPE	17.8 ± 1.29
Avon	AU NATURAL	7.5 ± 1.93	MAC	HONEYLOVE	10.5 ± 1.74
Avon	FRENCH TOAST	5.6 ± 1.14	MAC	WHIRL	9.7 ± 1.14
Avon	NUDE SUEDE	4.3 ± 1.19	MAC	VELVET TEDDY	9.6 ± 3.09
Avon	MAJESTIC PURPLE	6.8 ± 0.52	MAC	HEROINE	13.4 ± 1.41
Avon	CORAL FEVER	3.6 ± 0.36	MAC	LADY DANGER	12.6 ± 3.04
Avon	ABSOLUTE CORAL	4.1 ± 0.69	MAC	TROPIC TONIC	12.4 ± 2.31

Average Gloss Measurements of Shade Families for Ultra Matte & MAC Matte Lipstick

Brand	Shade Family	Average Gloss Measurement 60°
Avon	Reds	4.5
Avon	Berry	3.9
Avon	Pinks	5.7
Avon	Brown/Nude	5.5
Avon	Plum	4.6
Avon	Orange	3.9
MAC	Reds	13.7
MAC	Berry	13.7
MAC	Pinks	13.1
MAC	Brown/Nude	12.5
MAC	Plum	13.5
MAC	Orange	12.4

Individual Avon Shades 60° Gloss Measurements

Company	Shade	60° Gloss Reading
	REDS	
Avon	RED SUPREME	4.4 ± 0.88
Avon	ADORING LOVE	7.6 ± 1.82
Avon	RUBY KISS	6.9 ± 1.59
Avon	WISTFUL WINE	3.8 ± 0.70
Avon	SUPERB WINE	3.3 ± 0.46
Avon	VIBRANT MELON	2.7 ± 0.53
Avon	TRUEST RED	6.9 ± 1.07
Avon	TEMPTING MAUVE	4.2 ± 0.97
Avon	ROSE RED	7.2 ± 1.42
Avon	SUNBAKED RED	7.0 ± 1.02
Avon	MAIDEN MAUVE	2.8 ± 0.78
Avon	BOOM,BOOM ROUGE	1.9 ± 0.66
Avon	DEEPLY MAUVED	4.3 ± 0.69
Avon	GARNET QUEEN	2.4 ± 0.71
Avon	VIOLETTA	2.5 ± 0.64
	BERRY	
Avon	WILD CHERRY	3.1 ± 0.35
Avon	BERRY BLAST	4.9 ± 0.92
Avon	MAUVE MATTERS	7.1 ± 0.87
Avon	HIBISCUS BLOSSOM	2.6 ± 0.34
Avon	VELVET RASPBERRY	2.9 ± 0.36
Avon	ROSEBERRY RED	2.6 ± 0.51
	PINK	
Avon	PERFECTLY PEACH	5.7 ± 0.84
Avon	PINK PASSION	8.2 ± 1.55
Avon	RAVISHING ROSE	6.7 ± 0.88
Avon	ELECTRIC PINK	9.0 ± 0.74
Avon	ROSE AWAKENING	4.9 ± 1.09
Avon	PEACH FLATTERS	3.8 ± 0.58
Avon	IDEAL LILAC	4.4 ± 0.95
Avon	BLUSH	4.3 ± 0.49
Avon	POSH PETAL	3.2 ± 0.58
Avon	PURE PINK	5.7 ± 0.69
Avon	SPLENDIDLY FUCHSIA	5.0 ± 0.52
Avon	POWDER BLUSH	6.4 ± 0.61
Avon	PINK TRUFFLE	5.4 ± 0.89
Avon	PINK TULIP	6.9 ± 1.14
	BROWN/NUDE	
Avon	CRIMSON TIDE	3.9 ± 0.49
Avon	AU NATURAL	7.5 ± 1.93
Avon	MARVELOUS MOCHA	4.7 ± 0.69

Avon	CHOCOLATE CRUSH	5.1 ± 0.47
Avon	PERFECTLY NUDE	7.9 ± 0.57
Avon	CAFE AU LAIT	2.9 ± 0.24
Avon	DIVINE TWIG	4.4 ± 0.53
Avon	LUSH COCOA	10.6 ± 1.04
Avon	FRENCH TOAST	5.6 ± 1.14
Avon	CONTINUOUS COCOA	3.3 ± 0.65
Avon	NUDE SUEDE	4.3 ± 1.19
PLUM		
Avon	HOT PLUM	2.6 ± 0.53
Avon	PLUM KISS	4.4 ± 1.12
Avon	MAJESTIC PURPLE	6.8 ± 0.52
ORANGE		
Avon	CORAL FEVER	3.6 ± 0.36
Avon	ABSOLUTE CORAL	4.1 ± 0.69

Individual MAC Shades 60° Gloss Measurements

Company	Shade	60° Gloss Reading
	REDS	
MAC	RING THE ALARM	11.4 ± 0.87
MAC	MARRAKESH	9.9 ± 2.19
MAC	SIN	4.0 ± 0.87
MAC	RUSSIAN RED	18.8 ± 4.26
MAC	CHILI	22.2 ± 3.32
MAC	D FOR DANGER	11.6 ± 1.06
MAC	LADY DANGER	12.6 ± 3.04
MAC	RED ROCK	19.1 ± 3.2
MAC	MANGROVE	15.9 ± 1.76
MAC	SO CHAUD	11.9 ± 1.73
	BERRY	
MAC	KEEP DREAMING	12.4 ± 3.22
MAC	DIVA	20.1 ± 2.65
MAC	HEROINE	13.4 ± 1.41
MAC	SMOKED PURPLE	8.9 ± 2.32
	PINK	
MAC	FOREVER CURIOUS	18.7 ± 2.69
MAC	GET THE HINT?	13.5 ± 4.17
MAC	SOAR	16.1 ± 3.93
MAC	CANY YUM-YUM	11.1 ± 3.14
MAC	PLEASE ME	14.2 ± 3.67
MAC	MEHR	10 ± 1.64
MAC	LOVE U BACK	10.2 ± 1.09
MAC	NATURAL BORN LEADER	11.1 ± 1.77
	BROWN/NUDE	
MAC	SWEET DEAL	9.3 ± 2.28
MAC	COME OVER	13.9 ± 4.0
MAC	DOWN TO AN ART	16.3 ± 3.28
MAC	YOU WOULDN'T GET IT	15.9 ± 3.36
MAC	HONEYLOVE	10.5 ± 1.74
MAC	VELVET TEDDY	9.6 ± 3.09
MAC	WHIRL	9.7 ± 1.14
MAC	TAUPE	17.8 ± 1.29
MAC	YASH	12.2 ± 2.75
MAC	KINDA SEXY	11.4 ± 3.27
MAC	ANTIQUE VELVET	11.5 ± 2.62
MAC	DOUBLE FUDGE	11.0 ± 3.56
MAC	CONSENSUAL	10.9 ± 2.08
MAC	KINKSTER	11.9 ± 2.25
MAC	ACT NATURAL	16.7 ± 2.20
MAC	DERRIERE	12.0 ± 2.09

PLUM		
MAC	MATTE ROYAL	13.5 ± 2.68
ORANGE		
MAC	TROPIC TONIC	12.4 ± 2.31

U. S. Department of Commerce National Bureau of Standards

RESEARCH PAPER RP958

Part of Journal of Research of the Rational Bureau of Standards, Volume 18,

January 1937

METHODS OF DETERMINING GLOSS 1

By Richard S. Hunter

abstract

Glossiness is evidenced by almost every object and is to be attributed to specular reflection. Specular reflection occurs at the surfaces of reflecting object s;
and, because of the diversities of minute surface structure, many kinds of glossy appearance result. An attempt to classify these glossy appearances has led to the description of six different kinds of gloss: (1) specular gloss, identified by shininess; (2) sheen, identified by surface shininess at grazing angles; (3) contrast gloss, identified by contrasts between specularly reflecting areas of surfaces and other areas; (4) absence-of -bloom gloss, identified by the absence of reflection haze or smear adjacent to reflected high lights; (5) distinctness-of-reflected-image gloss, identified by the distinctness of images reflected in surfaces; and (6) absence -
of-surface-texture gloss, identified by the lack of surface texture and surface blemishes.

In describing the appearances of objects, one commonly distinguishes between the effects due to two t3^pes of reflection; glossiness, on the one hand, may be correlated with specular, or surface reflectance; the degree of lightness or darkness may, on the other hand, be correlated with diffuse reflectance usually occuring within the pigmented and scattering media beneath these surfaces. Specular reflection is evidenced by light preponderantly reflected in the direction of mirror reflection, whereas diffuse reflection is evidenced by light scattered in all directio ns
by the reflecting object. Unfortunately for the purposes of gloss and reflectance measurement, the effects of specular reflection and diffuse reflection cannot be completely separated. The gloss of a surface cannot, in the general case, be defined in any simple way that permits quantitative measurement.

Data which describe the directional distribution of light reflected by surfaces illuminated under specified conditions furnish the fundamental physical basis for describing gloss. However, such distribution data are cumbersome and involved and include the effects of both diffuse and specular reflection. It is because these goniophotometric (reflection distribution) data are unwieldy that, in the past, devices for measuring gloss have been developed by simple empirical means. By trial and error, methods have been found to measure the gloss of particular types of materials exhibiting particular types of gloss.

The article suggests that the designer of a prospective gloss meter should determine from goniophotometric data taken on representative samples what differences in apparent reflectance are most characteristic of the differences in glossines
s
observed visually. That is, gloss-meter design will have considerably less of the trial-and-error element when goniophotometric data are used to indicate the most pertinent reflectance measurements to make for various purposes.

Also included are descriptions of typical gloss instruments, descriptions of measurements they make, and a bibliography on gloss. Differences between the various types of gloss are analyzed in some detail.

i This paper was presented before the Thirty-Ninth Annual Meeting of the American Soci
ety for Testing
Materials, Atlantic City, July 3, 1936. Preliminary papers on the same subject were pr
esented before the
Optical Society of America, in Washington, October 20, 1934, and in Philadelphia, Octo
ber 25, 1935. (See
reference [19] in bibliography.)

19

20 Journal of Research of the National Bureau of Standards [Vol. ib

CONTENTS

Page

I. INTRODUCTION

Gloss is possessed by most materials encountered in everyday life, and its occurrence is so common that persons seldom stop to give it particular notice. People are, nevertheless, responsive to the general appearance of objects and nearly everyone is able to form opinions as to the beauty, attractiveness, or striking appearance of things they see. Gloss is one of the major factors in appearance, and a number of methods for determining it have been developed. The purpose of these methods is usually to enable the producers and vendors of articles in commerce to rate them according to glossiness.

1. DEFINITIONS

It should be noted that the term "gloss" is used in this paper in a general sense to include all properties of surfaces responsible for effects such as "shininess", "sheen", "lustre", etc. Following Jones [24], 2 gloss and glossiness are here denned so that the actual physical properties of surfaces responsible for their glossy appearance may be distinguished from the appearance itself. That is, the gloss of a surface is considered to be a property of the surface; glossiness , the appearance that results because the surface possesses that property.

1. The gloss of a surface is its power to reflect light specularly. Since, unfortunately, specular reflectance is a quality which may not be separated by any objective measurement from diffuse reflectance in any but special cases, this definition of gloss does not, in general, describe a quantity that can be unambiguously measured until, in addition, the conditions of measurement are precisely stated. (See

section V, p. 28.)

2. The glossiness of a surface is the appearance which results from its power to reflect light specularly. For any given surface, glossiness may vary with conditions of illumination and directions of view, but gloss is considered to be an inherent quality.

3. Specular reflection is that kind of reflection which causes surfaces to exhibit high lights and to appear somewhat like a mirror. This definition of specular reflection describes the process in terms of the appearance it produces and consequently does not explain the physical

* Numbers in brackets refer to the corresponding reference number in the bibliography at the end of this
paper.

Hunter) Methods oj Determining Gloss 21

cause of gloss. Specular reflection is commonly contrasted with diffuse reflection, which is likewise defined in terms of the appearance it produces.

4. Diffuse reflection is that land of reflection which causes a surface to possess lightness or darkness of some degree which may be represented on the scale of grays running from white to black. Specular reflection and diffuse reflection are constantly used in technical descriptions of the appearance of objects. Unfortunately there is no general way in which effects of these two processes may be accurately separated. It is impossible to measure specular reflectance and diffuse reflectance as separate entities in any but an approximate way. Consequently, the separate effects of the two processes cannot be rigorously specified; and the two processes are, for this reason, defined in the present paper in terms of the appearance each produces, even though it is customary to think of them as physically separate processes dependent upon the structure and composition of the object. Specular and diffuse reflection are discussed further in section IV, p. 26.

5. Apparent luminous reflectance, hereinafter termed apparent reflectance, is defined as the luminous reflectance a perfectly diffusing surface must have in order to yield the same brightness as the unknown surface under the same conditions of illuminating and viewing [35]. That is, any surface observed in any manner and illuminated by any combination of illuminants is compared to the theoretical, perfectly reflecting, perfectly diffusing surface observed and illuminated under exactly the same conditions. (See fig. 2 and section III.) In practice, of course, the theoretical, perfectly reflecting, perfectly diffusing surface is not obtainable, but material standards of known apparent

reflectances may be obtained in several ways. For many cases, relative apparent reflectances are all that are needed and standards of known apparent reflectances are not required.

The plan of the present paper is to describe first the six different types of gloss in terms of the appearances they produce. Following this is a discussion of the directional distribution of light reflected by surfaces and the various measures thereof. With information thus at hand on the appearance characteristics resulting from the different types of gloss and on the basic method of reflectometry which is inseparable from the discussion of gloss, it becomes possible to develop relationships between these two phases of the subject.

II. SIX TYPES OF GLOSS

The necessity for a classification of gloss types arises when one attempts to grade materials for gloss, or to describe their differences in appearance. With two materials of the same general appearance, it is possible to say that one or the other has the higher gloss, or that the two appear about the same. For two materials of different appearance, however, it often cannot be stated which has the higher gloss. They may not show a common type of glossiness by which they may be graded.

From a study of the appearance by which the gloss of surfaces is commonly graded and from a study of the different existing gloss-measuring instruments and the properties they measure, a classification off gloss into six types has been devised. A classification was first made by the author in the fall of 1935 when, however, only five types were identified [18]. Table 1, which gives the classification, is

Table 1. — Classification of the six types of gloss

Type of gloss

Appearance characteristics produced

Most often used to describe appearance of—

Gloss range

References in bibli-
ography

Specular gloss (for-
merly objective
gloss).

Brilliance of specular-
ly reflected light,
shininess.

Shininess at grazing

Contrast gloss (for-
merly subjective
gloss).

Absence - of-bloorn
gloss.

Distinctness - of-re-
flected - image
gloss.

Absence-of-surface-
texture gloss.

Contrast between
specularly reflecting
areas and other
areas.

Absence of smear or
excess semi -specu-
lar reflection adja-
cent to reflected high
lights and images.

The distinctness and
sharpness of reflect-
ed images.

Surface evenness, ab-
sence of texture, in-
dicated by difficulty
of recognizing pres-
ence of surface.

Paints, surfaces of
moderate gloss, dark
and chromatic ob-
jects.

Flat paints, papers,
and materials of low

Papers, mat and semi-
mat finishes, white
and light-colored
materials.

Surfaces in which re-
flected images and
high lights may be
seen.

Finishes, enamels, lac-

quers,and all smooth
image-reflecting sur-
faces.

Glossy materials, fin-
ishes, and coatings.

Medium gloss.

Low gloss.

Low gloss.

[3, 5, 14, 16, 17, 23,
31, 32, 39, 43, 44,
47, 52, 54.]

[37, 44.]

[7, 8, 9, 11, 12, 15,

22, 24, 25, 26, 27,

28, 29, 33, 34, 44
45, 46, 48, 49,]

High gloss

High gloss. ._

Medium to

high gloss. _.

[21, 26.]

[10, 18, 21, 43, 51.
53.]

[17.

a modification of the previous table and lists: (a) the six types of gloss; (b) the appearance characteristics of each; (c) materials with which each type of gloss is most often identified; (d) the position in the general gloss range in which surfaces possessing each of the types of gloss are most often found; and (e) references to instruments which measure each type of gloss. Figure 1, reproduced from this article [18] serves to illustrate some of these types and shows photographs of gloss-comparator images reflected in four pairs of surfaces. The first two surfaces differ essentially in specular gloss, the second two in contrast gloss, the third two in bloom, and the fourth two in surface texture. Variations in distinctness-of-reflected-image gloss are also seen; for instance, the first two samples reflect images quite accurately, but the second two do not. Sheen, which was only recently added to the list, is not illustrated. Further details regarding these types of gloss, their significance and their measurement, are given in the later sections of this paper and in other papers [18, 19, 20].

This scheme of identifying gloss types is based upon observation and upon methods of classification and grading gloss that are already in existence. It is not intended to be the final and complete method for describing gloss and glossiness. There seem to be several types of glossiness that are not adequately explained by this analysis; for instance, some of the appearances that are associated with degree of polish are particularly hard to describe in the terms given in table 1. It is possible, however, that these effects may be treated as combinations of several of the types of gloss already identified. Many more data are needed on the correlation of differences in glossiness identified by observers and the results of instrumental measures of gloss. Viewed under different conditions, surfaces apparently present more than six different types of glossiness.

Journal of Research of the National Bureau of Standards

Research Paper 958

Figure 1. – Images photographed with gloss comparator [18] showing types of gloss.

1. The right image is brighter than the left image and depicts higher specular gloss. 2. The right image
is from a black surface, the left image from a white surface. The black surface shows higher contrast
gloss. 3. Although the left image is sharper, it shows reflection smear, or bloom. 4. Camera focussed
on surfaces to record texture. Left: Pimpled; right: Orange peel.

Journal of Research of the National Bureau of Standards

Research Paper 958

Figure 11. – Gloss lamp target [21] reflected in pair of surfaces.

The specimen on the left shows the reflection haze due to its bloom in the dark area o
f the image adjacent
to the bright center circle. See text, page 35.

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Figure 12. — Detroit Paint Production Club method of rating distinctness-of -reflected
-

image gloss [10].

The series of standard lacquers of varying distinctness-of-reflected-image gloss are a
rranged in a row and
compared to any test sample. See text, page 35.

The need for simplicity in the treatment of the subject must be compromised with the need for an analysis of the problem complete enough to include within its scope methods of answering most of the questions that will arise. As an indication of the adequacy of table 1, it may be noted that it served to place, according to type of gloss measured, every one of the thirty-seven methods of measuring and analyzing gloss listed in the bibliography. On the other hand, some of the effects described in the papers dealing with the phenomenological and psychological phases of the subject w^ere difficult to represent in terms of the six-gloss-type classification.

Smooth metal surfaces exhibiting metallic glossiness are distin-
guished by the fact that a major portion of the incident light is reflected specularly; whereas but 3 to 8 percent of the incident light is reflected specularly from nonmetallic surfaces at the nongrazing angles. Thus a major portion of the light incident upon a nonmetallic surface may be reflected diffusely whereas metallic surfaces are commonly charac-
terized by a relative lack of diffuse reflectance. In spite of these differences, it is believed that, inasmuch as both metallic and non-
metallic surfaces exhibit specular reflectance, the above classification designed to describe nonmetallic surfaces may also be used to describe

metallic surfaces. At present, however, no data are at hand to show the applicability of the six-type classification to descriptions of metallic appearance.

III. DIRECTIONAL DISTRIBUTION OF REFLECTED LIGHT

In this section the reflectance characteristics of surfaces responsible for glossy appearance are treated. Data describing the intensity distribution of incident and reflected light as a function of angle form the physical bases for descriptions of gloss. Such data are commonly presented as curves or numerical values giving, for specified angular distributions of illumination, values of apparent reflectance for different directions of reflection.

In figure 2, two experimentally obtained reflection-distribution curves are given together with a theoretical curve for comparison. In this diagram, light from a single direction is represented by I and is incident upon the reflecting surface, 0, at 45°. S indicates the direction of reflection of this light for the case in which the reflecting surface is optically smooth and mirror-like. The curve D gives the apparent reflectance for the theoretical, perfectly reflecting, perfectly diffusing surface which possesses, by definition, an apparent reflectance of unity in all directions. It will be recalled that apparent reflectance is defined as the reflectance a perfectly diffusing surface would have to have in order to yield the same brightness as the unknown surface under the given conditions of illuminating and viewing. Compared to the perfectly diffusing surface, surfaces commonly reflect a disproportionately large amount of light in the general direction of mirror reflection because of gloss; consequently their apparent reflectance may rise to well above unity in that direction.

Curve M gives the apparent reflectance for a nearly mat sample of mimeograph paper; and P the apparent reflectance for a vitreous, porcelain-enamelled plate. As would be expected, the vitreous porcelain concentrates the reflected light about the direction of mirror reflection, rising to a measured apparent reflectance of 25.0 at 45°. In the case of the mimeograph paper, it can be seen that the apparent

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A.'- Cq

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Figure 2. — Reflection distribution curves for 'porcelain-enamelled plate, P, and shee t of mimeograph paper, M.

Direction of incident illumination, I; direction of mirror reflection, S; reflecting s urface, 0; and reflection distribution for ideal, completely reflecting, perfectly-dif fusing

surface, D, also indicated.

reflectance is higher opposite the incident illumination but that there is no concentration of apparent reflectance in the direction of mirror reflection. In fact, it is interesting to note that the highest apparent reflectance appears in a direction further from the normal than mirror reflection. This type of curve is characteristic of many types of nearly mat surfaces.

Because it is known 3 that a freshly prepared magnesium oxide surface illuminated at 45° and viewed normally possesses an apparent reflectance of 1.00, secondary standards of reflectance obtained by comparisons with magnesium oxide are satisfactory standards of apparent reflectance for these conditions. If the apparent reflectance of a given surface is known for one direction of illumination and view together with its relative brightnesses for other directions of view, its apparent reflectances for these other directions may be derived because the brightness of the perfectly diffusing surface does not vary with direction of view.

The complete specification of a surface's ability to direct reflected light is so complex that it is virtually never determined. Light may be reflected by a surface in all directions; furthermore, with an infinite number of possible incident illuminations, each of which may result iin a different distribution of light, the complete reflection-distribution ■specification for any surface is made up of a "quadruple infinity" of apparent reflectances. Instead of complete goniophotometric analyses, partial analyses such as shown by the curves presented in figure 2 are usually adopted. For example, only those values of apparent reflectance in the plane of the 45° incident beam and the normal to the surface are given in figure 2. In using single curves such as these, it must be realized that they do not present in any case the complete physical basis of glossiness and that there may often be reflectance effects of importance to the investigator not indicated by the data given. Thus, for example, figure 2, as it is given, does not show sheen because the illumination is not at grazing incidence.

Jones [24] was the first to emphasize the importance of goniophotometric measurements in gloss work. McNicholas [35] has treated the theoretical side of the subject and, in addition, published many valuable experimental data.

In discussing reflection distribution above, it was assumed that exact values of apparent reflectance for exact unidirectional illuminations and directions of view could be obtained. Actually, it is impossible to obtain curves for true unidirectional illumination and true unidirectional viewing because every source and every receptor used in a reflectance measuring instrument possesses finite size. It is doubtful whether there exists any goniophotometer possessing sufficiently small illuminating and viewing apertures to deal successfully with all gloss problems.

The eye is able to resolve images separated by one minute of visual arc. To equal the eye in distinguishing differences between surfaces of high gloss the goniophotometer should likewise be capable of revealing these effects in terms of brightness. Up to the present time it is believed that no goniophotometer has been produced which possesses this power of resolution. To build such an instrument it will be necessary to have the source and receptor of narrow aperture. For each determination, the light which reaches the reflecting surface from

» Preston, J. S., The reflection factor of magnesium oxide, Trans. Opt. Soc. London 3 1, 15 (1929-30).

the source must follow a path in which all rays are parallel to within one minute of arc, and that reaching the receptor from the reflecting surface must satisfy the same conditions, so that, within this tolerance, light of one, and only one, direction of incidence and reflection is accepted for measurement. Only with such an instrument will it be possible to obtain sufficiently accurate reflection-distribution curves to differentiate all surfaces of high gloss.

Most of the goniophotometers now in use accept, for measurement in one setting, light reflected by the test surface at angles comprising several degrees. Therefore the distribution curves obtained with such instruments are less selective with respect to angle of reflection than are the ideal curves for unidirectional illumination and measurement. That is, each apparent-reflectance value obtained with an instrument of appreciable angular aperture represents the average of apparent reflectances for all the directions included in the measurement. Figure 3 is a diagram of the modification of McNicholas'

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REFLECTING SURFACE

Figure 3. — Photoelectric modification of McNicholas' goniopliotometer with narrow source and receptor apertures [36].

The receptor is fixed in position; the source and reflecting surface may be rotated ab out the center of the
reflecting surface, either separately or together.

goniophotometer [36] constructed at the National Bureau of Standards. This modification has been designed to give high angular resolving power for reflection-distribution measurements. A single coil of a monoplane-filament lamp provides a source of narrow aperture. In front of the photocell receptor is an adjustable slit which can be made as narrow as desired, the only requirement being that sufficient light pass through it to give a current from the photocell that will register satisfactorily. This new apparatus was used to obtain the curves of figure 2. It will resolve about one-half of one degree. The source and sample may be rotated about the axis of the sample position, but the receptor position is fixed.

IV. SPECULAR AND DIFFUSE REFLECTION

In the previous sections gloss types have been classified according to appearance, and the fundamental reflectance method necessary for basic gloss specification has been described. The remainder of the

paper will be devoted to relationships between these two phases of the subject. It was pointed out in the introduction that the concepts of specular and diffuse reflection are widely used in descriptions of the appearance of opaque objects. It has, in fact, been customary to say that specular reflection is responsible for gloss, although in table 1 above it may be seen that absence of diffuse reflection increases gloss of at least one type (contrast gloss).

In order to form a picture of the mechanism of reflection, one should consider the minute reflecting areas of individual particles as well as the larger visible areas of objects. Reflection occurs whenever light encounters a boundary between two media differing in refractive index. Specular reflection is ordinarily "first-surface" reflection taking place at the initial contact of the incident light with the reflecting object – as from enamelled tile. Diffuse reflection is, in most cases, principally a combination of reflection, refraction, and Rayleigh scattering taking place within the body of the reflecting object by the pigment particles and other particles having refractive indices differing from the refractive index of the surrounding medium. Only when the surface of an object is optically smooth is it possible to separate quantitatively the specular reflectance from the diffuse, the former in this instance being confined entirely to the direction of mirror reflection. The porcelain plate, represented by curve P, figure 2, is quite smooth. From its reflection-distribution curve, it may be seen that it would be possible to divide the observed reflectance satisfactorily into two components: one, diffuse reflectance, nearly constant in all directions; and the second, specular reflectance, which is the excess in the direction of mirror reflection.

For objects whose surfaces are not optically smooth – and the majority fall in this class – it is not possible to separate the observed reflectance into its components so easily. That is, it is not possible to decide, even approximately, wiiat portion of the reflectance is diffuse and what portion is specular. The mimeograph paper, represented by curve M, figure 2, presents a characteristic reflection-distribution in which the usual transition from high reflectance in the approximate direction of mirror reflection to lower reflectance in other directions is wholly wanting – giving no indication of a separation into diffuse and specular components. Typical of materials which possess surfaces that are not optically smooth are semimat, painted finishes whereon protruding pigment particles or voids left after the evaporation of minute pools of volatile liquid break the smoothness of the surface; also sheets of paper in which there are voids between the individual fiber, pigment, and resin particles composing the sheet. Materials such as these frequently present a glossy appearance probably ascribable to a tendency for the individual surface units to follow the surface shape of the object.

Each specimen has its own reflection distribution, and only where the surface as a whole is optically smooth is it possible to separate the diffuse reflectance from the specular reflectance. For materials that differ as much in their power to direct reflected light as the white porcelain and white mimeograph paper of figure 2, the question of whether one or the other is lighter is obviously a question of how they are illuminated and viewed.

V. WHAT GLOSS METERS MEASURE

Most instruments designed to measure gloss actually determine some arbitrarily chosen type of apparent reflectance which has been found by experience to correlate closely with the particular type of gloss being studied. That is, most gloss meters have been designed empirically because few of their designers have had the opportunity to obtain goniophotometric data pertinent to the types of material whose gloss is to be measured.

It is advantageous for the designer of a gloss meter to determine from goniophotometric data on representative samples what particular apparent reflectance, or function of apparent reflectances, correlates best with glossiness, and then construct an instrument to measure this particular function. It is the object of research now being carried forward at the National Bureau of Standards to develop high-precision goniophotometric apparatus to study various gloss problems, to determine to what extent existing gloss-measuring apparatus is applicable to each problem, and to devise new apparatus if existing devices are found inadequate. Only Jones [24] is known to have made goniophotometric measurements on his materials before developing a gloss meter to measure them. The primary requirement for a gloss meter is that it give results which correlate satisfactorily with the gloss ratings on these same specimens assigned by visual inspection. In addition, the instrument should be reproducible from the description, so that the ratings obtained will not depend upon any particular instrument. Other desirable features are portability, inexpensiveness, ruggedness, and simplicity.

Information on three matters is needed in the description of a gloss-deterrnining method: (1) direction and aperture of both incidence and view; (2) spectral composition of the light; and (3) polarization of the light. In describing any method of measuring gloss, the indication of (1) is most significant.

1. DIRECTION AND APERTURE OF INCIDENCE AND VIEW

For a complete description of a reflectance measurement, it is necessary to give the angles of incidence and reflection of all rays of light leaving the source and reaching the receptor by way of the test surface. That is, all those portions of the reflection distribution which enter the measurement must be given. Since every source of light and every receptor must possess finite size, illumination of the sample in any instrument comes not from a single point but from the integral parts of the source. Similarly, light leaving any one point of the surface of the sample may take any one of several directions and be incident upon various parts of the receptor. The elements that determine the possible combinations of angles of incidence and reflection by which light may travel from the source to the receptor are (1) the central directions of incidence and viewing, (2) the solid angular apertures of source and receptor, and (3) the area of the surface tested. Thus to describe completely the reflectance indication of a given gloss meter, it is practically necessary to have a drawing to scale of its complete optical system.

For an approximate angular specification of a gloss measurement, the factors of first importance are the angles which the axial rays of the incident and viewing beams make with the normal to the test

surface. This information is available for practically all gloss meters. Thus, with Jones' gloss meter [24], figure 8, two beams reflected at 0° and minus 45° are compared, the surface being illuminated at 45°. Pfund's instrument [44], figure 5, always makes the angle of view equal to the angle of incidence of the illumination. The Ingersoll glarimeter [22], figure 9, measures the polarization of light reflected at minus 57.5°, with illumination incident at 57.5°.

In addition to the axial directions of illumination and view, data on the angular aperture of the light within the beams are important for the description of a gloss meter. This factor is of major importance in any measurement involving specular reflection, because, as can be seen from the reflection distribution curves above, the angular spread

throughout the paper industry, it probably enjoys wider use than
any other gloss meter. The angle of reflection is 57.5°, the angle of
polarization for paper. A doubly refracting Wollaston prism is
employed to divide the reflected beam into two beams polarized
at right angles for comparison.

IX. ABSENCE-OF-BLOOM GLOSS

By bloom is meant the appearance of haze or smear upon a glossy
surface adjacent to a strong specularly reflected high light. Bloom
appears most strikingly on dark surfaces which give by reflection

34 Journal of Research oj the National Bureau oj Standards [Vol. is

relatively bright images; thus, on a highly polished automobile finish,
the smear from a dirty rag or a little oil is plainly visible, particularly
when the surface is viewed near an adjacent high light. But little
scientific work has been done on this type of gloss, although it seems
to have an important influence on appearance.

»PPlNGSFCf>HOlD/N<i GLAhiPLAr£>

FtiOSr£0 MAZDA CAMP

A.ojuirAas.e &t/r-

Figure 9. — Vertical cross-section of Ingersoll glarimeter [22].

Contrast gloss is indicated by the state of polarization of light reflected in the dir
ection of specular reflec-
tion for an angle of reflection of 57.5°.

This completes the list of types of gloss which are at present subject
to photometric determination. Except for a little work that has been

done on metallic surfaces [26], little is known
about the quantitative aspect of bloom,

which is indicated visually by an excess of apparent reflectance adjacent to the mirror reflection. Whether, for its measurement, it will be desirable to take the difference between apparent reflectance in the direction adjacent to mirror reflection and apparent reflectance in a direction well removed from mirror reflection, or to take some other function of these apparent reflectances, is not yet decided. Different possible magnitudes for indicating bloom are suggested by the diagram in figure 10. In any case, care must be exercised to insure that none of the strongly reflected high light is admitted as bloom.

Figure 10. — Bloom indicated by excess of apparent reflectance adjacent to mirror reflection.

(Possible functions are B-D, 1—D/B, and BID.)

Hunter]

Methods of Determining Gloss

85

In figure 11, 7 from [21], is shown a comparison of the power of two surfaces to reflect images of the target used in the gloss lamp. The specimen on the left clearly shows bloom in the dark areas of the image.

X. DISTINCTNESS-OF-REFLECTED-IMAGE GLOSS

Surfaces which give images by reflection are, in general, surfaces of high gloss. Because these images are often the most pronounced feature of the appearance of a surface of high gloss, they are widely used as a

criterion in gloss investigations. No photometric method of measuring
distinctness-of-reflected-image gloss has as yet been developed, but
this type can probably be associated in magnitude with the steepness
of the reflection-distribution curve in the region of specular reflection

Figure 13. — Hunter gloss comparator for determining distinctness-oj f -rejected-imag
e

gloss [18].

A pair of target patterns, A (reflected images of which may be seen in figs. 1 and 1
1), are illuminated from
behind. An observer views the images of this pair of targets, one of which is reflecte
d by the test surface
at B, the other by the glass mirror at C. The image of the target reflected by the gla
ss mirror is diffused
by means of a ground-glass plate, D. Motion of this plate toward or away from the targ
et varies the
amount of diffusion of the target image, and the position of the glass plate for which
the distortion pro-
duced by the test surface and that produced by the movable plate appear equal may be d
etermined by
an observer and noted on the gloss scale, E.

(see curve P, fig. 2). So far the methods which have been developed
to measure it depend on empirical comparisons.

Probably the method most widely used to reveal gloss differences
consists in the comparison of the reflected images which two surfaces
give of a window sash. This procedure is usually one of grading the
specimens for distinctness-of-reflected-image gloss.

Figure 12 7 illustrates one attempt to establish a distinctness-of-
reflected-image gloss scale on a more permanent and reproducible
basis than is furnished by the window sash combined with day-to-day
comparisons of samples and standard. In 1932 the Detroit Paint
Production Club [10] developed a series of standard lacquers of varying
degi 2es of distinctness-of-reflected-image gloss. These lacquers were

7 Opposite page 23,

36 Journal of Research of the National Bureau of Standards [Vol. u

arranged on panels and under a lattice frame as illustrated in figure 12.

surface of an object is thus nearly invisible, the observer tends to see details of grain or mottling as appearing to be at an unlocated depth within the object.

XII. SUMMARY

The problems of gloss determination differ from many other problems of measurement in that the principal problem seems to be not how to measure the quantities involved, but rather how to determine the best quantities to measure. Gloss is associated with

the ability of objects to reflect light specularly. The structural properties of objects responsible for specular reflection and the glossiness of these objects which results from specular reflection can be described at some length; but the specular reflectance itself, for most objects, cannot be measured because it cannot be separated in any but an approximate way from the diffuse reflectance. Reflection-distribution functions, though complex and cumbersome, offer the only means by which the reflectance properties of surfaces responsible for their glossiness may be completely specified.

Different types of gloss may be classified according to their appearance characteristics. Six types are identified in the present paper, as follows: (1) specular gloss, identified by surface shininess; (2) sheen, identified by surface shininess at grazing angles; (3) contrast gloss, identified by contrasts between specularly reflecting areas of surfaces and other areas; (4) absence-of-bloom gloss, identified by the absence of excess reflection (haze or smear) adjacent to reflected high lights; (5) distinctness-of-reflected-image gloss, identified by the distinctness of images reflected in surfaces; and (6) absence-of-surf ace-texture gloss, identified by the lack of surface texture and points of fixation which locate the surface. If the designs of existing gloss meters are examined they will usually be found to measure one or more of the above types of gloss. The primary requirement for each of these gloss meters is that, when applied to specimens of the type for which it is intended, it shall give results which correlate satisfactorily with gloss ratings on the same specimens assigned by visual grading. In order to describe gloss meters so that the measurements they make may be reproduced, it is necessary to specify precisely the apparent-reflectance measurement made. Each type of gloss is considered separately and the devices by which each may be measured described. Goniophotometric data provide a basis for the design and improvement of gloss-determining devices.

XIII. BIBLIOGRAPHY ON GLOSS

Because gloss literature has originated in so many sources and appeared in connection with work in so many different fields, it has been thought worth while to make this bibliography on gloss as complete as possible. Listed in parentheses following each reference below are (1st parentheses) the type of gloss or phase of the subject treated and (2d parentheses) the materials and types of specimens studied.

[1] Bancroft, W. D. The colors of colloids, part V. Metallic and vitreous lustre, J. Phys. Chem. 23, 289 (1919). (Psychological.) (Metallic and vitreous surfaces, gems.)

[2] Bancroft, W. D., and R. P. Allen. Metallic lustre, part I, J. Phys. Chem. 28, 588 (1924), and part II, J. Phys. Chem. 29, 564 (1925). (Psychological.) (Metallic and semimetallic surfaces.)

[3] Bausch & Lomb Optical Co., Rochester, N. Y. Bausch and Lomb Photoelectric Glossmeter, descriptive circular. (Specular gloss.) (Paper.)

[4] Bixby, F. L. A phenomenological study of luster, J. Gen. Psychol. 1, 136 (1926). (Psychological.) (General materials.)

[5] Bloch, Ing. L. Papierprufung mit Sperrschicht-Photozellen, Zellstoff u. Papier 14, 9 (Jan. 1934). (Specular gloss.) (Paper.)

[6] Boffy, H. and D. A. Dewitt-Smith. A new lustre-meter and spectrophotometer, J. Sci. Instr. 8, 356 (1931). (Goniophotometry.) (General materials.)

[7] Central Scientific Co., Chicago, 111. The Ingersoll Glarimeter, Bui. 100 (May 1, 1923.) (Contrast gloss.) (Paper.)

[8] Olivers, J. H. Pulfrich -photometer, World's Paper Trade Rev. 101, 1528

(May 11, 1934). (Contrast gloss.) (Paper.)
[9] Desbleds, L. Blin, Photoelectric measurement of luster, Dyer and Calico

Printer, 64, 515 (1930). (Contrast gloss.) (General.)
[10] Detroit Paint Production Club. Standard Method of Gloss Measurement,

Sci. Sec. Cir. 423, Nat. Paint, Varnish, and Lacquer Assn., Washington,

D. C. (1932). (Distinctness-of-image gloss.) (Paints and lacquers.)
[11] Douglas, W. Das Halbschatten Photometer, Melliand Textileberichte 2,

411 (1921). (Contrast gloss.) (General.)
[12] Ewald, W. The measurement of luster. Instruments 1, 111 (1928). (Contrast gloss.) (General.)
[13] Gardner, H. A. Physical and Chemical Examination of Paints, Varnishes,

Lacquers, and Colors (Chap. 6). Washington, D. C, 7th ed. (1935).

(Review of methods.) (Paints.)
[14] Haslam, G. S. and L. D. Grady. The Pfund glossmeter applied to paints and

lacquers, Ind. Eng. Chem., Anal. Ed. 2, 346 (1930). (Specular gloss.)

(Paints and lacquers.)
[15] Horsfeld, W. R. Means for the Measuring of Gloss, U. S. Patent 2032128

(Feb. 25, 1936). (Contrast gloss.) (Paper, textiles.)
[16] Hunter, R. S. The Glossmeter, Sci. Sec. Cir. 456, Nat. Paint, Varnish, and

Lacquer Assn., Washington, D. C. (1934). (Specular gloss.) (Paints,

general.)
[17] Hunter, R. S. A glossmeter and surface texture comparator, Paper Trade J.

99, no. 7, 38 (Aug. 16, 1934). (Specular gloss, surface texture.) (Paper.)
[18] Hunter, R. S. A New Gloss Comparator and a Study of Different Types of

Gloss Effects, Sci. Sec. Cir. 493, Nat. Paint, Varnish, and Lacquer Assn.,

Washington, D. C. (1935). (Distinctness-of-image gloss, review of gloss
PI types.) (Paints, general.)
[19] Hunter, R. S. Identification of five different types of gloss effects, J. Opt. So
c,

Am. 26, 224 (1936); see also J. Opt. Soc. Am. 25, 47 (1935). (Review of

gloss types.) (General.)
[20] Hunter, R. S. Reflection measurements on pulp and paper, Paper Trade J.

100, TS40 (June 27, 1935). (Review of methods.) (Paper.)

[21] Hunter, R. S. Gloss investigations using reflected images of a target pattern,

J. Research NBS 16, 359 (1936) RP879; see also J. Opt. Soc. Am. 26,

190 (1936) and Sci. Sec. Cir. 503, Nat. Paint, Varnish, and Lacquer Assn.,

Washington, D. C. (1936) . (Distinctness-of-image gloss, bloom.) (General.)
[22] Ingersoll, R. S. The Glarimeter — An instrument for measuring the gloss of

paper, J. Opt. Soc. Am. 5, 213 (1921); see also Elec. World 63, 645 (1914), Elec. World 64, 35 (1915); Paper 27, 18 (Feb. 9, 1921), and U. S. Patent 1225250 (May 8, 1917). (Contrast gloss.) (Paper.)

[23] Institute of Paper Chemistry, Appleton, Wis. Report on Gloss, Nov. 20, 1934 and Report on the Modified Oxford Glarimeter Jan. 10, 1935). (Specular gloss.) (Paper.)

[24] Jones, L. A. The gloss characteristics of photographic papers, J. Opt. Soc. Am. 6, 140 (1922); see also British J. Photography, p. 216 (April 14, 1922). (Goniophotometry, contrast gloss.) (Photographic papers.)

[25] Keiser, Karl. Simple apparatus to measure gloss on paper, Paper Trade J. 71 (no. 11), 60 (1920); see also Z. angewandte Chem. 32 (1), 357 (1919); Paper, p. 16 (May 26, 1920) ; and Deutsche Faserstoff Spinnpflanzen Z. 4, 1 (1922). (Contrast gloss.) (Paper.)

[26] Kenworthy, L. and J. M. Waldram. A reflectivity method for measuring the tarnishing of highly polished metals, J. Inst. Mefrals 55, 247 (1934). (Contrast gloss, bloom.) (Metallic surfaces.)

[27] Klughardt, A. Uber die Bestimmung des Glanzes mit dem Stufenphotom- eter, Z. tech. Physik 8, 109 (1927). (Contrast gloss, goniophotometry.) (General.)

[28] Klughardt, A. Eine Methode der Glanzmessung nach Einheiten des psycho- logischen Helligkeits-Unterschiedes, Central-Ztg. Optik Mech. 51, 89 (1930). (Contrast gloss.) (General.)

; [29] Klughardt, A. and H. Naumann. Zur Photometrie diffuse reflektierender und spiegelnder Flachen gegeneinander, Central-Ztg. Optik Mech. 48, 289 (.1927). (Contrast gloss.) (General.)

[30] Kreezer, G. Luminous appearances, J. Gen. Psychol. 4, 347 (1930). (Psychological.) (General.)

[31] Lange, B. Die Photoelemente und ihre Anwendung, part 2, Technical Applications J. A. Barth (Leipzig), see p. 56 (1936). (Specular gloss.)

Richter, M. Eine andere Art der Glanzbestimmung mil dem Slufenphotometer,

Central- Ztg. Optik. Mech. 49, 287 (1928). (Contrast gloss.) (General.)
Riddell, G. L. A photoelectric glossmeier, World's Paper Trade Rev. 101,

1480 (May 11, 1934). (Contrast gloss.) (Paper.)
Ries, E. D. and C. B. Gilbert. Gloss and its quantitative measurement, Proc.

Am. Soc. Testing Materials 30, II, 911 (1930). (Goniophotometry and

specular gloss.) (General.)
Schulz, Hans. Uber Glanz and Glanzmessung, Z. tech. Physik 5, 135 (1924),

see also Melliand Textilberichte 5, 25 (1924). (Contrast gloss and review

of methods.) (General.)
Shook, G. A. A portable glarimeter, J. Opt. Soc. Am. and Rev. Sci. Instr. 9,

61 (1924). (Contrast gloss.) (General.)
Slator, J. M. A recording goniophotometer, J. Opt. Soc. Am. 25, 218 (1935).

(Goniophotometry.) (General.)
Sward, C. G. and S. A. Levy. A Simple Device for Measuring Gloss, Sci.

Sec. Cir. 380, Nat. Paint, Varnish and Lacquer Assn., Washington, D. C.

(1931). (Distinctness-of-image gloss.) (Paints.)
Vernon, W. H. J. First (experimental) report to the Atmospheric Corrosion

Research Committee (of the British Non-Ferrous Metals Research Association) , Trans. Faraday Soc. 19, 839 (1923-24) . (Specular gloss.) (Metallic

surfaces.)
Wolff, H. tlber der Bestimmung des Glanzes von Anstrichen, Farben-Z.

29, 277 (1923-24). (Distinctness-of-image gloss.) (Paints.)
Wolff, H. and G. Zeidler. On the Measurement of Gloss and a New Glossmeter for the Practice, Paint and Varnish Production Manager, p. 5 (Sept.

1934). (Specular gloss, goniophotometry-) (Paints.)

Washington, October 23, 1936,

which is indicated visually by an excess of apparent reflectance adjacent to the mirror reflection. Whether, for its measurement, it will be desirable to take the difference between apparent reflectance in the direction adjacent to mirror reflection and apparent reflectance in a direction well removed from mirror reflection, or to take some other function of these apparent reflectances, is not yet decided. Different possible magnitudes for indicating bloom are suggested by the diagram in figure 10. In any case, care must be exercised to insure that none of the strongly reflected high light is admitted as bloom.

Figure 10. — Bloom indicated by excess of apparent reflectance adjacent to mirror reflection.

(Possible functions are B-D, 1—D/B, and BID.)

Hunter]

Methods of Determining Gloss

85

In figure 11, 7 from [21], is shown a comparison of the power of two surfaces to reflect images of the target used in the gloss lamp. The specimen on the left clearly shows bloom in the dark areas of the image.

X. DISTINCTNESS-OF-REFLECTED-IMAGE GLOSS

Surfaces which give images by reflection are, in general, surfaces of high gloss. Because these images are often the most pronounced feature of the appearance of a surface of high gloss, they are widely used as a

Since the gloss of these materials IS low, apparent reflectance in another
the excess light due to specular reflectance direction.
is widely distributed in the general direc- (Possible functions are i-dis and sid)
tion of mirror reflection in a manner char-
acteristic of such surfaces (see curve M, fig. 2). For this reason the
apertures of instruments used to measure this type of gloss may be

« Formerly termed "subjective gloss" [18, 44].

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Methods of Determining Gloss

33

made large if desired. Two contrast-gloss meters are illustrated in
figures 8 and 9. In Jones' instrument) figure 8, it may be seen that
the apparent reflectance at 45° is photometrically compared with the
apparent reflectance at normal viewing.

In the Ingersoll glarimeter, figure 9, the large source-aperture
(indicated by the heavy lines, 1 by 1 inch opening, b){ inches from
the center of the sample) is equivalent to a circular opening approxi-
mately 13° in diameter. Since this instrument is generally employed

Figure 8. — Diagram of Jones' contrast-gloss meter [BJfl*

Light from the source, S, is incident upon the sample, B, at 45°. The apparent reflect
ance at"'— 45° (dif-
fuse plus specular) is brought into juxtaposition with the apparent reflectance at 0°
(diffuse) by means of
mirrors, and H and the Lummer-Brodhun cube, K. The observer can adjust the resulting b
eams to
equal brightness by means of wedges Cand D. The relative brightness of the two reflect
ed beams is given
by the inverse ratio of the transmissions of the wedges necessary to bring them to bal
ance in the eyepiece.

Typically, gloss values are evaluated at a specific geometry based on the value reported at the 60° geometry. For very matte values (<10 at 60°) it is recommended that the value at the as• geometry is reported per PSM-11-2. However, in order to compare gloss values that range from 2-2O at 60° (which was the case for the Perfectly Matte), the values must be reported for the same geometry and in this case the 60° geometry was selected. It should be noted that gloss values trend the same at all angles, meaning if Sample A is more matte than Sample B the gloss value of Sample A will always be lower than Sample B no matter what geometry used.

SUMMARY:

This test quantitatively measures the shine or gloss intensity of cosmetic products, e.g. lip products, with a Glossmeter (BYK-Gardner, MICRO-TRI-GLOSS, Model 4520) at body temperature of 35°C. Gloss value of different products can be compared to assess if there is significant difference in shine/gloss intensity.

SAFETY:

Always wear standard lab personal protection equipments, such as gloves, eye safety glasses, and lab coat while operation the test.

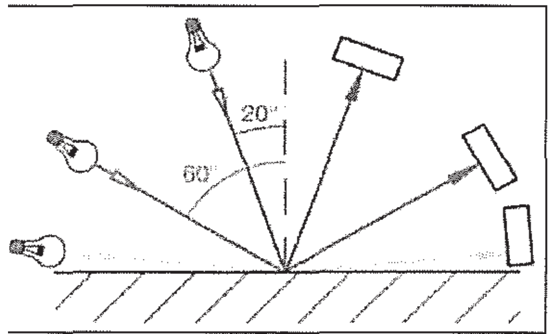
PRINCIPLE:

Gloss is an optical property based on the interaction of light with physical characteristics of a surface. It is the ability of the surface to reflect light into the specular direction. Gloss is influenced by several factors: reflective index of the materials, the angle of incidental light and the surface topography.

Gloss is typically measured with an instrument called Glossmeter, which measures specular reflection. The measurement results of a glossmeter are related to the amount of reflected light from a black glass standard with a defined refractive index. The measurement value for this defined standard is equal to 100 gloss unit. The measurement is conducted at -35°C, a body temperature that is relevant to cosmetic usage.

The angle of illumination highly influences the measurement results. In order to obtain a clear differentiation over the complete measurement range from high gloss to matte, 3 different angles of illumination are defined

Gloss Level	60° value	Recommended geometry
Low gloss	< 10 units	85° geometry
Semi gloss	10-70 units	60° geometry
High gloss	> 70 units	20° geometry


20°
60°

UNIQUE APPARATUS:

(1) Clear Polyester Sheet

(2) 3 mil thickness slot draw-down bar

(3) Glossmeter (Micro-Tri-Gloss, Model 4520; BYK-Gardner)

(4) Heating Blanket (BriskHeat Model SRL1224, Thermo Scientific)

(5) Black Leneta card

PROCEDURE:

Sample Preparation

Test samples should be flat, free of structures, similar in color and lightness and non-luminescent materials

1. Prepare Eight (8) clean polyester sheets
2. Draw down a 3 mil thickness film on the polyester sheet
3. Allow film to dry for 1 hour or completely dry
4. Place polyester sheet on the heated blanket (-35°C) for at least 20 min
5. Slide a black leneta card underneath the polyester sheet before the Gloss measurement

Operation

Automatic Calibration

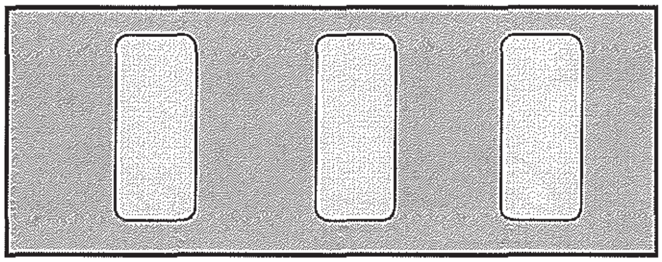
1. Press Mode button
2. Press Operation button. After 10 second, it appears "Calibration Done"
3. Remove unit from Glossmeter holder and ready for measurement

Select Geometry

1. Press Mode button repeatedly until "Change Geometry" appears
2. Press Operation Button repeatedly until desired geometry appears
3. Confirm by pressing Mode button

Measurement

1. Press Mode button repeatedly until "Sample Mode" appears
2. Place the holder on film and activate measurement by pressing the Operation button
3. Measure the Gloss Value in 3 positions for each sample as described below
4. For each position, 3 readings are taken and the average of the 3 readings is recorded



Statistical Analysis

A paired t-test is performed to analyze if there is significant difference in Gloss/Shine intensity between two cosmetic samples.

NOTES:

In order to differentiate gloss of samples, it is necessary to select the appropriate measuring geometry.

Geometry Selection

1. Measure the sample with the 60° Geometry.
2. The 60° Geometry should be used if the gloss reading is between 10-70 units.
3. If the 60° Geometry Gloss is higher than 70 units, the 20° Geometry should be used
4. If the 60° Geometry Gloss is lower than 1O units, the 85° Geometry should be used

STUDY DESIGN:

When two or more lip products are compared, they are evaluated in a blind test. Lip products are identified by letter codes and brand names are covered. The blinded lip products are given to operator for Gloss Unit measurement

WRITTEN BY:

2/28/2012

Wendy Chan

APPROVED BY JACK GLYNN 2/28/2012

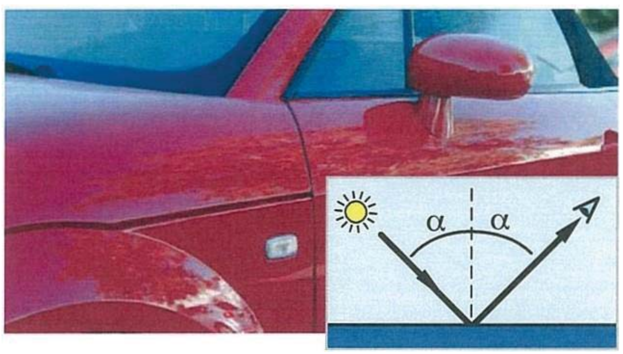
Introduction

Gloss Measurement

Gloss is a visual impression resulting from surface evaluation. The more direct light is reflected, the more obvious the impression of gloss will be.

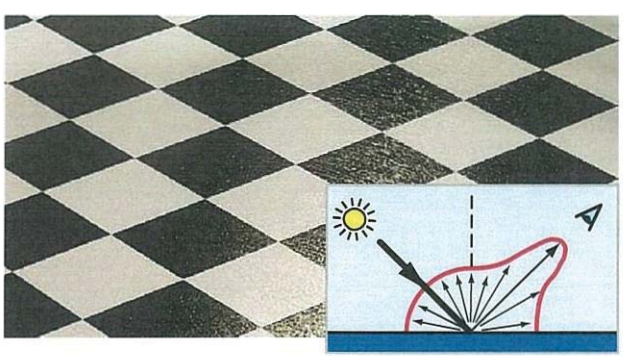
High Gloss

Smooth and highly polished surfaces reflect images distinctly. The incident light is directly reflected on the surface, i.e. only in the main direction of reflection. The angle of incidence is equal to the angle of reflection.



Matte to Semi Gloss

On rough surfaces the light is diffusely scattered in all directions. The image forming qualities are diminished: A reflected object no longer appears brilliant, but blurred. The more uniform the light is scattered, the less intense the reflection in the main direction and the surface will appear duller.

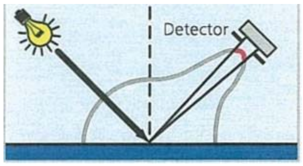


Glossmeter

A glossmeter measures the specular reflection. The light intensity

GLOSS

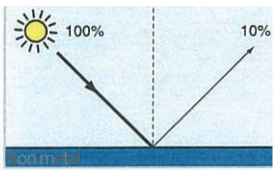
is registered over a small range of the reflection angle.

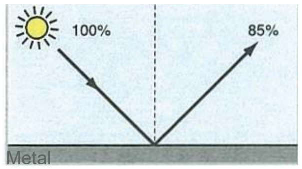


Measurement of specular reflection

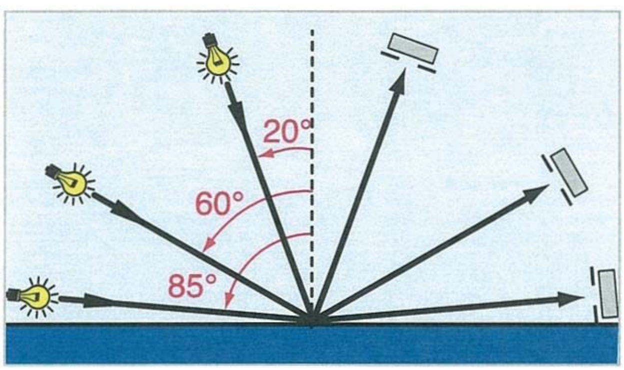
The intensity is dependent on the material and the angle of illumination. Incase of non-metals (coatings, plastics) the amount of reflected light increases with the increase of the illumination angle. The remaining illuminated light penetrates the material and is absorbed or diffusely scattered dependent on the color. Metals have a much higher reflection and are less angle dependent than non metals.

Example:





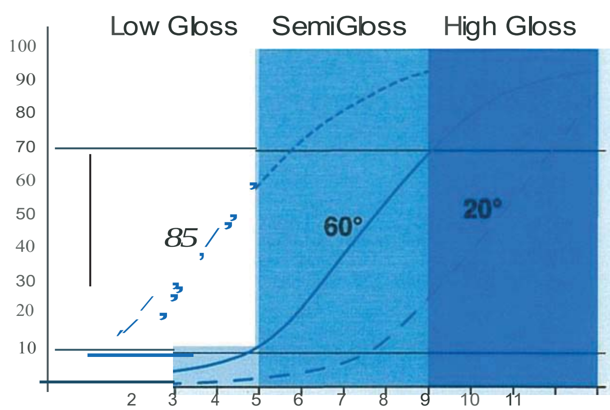
The measurement results of a glossmeter are related to the amount of reflected light from a black glass standard with a defined refractive index, and not to the amount of incident light. The measurement value for this defined standard is equal to 100 gloss units (calibration). Materials with a higher refractive index can have a measurement value above 100 gloss units (GU), e.g. films. In case of transparent materials, the measurement value can be increased due to multiple reflection in the bulk of the material. Due to the high reflection capabilities of metals, values of up to 2000 GU can be reached. For these applications it is common to document the measurement results in % reflection of the illuminated light.



Gbssmete rs and their handling procedures had to be internationally specified to allow comparison of measurement values. The angle of illumination is of high influence. In order to obtain a clear differentiation over the complete measurement range from high gloss to matte, 3 different geometries, i.e. 3 different ranges, were defined:

Gloss Range	60° value	To be measured with
SemiGloss	10 to 70	60'geometry
Hi9h Gloss	>70	20'geometry
Low Gloss	< 10	85'9eomet!}'.

In addition, there are industry specific applications for 45° and 75° measurement geometry.



In this case study 13 samples were visually ranked from matte to high gloss and measured with the 3 specified geometries. In the steep slopes of the curves, the differences between the samples can be clearly measured, while in the flat part, the measurement geometry no longer correlates with the visual.

Gloss measurement for any application – whether you are dealing with specific applications or need a universal solution for matte to high gloss samples. BYK-Gardner offers a complete line of glossmeters:

- Reference laboratory instrument - haze-gloss
- Portable micro-gloss family

Their unique features and benefits have made them the industry standard for gloss measurement.

Application	2W	6W	8	45°	75°
	Coatings, plastic and related materials			Ceramic, Fiim	Paper, Vinyl
	High Gloss	Semi Gloss	Low Gloss	Semi Gloss	Low Gloss
DIN EN ISO 2813	●	●	●		
ASTM D523	●	●	●		
ASTM D 2457	●	●		●	●
DIN 67530	●	●	●		
JIS Z 8741	●	●	●	●	●
ASTM C 346				●	
Tappi T 480					●
	Brightened Metal				
EN ISO 7668	●	●	●	●	

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Portable Gloss Measurement

AVAILABLE IN: English

Portable Gloss Measurement

Haze-gloss

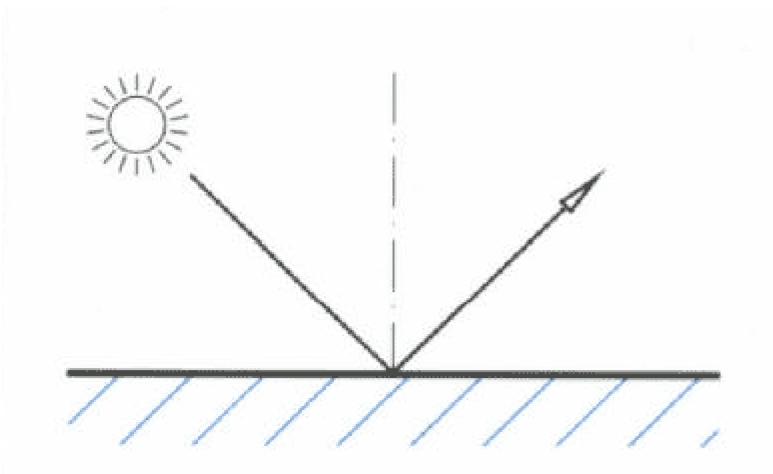
What is Gloss?
Gloss is an optical phenomenon caused when evaluating the appearance of a surface. The evaluation of gloss describes the capacity of a surface to reflect directed light.

Why is gloss measured?
Gloss is often used as a criterion to evaluate the quality of a product, especially in the case of products where the aesthetic appearance is of importance. This includes products such as automotive coatings, furniture coatings, plastics, metals and paper. A visual gloss evaluation includes many subjective sources of error and is not sufficient. Therefore, to be objective, it is necessary to put a measured value on the degree of gloss. A complete evaluation of gloss is dependent on several factors. Since the 1930's, measuring instruments have been used to associate reflection behavior and a defined measurement value under defined conditions. How this is done and what has to be considered will be explained on the following pages.

How is Gloss Perceived?
Gloss when perceived by the human eye is a subjective evaluation. However, visually observed differences can not always be measured physically by using, for example, glossmeters.

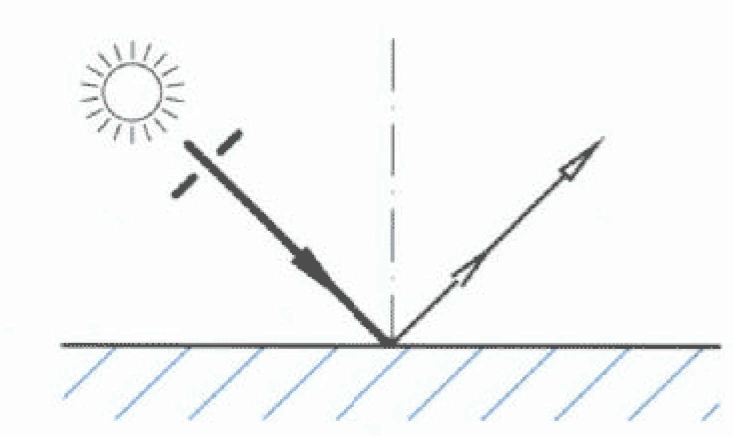
The appearance of gloss is influenced by several factors.

Surface properties



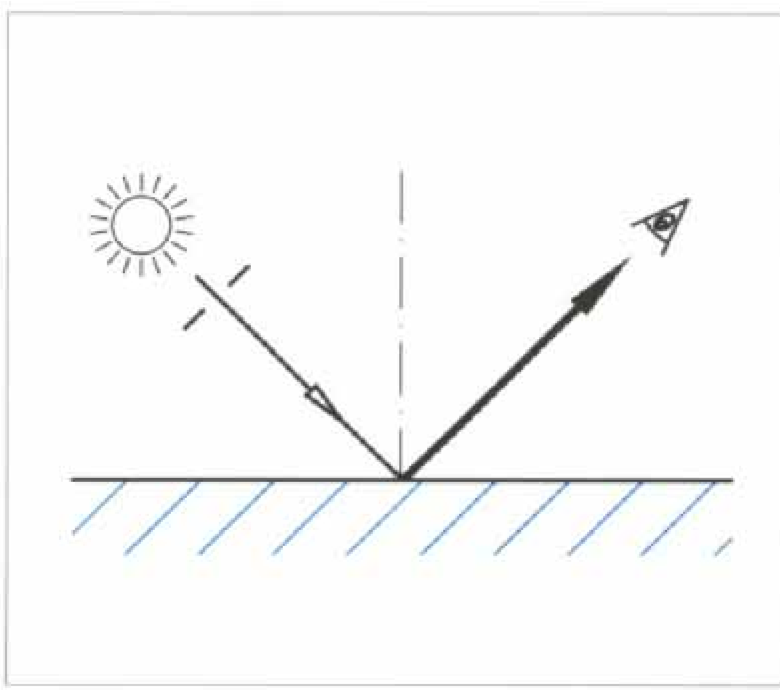
- Material (e.g. glass, coatings, metals)
- Surface profile (e.g. flat, structured)
- Transparency and substrate

Type of illumination



For gloss evaluation it is required to have direct illumination. A diffuse illumination causes diffuse reflection resulting in decreased gloss impression.

Observer

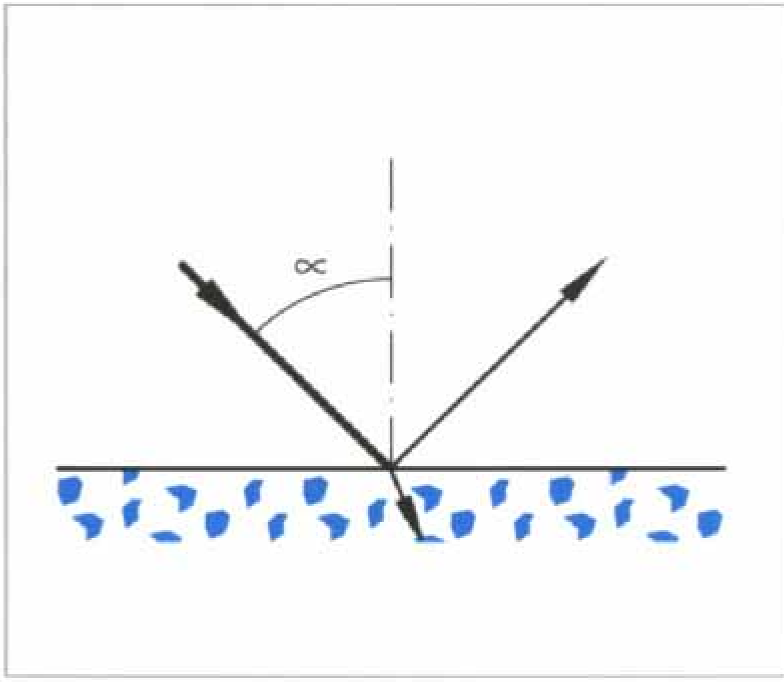


Visual evaluation is dependent on the eyesight -> physiology and the mood -> psychology.

As the perception of gloss is a sensation which is not a mere physical measurement, it is difficult to describe with physical parameters.

Reflection Behavior of Surfaces
Different types of surfaces and their reflection behavior under direct illumination are evaluated in the following chapter.

Glossy surface

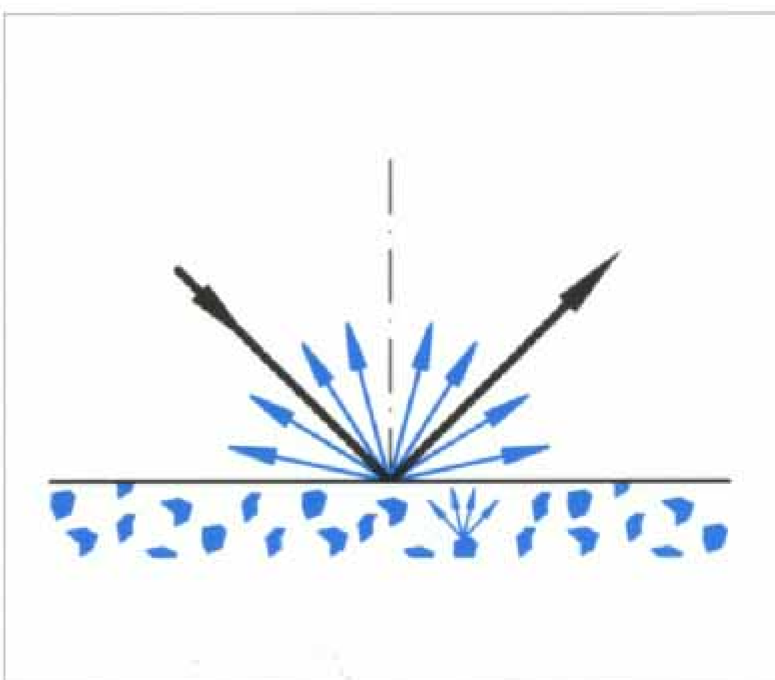


Gloss => direct reflection on the 1st surface.

In case of high gloss surfaces, light reflected from the surface follows the reflection law (angle of illumination = angle of reflection). The intensity of the reflected light is dependent on the angle of illumination and material properties.

Metals: very high intensity, hardly angle dependent

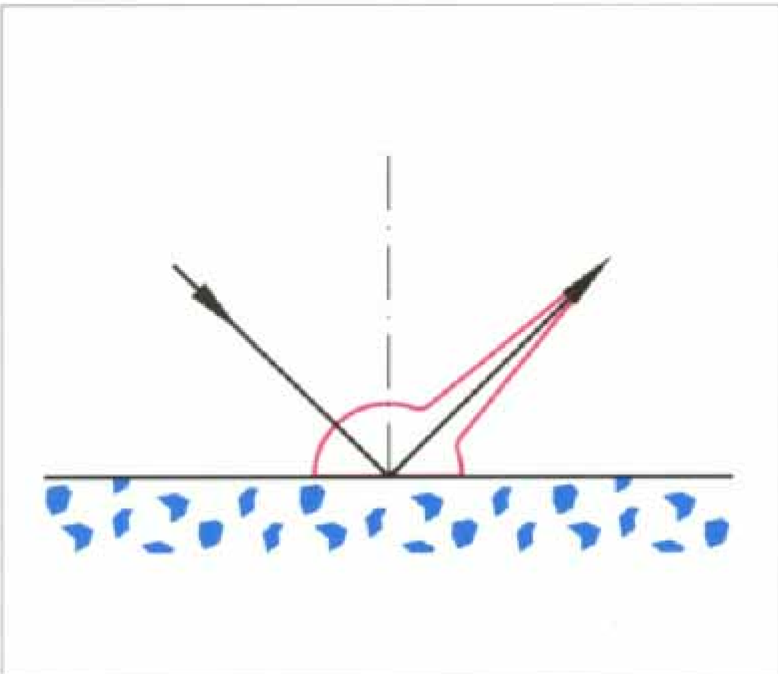
Coatings: low intensity, angle dependent



Color => diffuse reflection from within the sample.

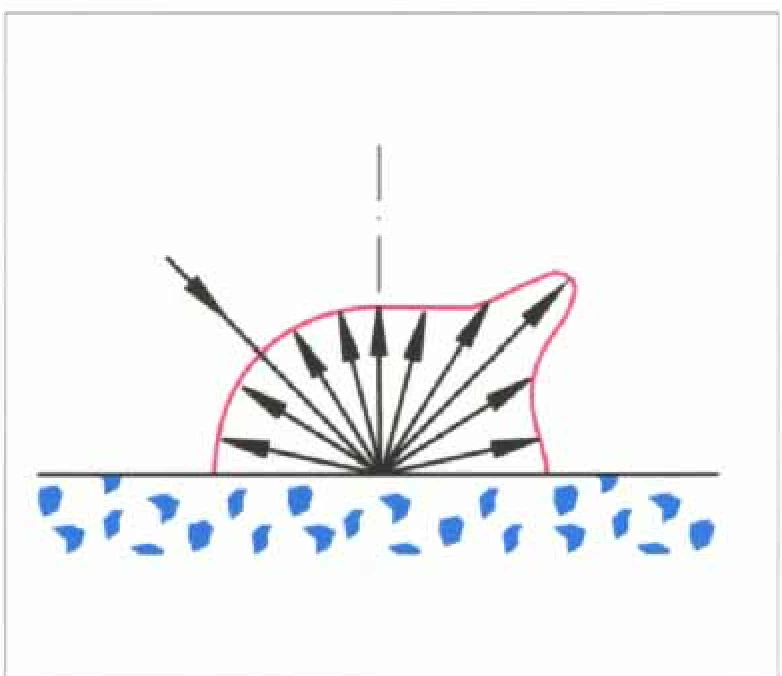
Part of the illumination penetrates the surface and is selectively absorbed and scattered internally by pigment particles and other bodies. It then is diffused from within the first surface. This is how the impression color is caused. This diffuse reflection can be measured with BYK-Gardner color measuring instruments.

Glossy surface with haze



The dominant part of light is reflected in the main direction of reflection (specular). A small amount of light is scattered in directions adjacent to the direction of specular reflection. This scattered light of low intensity causes haze. The surface seems to be glossy, yet has a milky appearance.

Medium to mat surfaces

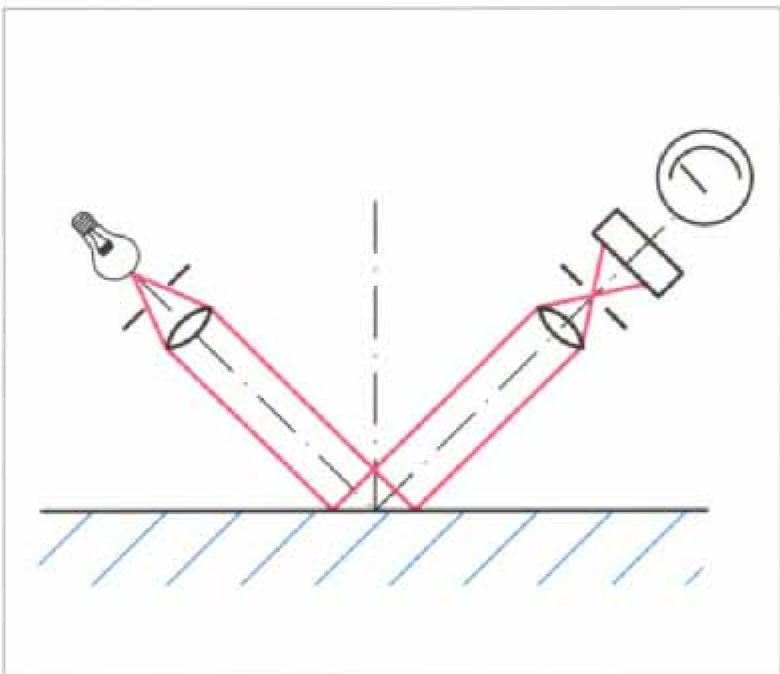


In this case light is not only reflected in the direction of specular reflection but also in other directions. The capacity of a surface to reflect a light source or other images is strongly reduced. The more evenly the intensity is distributed in all directions, the less glossy a surface will appear.

The differences between high, semi and low-gloss surfaces can be determined with a regular glossmeter (e.g. micro-gloss, micro-TRI-gloss). The visually perceived phenomenon "haze" can hardly be detected with a regular glossmeter, and to date, only very complicated instruments have been available to measure this effect. Due to these facts, measurement of reflection haze is performed only on rare occasions. Consequently, supplier and vendor were often faced with disputes concerning the appearance quality as they were not able to measure haze.

By developing the haze-gloss, BYK-Gardner allowed the practical measurement of gloss and reflection haze with one laboratory instrument. Now it is possible to measure reflection haze as easily and as fast as you can measure gloss.

How is Gloss Measured?
By using reflectometers reflected light of a surface is measured in an angle range which is limited by aperture dimensions.



Light beam in a reflectometer
The light source is projected over the sample surface onto the opening of aperture 2. A photoelectronic detector measures the light passing through the aperture.

The measurement results are influenced by various factors:

- Type of measuring instrument
- Angle of illumination
- Calibration of the instrument
- Surface characteristics

In order to obtain comparable measurement results apparatus and measurement procedure were internationally specified.

What are the conventions of an international specification?

- Measuring instrument (optics)

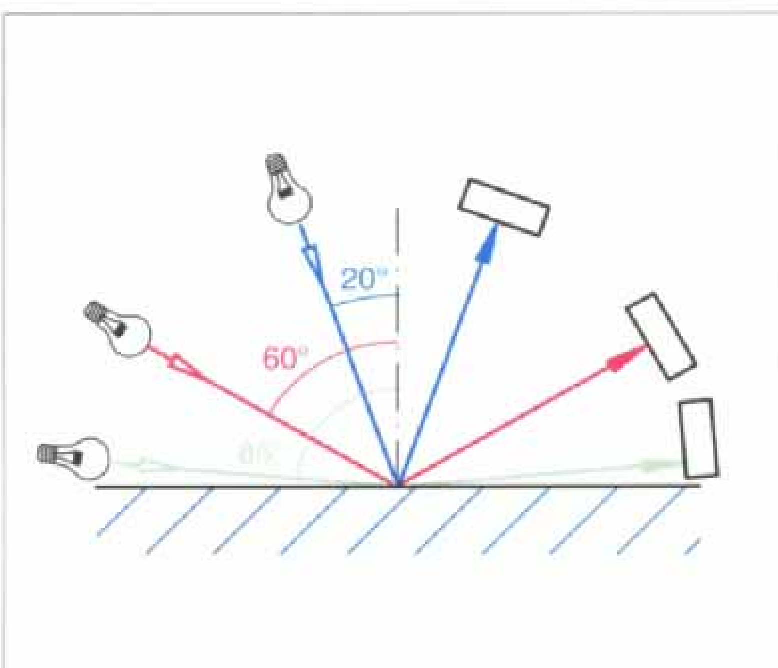
- Calibration of the instrument
- Surface of the sample
- Measurement procedure

The most important specifications
ISO 2813
ASTM D 523
DIN 67530

These different specifications agree in the essential points.
Standardization of the instrument

- Angle of illumination I reflection 20°/60°/85°
- Dimensions of the source and receptor aperture
- Light source
- Receptor response (sensitivity).

The angle of illumination highly influences the measurement results. In order to evaluate the whole range from high-gloss to mat surfaces, three different angles Of illumination (which means three different measuring ranges) are defined for the paint and coatings industry:



20° high gloss surfaces
60° medium gloss surfaces
85° mat surfaces other industry specifications:
45° ceramic industry
75° paper industry (TAPPI specification)
Instrument calibration

The measurement of the reflectometer value R' is a relative measurement. Results are related to a highly polished black glass with a refractive index of 1.567. The glass has an assigned specular gloss value of 100 for each geometry. As instrument and standard tolerances are tightly controlled, the measurement error should not be more than ± 1 unit.

Surface properties
In order to achieve highly accurate and repeatable results, the test specimen should be

- flat
- free of structures
- similar in color and lightness
- non-luminescent material

Measurement procedures and measurement results
In order to differentiate gloss of samples, it is necessary to select the appropriate measuring geometry.

- First the test specimen is measured with the 60° geometry. The 60° geometry should be used if the gloss reading is between 10 and 70 units.
- If the 60° gloss is higher than 70 units the 20° geometry will be advantageous for comparison.
- If the 60° gloss is lower than 10 (30*) units, the 85° geometry should be used.

*recommendations according to DIN.

In some cases the 60° geometry will be advantageous for very mat test specimens.

At least three readings should be taken on a test specimen. If the range is greater than five gloss units, additional readings have to be taken. For correct measurement results, the mean gloss reading is to be calculated and the geometry used is to be reported. e.g. 20° reflectometer value R'20 = 55 units.

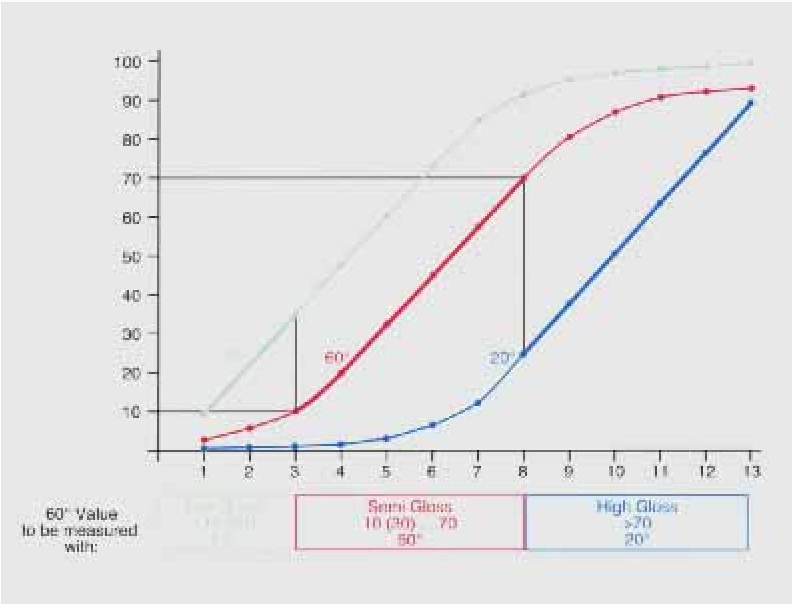
Why do specific gloss levels require different measuring geometries? The reflection on paint and plastic surfaces basically follows the Fresnel equation.

The amount of light that is reflected on the 1st surface or penetrating the material is dependent on the illumination angle. Since, in the case of a mat surface, the amount of reflected light is distributed over a wide-angle range only a small part is detected by the aperture of the reflectometer.

Therefore it is necessary to choose the correct measurement geometry to guarantee high measurement accuracy.

Which measurement geometry is required for which gloss level? In order to illustrate the proper selection for a measuring geometry, the following test was performed:

Thirteen black glass tiles (sample number 1-13) were visually ranked from mat (1) to high-gloss (13) and were measured with 20°, 60° and 85° geometries. By graphing the measurement results (0-100 gloss units) against sample number 1-13 each geometry has a different curve. It is remarkable that the measured gloss difference between two successive tiles is different on each curve. For example, sample number 10 and 11 show the largest difference in the 20° geometry and confirm the use of the 20° geometry for high gloss samples. While in the low gloss area, for example sample number 2 and 3, the largest differences can be achieved with an 85° geometry.



Peculiarities when measuring gloss

Different phenomena can cause problems when measuring gloss.

Calibration Mistakes during calibration will result in wrong measurement results.

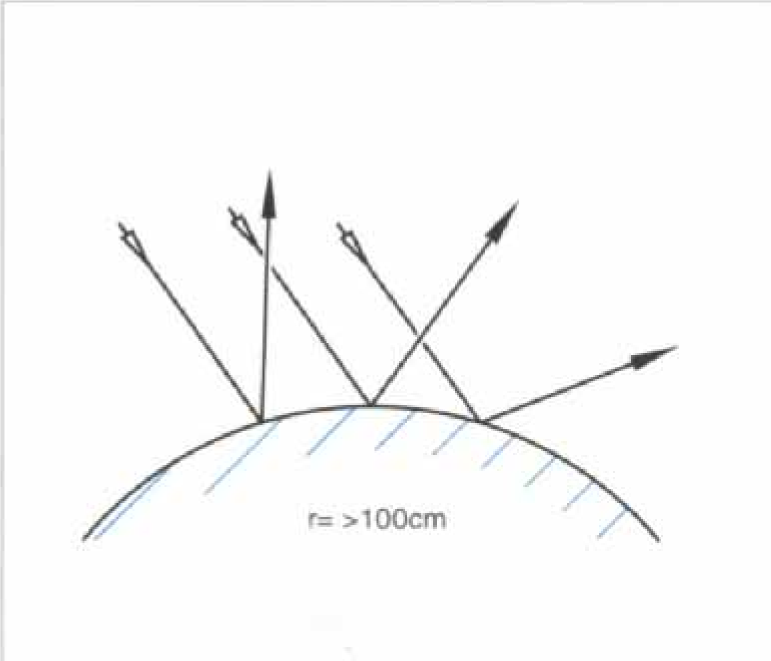
- Calibration standard is not clean (fingerprints, dust)
- Calibration standard is damaged (scratches)
- Calibration standard has changed because of other influences (aging)
- Usage of semi-gloss standards as calibration standards.

In order to avoid the above mentioned sources of errors international specifications recommend a yearly re-calibration of the calibration standard.

These types of errors are to a large extent excluded with BYK-Gardner micro-gloss, micro-TRI-gloss and haze-gloss. In the case of the micro-gloss and micro-TRI-gloss the calibration standard is securely housed in a holder. The calibration is performed automatically.

Due to the long-term stability of the haze-gloss, re-calibration is only necessary every two months, which protects the standard from routine use.
Surface properties

Curved surfaces
Gloss measurement is based on the detection of the spatial reflection behavior of a surface, which is strongly influenced by a curvature (distorted image). Depending on the geometry and the degree of gloss, a curvature < 100 cm (dia.) can contribute an influence on the measured value. In addition, the risk of tilting the sample and the influence of ambient light has to be considered.



Regular structures on surfaces
will result in different gloss values dependent on the measuring direction. If gloss measurement is used as a quality control criterion for those types of surfaces, it is recommended to indicate the measuring direction.

Irregular structures
(artificial leather) show relatively high variations.

Peculiarities for high-gloss surfaces
When visually observed, high-gloss surfaces can differ in their appearance, while readings taken with a 200 glossmeter are equal or are very close. The reason for this phenomenon is scattered light being observed by the human eye. A regular glossmeter is not capable of measuring this scattered light.

Scattered light can be caused by:

- Long term surface structures--> Flow/leveling defects, orange peel leading to a distortion of the reflected image on the surface
- Short term surface structures--> Reflection haze: Microscopic defects on or just beneath the surface cause scattered light of low intensity adjacent to the direction of specular reflection (see "scattered light with gloss measurement").

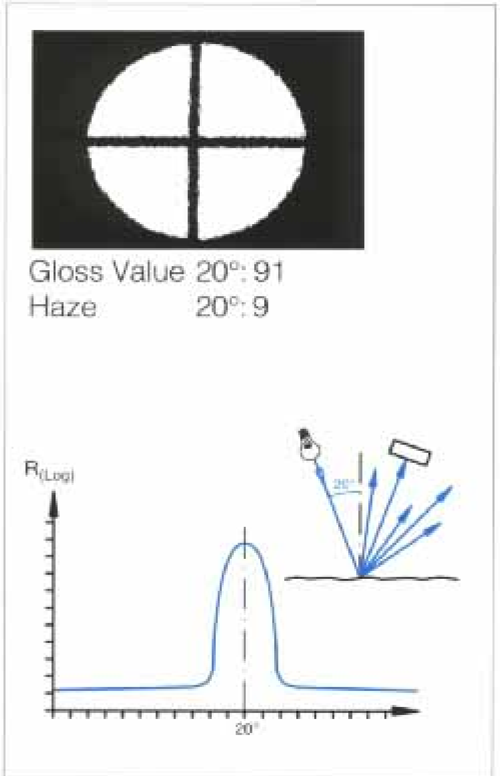
Scattered light with gloss measurement
When describing the appearance of a surface with a reflectometer, the limits of this test method are often reached.

How is visual appearance evaluation performed?
The image of a light source or another illuminated object (e.g. an overhead fluorescent light) reflected by the sample surface is visually evaluated. By using three different types of surfaces the following phenomena will be described:

- quality of a reflected image

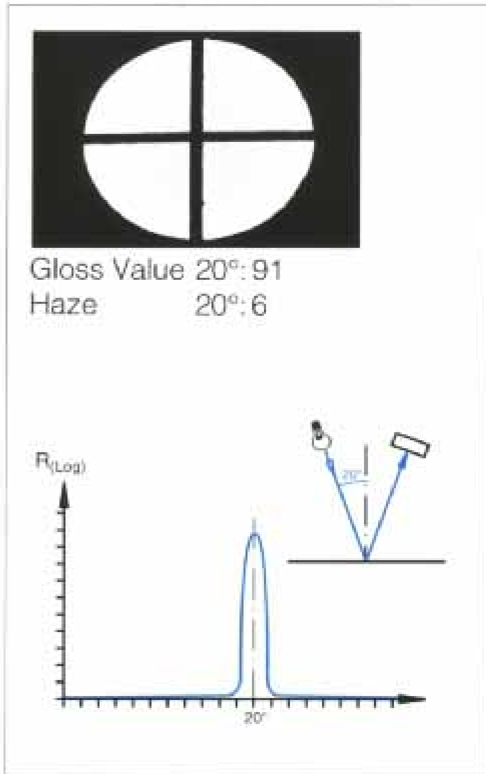
- theoretical reflection behavior
- measured reflection distribution

On surfaces that exhibit flow/leveling defects or orange peel, the reflected image will be distorted.



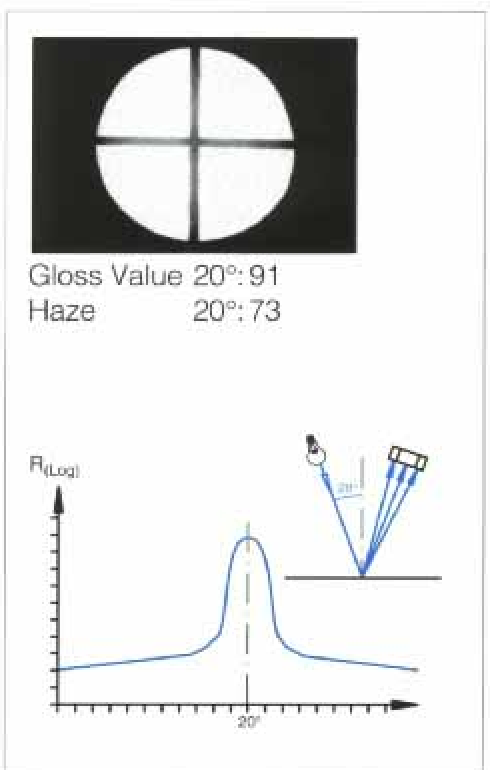
This type of image distortion, caused by long term waviness, results in an enlargement of reflection peak.

In the case of an undisturbed high-gloss surface, the reflected image appears as clean and distinct as observing it directly.



How is reflection haze measured?
Reflection haze is caused by microscopic defects, which result in scattered light adjacent to the direction of specular reflection, and is visually observed. With the haze-gloss, it is now possible to measure and differentiate both the directly reflected (gloss) and diffusely scattered (haze) light. With the haze-gloss, the measurement of reflection has become as easy and as fast as the measurement of gloss.

On surfaces with reflection haze the reflected image is surrounded by a halo.



Reflection haze caused by scattered light of low intensity, adjacent to the direction of specular reflection, can be measured with the haze-gloss.

Last Updated: 10/15/18

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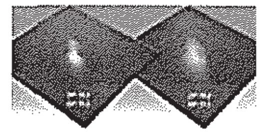
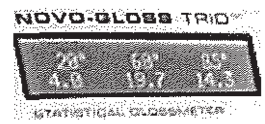
Products



C) Larger View



0 larger View

El GLOSS Meters

An introduction to Gloss Measurement

(because we care and we hope you in turn will purchase from us)

1. What is Gloss?,
2. What difference in gloss units is visible to the human eye?
3. Why Measure Gloss?
4. How is Gloss Measured?

Or sklp to;

Continue to Gloss Meter Selection Guide

For a Novo Gloss Meter CLICK HERE

For a Byk Gardner Gloss Meter CLICK HERE

U.S. Prices on Novo Gloss U.S. Prices on Byk Gardner

CON Prices on Novo Gloss CON Prices on Byk Gardner

1) What is Gloss?

Gloss is an aspect of the visual perception of objects.
Gloss is the attribute of surfaces that causes them to have shiny or lustrous, metallic or mat appearances.
Gloss Js a visual impression that is caused when a surface is evaluated. The more direct light is reflected, the more obvious will be the impression of gloss.

Gloss effects are based on the interaction of light with the physical properties of the sample surface. The other influencing component is the physiological evaluation scale. The human eye is still the best tool to evaluate gloss differences. However, the visual surface control rs Insufficient, because evaluation conditions are not clearly defined, and people see and judge differently
h addition, the subjective perception of appearance is dependent on the personal experience: what is glossy for a paper manufacturer might be dull for an automotive maker. Gloss is measured by focusing on the reflected image and not by focusing on the surface. Eyesight and mood have a decisive role in the visual judgment. Also, important is what our eye is focused on. We evaluate a surface by focusing our eye on a reflected image of a light source. n order to guarantee a reliable and practical quality assurance it is necessary to define appearance with objective, measurable criteria. Accurate characterization of

appearance does not only help to control quality, but improves quality and optimizes manufacturing processes.

High Gloss c:) *Novo Gloss Lite 20° micro-gloss* 20 °

A smooth and highly polished surfaces reflect images distinctly. The incident light is directly reflected on the surface, I.e. only in the main direction of reflection. The angle of incidence is equal to the angle of reflection.

Semi Gloss c:::> *Novo Gloss Lite 60° micro-gloss* 60 °

On rough surfaces the light is diffusely scattered in all directions. The image forming qualities are diminished: A reflected object does no longer appear brilliant, but blurred.
The more uniform the light is scattered, the less intense is the reflection in the main direction and the duller the surface will appear.

High and Semi Gloss c:::> *Novo Gloss Lite Dual 60120°*

One Gloss meter does double work. The DUAL is a new model from 2007 re-engineered and at a lower price.

Low Gloss or Mat *Novo Gloss 85° Stats micro-g/OSS 85°*

On very rough surfaces the light is diffusely scattered in all directions. The image forming qualities are much diminished: A reflected object no longer appears brilliant, but almost non-existent.

Measure all three modes Simultaneously *NG TRIO TRI-gloss*

When one requires measuring all three types of surfaces described above, we have two gloss meters that simultaneously measures all three geometries.

All three modes plus Coating Thickness NFe/Fe o:> *Tri + u Gloss*

Our gloss meter incorporates all the technological advances into one unit offering a unique package in an economical package. The micro-tri-gloss µ has everything you require in one compact gloss and coating thickness meter.

Measure small rounded objects or small areas *Novo Curve*

2) What difference in gloss units is visible to the human eye?

If two different coatings are measured, what number of gloss units wou ld be detectable by the human eye, how many un its would be perceived as significantly different?

When measuring at 60 Degrees these detectable differences depend on the gloss level of the sample, for instance 3.0 GU difference measured on a very matt surface (perhaps SGU), would be seen by the human eye but on a higher gloss coating (perhaps 60 GU) the difference would be very difficult to notice. The only way that you can determine tolerances for your products would be experimentally, perhaps preparing printed samples at different gloss levels that you can show to end users of your coatings or internal "experts"
The other option is to change to a 20/60/85 degree instrument, the 85 degree glossmeter is more sensitive to differences in gloss below 10 GU @ 600 and the 20 Degrees has higher resolution on high gloss coatings (above 70 GU @ 60°). The advantage of using the three angles is that there is more equality to the gloss differences, in our experience a gloss difference of 5 GU, when measured with the correct geometry is just visible to a trained observer.

3) Why measure gloss?

Gloss is an aspect of the visual perception of objects that is as important as colour when considering the psychological impact of products on a consumerI has been defined as the attribute of surfaces that causes them to have shiny or lustrous, metallic appearance.

The gloss of a surface can be greatly influenced by a number of factors, for example the smoothness achieved during polishing, the amount and type of coating applied or the quality of the substrate. Manufacturers design their products to have maximum appeal- highly reflective car body panels, gloss magazine covers or satin black designer furniture.

It is important therefore that gloss levels are achieved consistently on every product or across different batches of products. Gloss can also be a measure of quality of a surface, for Instance a drop in the gloss of a coated surface may indicate problems with its cure- leading to other failures such as poor adhesion or lack of protection for the coated surface.

It is for these reasons that many manufacturing industries monitor the gloss of their products, from cars, printing and furniture to food, pharmaceuticals and consumer electronics.

4) How is gloss measured?

Gloss is measured by shining a known amount of light at a surface and quantifying the reflectance. The angle of the light and the method by which the reflectance is measured are determined by the surface. Gloss is determined using a **Gloss Meter** which directs a light at a specific angle to the test surface and simultaneously measures the amount of reflection. The type of surface to be measured determines the gloss meter angle to be used and thus the gloss meter model. The intensity is dependent on the material and the angle of illumination.h case of nonmetals {coatings, plastics) the amount of reflected light increases with the increase of the illumination angle. The remaining illuminated light penetrates the material and is absorbed or diffusely scattered dependent on the color.

Gloss Meter

A glossmeter measures specular reflection. The light intensity is registered over a small range of a pre-defined reflection angle. The intensity is dependent on the material and the angle of illumJnation. n case of nonmetals {coatings, plastics) the amount of reflected light increases with the Increase of the illumination angle. The remaining illuminated light penetrates the material and is absorbed or diffusely scattered dependent on the color. Metals have a much higher reflection and are less angle dependent than non metals.

Metals have a much higher reflection and are less angle dependent than non metals. The measurement results of a glossmeter are related to the amount of reflected light from a black glass standard with a defined refractive index, and not to the amount of Incident light. The measurement value for this defined standard is equal to 100 gloss units.

Materials with a higher refractive index can have a measurement value above 100 gloss units {GU), e.g. films. n case of transparent materials the measurement value can be increased due to multiple reflectlons in the bulk of the material. Due to the high reflection capabilities of metals values of up to 2000 GU can be reached. For these applications it is common to document the measurement results in % reflection of the illuminated light. Gfossmeters and their handling procedures had to be internationally specified to allow comparison of measurement values. The angle of illumination is of high influence. n order to obtain a clear differentiation over the complete measurement range from high gloss to matte, 3 different geometries, i.e. 3 different ranges, were defined using a 60° gloss meter.

Gloss Type	Gloss Range	**Measure with**
Semi Gloss	10 to 70	60° geon1etry
High Gloss	> 70	20° geometry
Low Gloss	< 10	85° geometry

h addition, there are industry specific applications for 45° and 75° measurement geometry. n this case study, 13 samples were visually ranked from matte to high gloss and measured with the 3 specified geometries. h the steep slopes of the curves the differences between the samples can be clearly measured, while in the flat part the measurement geometry no longer correlates with the visual. Gloss measurement for any application, whether you are dealing with specific applications or need a universal solution from high luster to a matte gloss sample or a small curved surface, mbotec can help through their knowledge and complete line of solutions:

Continue to Gloss Meter Selection Guide **For a Novo Gloss Meter CLICK HERE**

For a Byk Gardner Gloss Meter CLICK HERE

u.s. Prices on Novo Gloss **u.s. Prices on Byk Gardner**

Industry:

- Food
- Plastics
- Pulp and Paoer
- Coated Glass
- Printer. Prepress. Photo
- Textile
- Paint
- Cosmetics
- Automotive
- Pharmaceutical
- Ad Agenqy
- Woodworking. Wood
- Architects
- Wood Flooring

PS Lip Touchpoint Study
#68325-106

Summary on Lip Finishes and Gloss Values

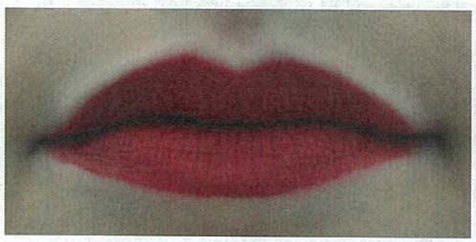
Prepared on January 13, 2016

Objective: As part of an Exploratory Study, the team also wishes to translate consumer language (matte, shiny, satin) into technical gloss measurement.

Summary

- When shown pictures, in a randomized order, women were able to distinguish between various finishes.
  - Women selected the (UC Matte HER with Gloss Value 0-10) image as "matte" most often.
  - Women selected the (Color Precise with gloss value 60-70) image as "satin" most often.
  - Women selected the Image (UCMatte + Lip Gloss 80+) image as "shiny" most often.

Most Matte

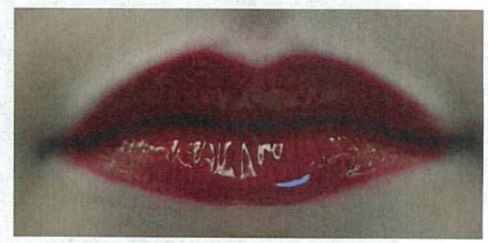


Gloss Value 0-10

Most Satin

Gloss Value 60-70

Shiny



Gloss Value 80+

RESEARCH DETAILS

Methodology

- Lipstick Category survey study

Survey Coverage/Sample Size

- US (N=100), Brazil (N=101), Russia (N=103), China (N=110)

Sample Definition

- Women 18 to 64 yrs. old who use multiple lip products (including lipstick) at least occasionally

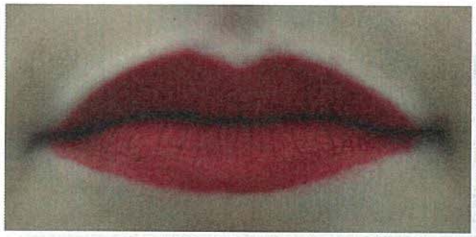
Questionnaire Flow

- Screening ➡ Main Questionnaire ➡ Socio Demo

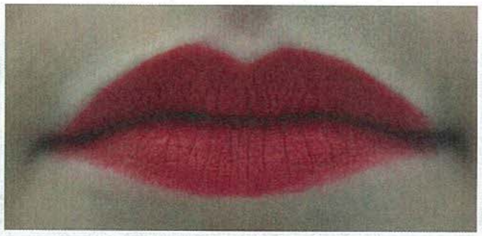
Field Date

- September 19 to September 26, 2013

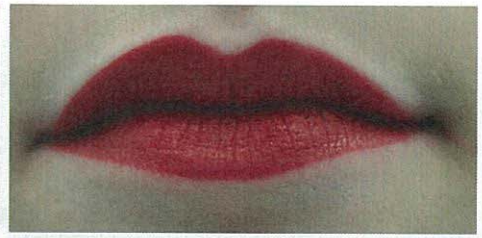
STIMULI



UCMatte_EHR
Prototype Red
(Gloss Value 0-10)



SMASHBOX
Infared Matte
(Gloss value 10-20)

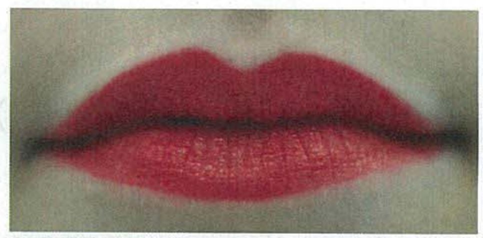


Extralasting
Eternal Flame
(Gloss Value 30-40)

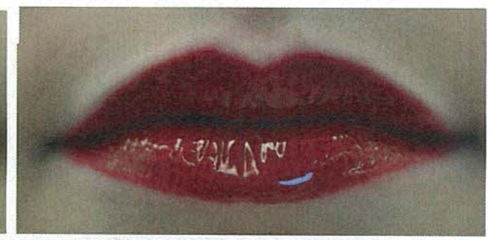
UC MATTE
Matte Garnet
(Gloss Value 40-50)

Ultra Color Rich
RED RULES MATTE
(Gloss Value 50-60)

COLOR PRECISE
Just Right Red
(Gloss value 60-70)



Ultra Color Rich
RED2000Satin
(Gloss Value 70-80)



UCMatte + Gloss
Prototype Red + gloss
(Gloss Value 80+)

Pictures were coded and presented in a randomized order.

Results

Type of "finish" Considered Matte (%)

Consumers selected the (UC Matte HER with Gloss Value 0-10) image as "matte" most often.

Type of "finish" Considered Matte (%)						
		Total (N=400)	USA (N=100) [A]	Brazil (N=100) [B]	Russia (N=100) [C]	China (N=100) [D]
(0-10) [E]		67	57 HJKMN	AcD 86 HJKMN	76 AD fgHJKMN	47 GHJKMN
(50-60) [F]		51	45 HJKMN	65 ADHJKMN	55 DHJKMN	37 gHJKMN
(10-20) [G]		49	45 D HJKMN	72 ACD HJKMN	55 DHJKMN	25 KmN
(30-40) [H]		18	19 MN	15 MN	15 jKMN	23 kN
(40-50) [J]		15	17 CN	16 CMN	7 N	18 CN
(70-80) [K]		10	11 c	14 CMN	4 N	12 C
(60-70) [M]		7	9 bc	3	3 n	14 BCn
(80+) [N]		4	7 C	3 c	0	6 C

Q10. Looking at the same images you just saw, which do you consider to be matte? Please select all that apply.
Base: Total Respondents

A / a = Difference across regions. Significantly greater than corresponding column at 95% / 90% confidence level
E / e = Difference among finishes. Significantly greater than corresponding row at 95% / 90% confidence

AVON

Type of "finish" Considered Satin (%)

Consumers selected the (Color Precise with gloss value 60-70) image as "satin" most often.

Type of "finish" Considered Satin (%)

		Total (N=400)	USA (N=100) [A]	Brazil (N=100) [B]	Russia (N=100) [C]	China (N=100) [D]
(60-70) [E]		42	39 hJKMN	55 ACD GHJKMN	38 HjKMN	35 GHKMN
(70-80) [F]		35	28kMN	48 ADJKMN	37 HjKMN	27 HKMN
(40-50) [G]		27	28d kMN	35DJKMN	28 dKMN	17kN
(30-40) [H]		23	25DMN	39 ACD JKMN	19dKMN	10n
(80+) [J]		20	22BMN	6	24BKMN	27 BHKMN
(50-60) [K]		11	17cdn	12	8	8
(10-20) [M]		9	10	7	9	11n
(0-10) [N]		6	8	7	6	4

Q11. Which lips do you consider to be satin? Please select all that apply.
Base: Total Respondents

A / a = Difference across regions. Significantly greater than corresponding column at 95% / 90% confidence level
E / e = Difference among finishes. Significantly greater than corresponding row at 95% / 90% confidence

AVON

Type of "Finish" Considered Shiny (%)

Consumers selected the Image (UCMatte + Lip Gloss <u>80+</u>) image as "shiny" most often.

Type of "finish" Considered Shiny (%)						
		Total (N=400)	USA (N=100) [A]	Brazil (N=100) [B]	Russia (N=100) [C]	China (N=100) [D]
(80+)		89	D 96	D 96	D 93	71
(60-70)		26	15	30 A	31 A	28 A
(70-80)		9	7	8	10	12
(40-50)		5	3	6	7	4
(30-40)		4	3	5	6	3
(10-20)		2	0	0	1	5 ABc
(50-60)		1	0	1	0	3 ac
(0-10)		1	1	0	0	2

Q12. Now, which lips do you consider to be shiny? Please select all that apply.
Base: Total Respondents

A / a = Difference across regions. Significantly greater than corresponding column at 95% / 90% confidence level
E / e = Difference among finishes. Significantly greater than corresponding row at 95% / 90% confidence