NATIONAL BUREAU OF STANDARDS REPORT

4953

SPECTROPHOTOMETRIC AND COLORIMETRIC
STUDY OF COLOR TRANSPARENCIES
OF SOME MAN - MADE OBJECTS

By

Harry J. Keegan,

John C. Schleter,

Gladys M. Haas,

and

Wiley A. Hall, Jr.

To

U. S. Department of the Air Force
Aerial Reconnaissance Laboratory
Wright Air Development Center
Wright-Patterson Air Force Base, Ohio

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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Harry J. Keegan,
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Photometry and Colorimetry Section
Optics and Metrology Division

To

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PREFACE

This is one of a series of NBS reports of spectrophotometric and colorimetric work done under NBS Project 0201-20-2325 entitled Color Reconnaissance Studies, financed by the Aerial Reconnaissance Laboratory, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, under Air Force Contract No. AF 33(616) 52-21. It was coordinated with Air Force Contract No. AF 33(616)-262 under Dr. Hugh T. O'Neill, O'Neill Associates, Annapolis, Maryland. The present report resulted from several requests for spectrophotometric and colorimetric tests of color transparencies of some man-made objects.

Harry J. Keegan
Project Leader

SPECTROPHOTOMETRIC AND COLORIMETRIC STUDY OF COLOR TRANSPARENCIES OF SOME MAN - MADE OBJECTS

Harry J. Keegan, John C. Schleter, Gladys M. Haas*, and Wiley A. Hall, Jr.

Abstract

The effects that a few man-made reflecting objects have upon the various emulsion layers that comprise color positive photographic films, when these films are exposed to the objects, are described. Spectral transmittance measurements and colorimetric computations are made and reported on these effects as well as spectral directional reflectance measurements and colorimetric computations for the objects; namely a U. S. Army shirt and several dyed papers and cardboards. The spectrophotometric data are reported for these materials, their color transparencies, a number of other transmitting and reflecting materials, and some color transparencies of other objects, together with the C.I.E. chromaticity coordinates, Munsell renotations, daylight reflectances or daylight transmittances, ISCC-NBS color designations, and Lovibond notations. Color differences between a few of these reflecting materials and their corresponding color transparencies are also discussed.

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* Miss Haas is at present employed at the Mare Island Naval Shipyard, San Francisco, California.

Contents

I. Introduction

The overall objective of this Air Force investigation is stated as follows: "To develop by visible, near infrared, and near ultraviolet spectrophotometry, methods for the detection of objects from color reconnaissance; to study the colors, tonal contrast, and color separation necessary in aerial photography to yield maximum information; to determine the wavelength region at which the film manufacturer should strive to obtain maximum sensitivity to yield clear separation of an object from its adjacent area rather than to yield true color fidelity; to determine the characteristics required in a sensitized material for the rapid and accurate extraction of this information".

This particular report pertains to the spectral transmissive and colorimetric properties of sixty-six color transparencies on one-, two-, and three-emulsion color positive films of eight reflecting man-made objects (seven papers and one textile) which are considered representative of objects that may be seen in ground or aerial photographs. These are some of the films reported by O'Neill [1, 2].*

Also included in this report are the visible and near infrared spectral directional reflectances of twenty-one man-made objects; such as, U. S. military wearing apparel and painted pressboard samples; the visible spectral transmittance of forty-three dyed gelatine films; the visible spectral directional reflectance of thirty-four Munsell papers and of five of the seven dyed papers; and visible visual spectral transmittance of twenty-seven color transparencies of three sets of light sources [3].

From the visible spectrophotometric measurements (400 to 750 millimicrons) of all of these one hundred and ninety-six samples, computations of C.I.E. chromaticity coordinates and daylight reflectances or daylight transmittances are tabulated and illustrated for C.I.E. Source C. Munsell renotations and Lovibond notations (for transmitting materials only) are reported and illustrated for the reported samples. Color differences are reported and illustrated only for those reflecting materials that have been measured and photographed for this report.

The method of measurement and computation is that requested in the original project proposal and used in seven previous reports of this project [4 - 10]. The last report (NBS Report 4794) dealt in the same manner as the present report with photographs of natural objects on the same types of color films.

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* Numbers in brackets refer to the bibliography on page 159 of this report.

II. Material

All of the materials of this report were furnished by Dr. Hugh T. O'Neill, O'Neill Associates, Annapolis, Maryland. The reflecting materials, dyed papers and cardboard, U. S. military wearing apparel, painted pressboards and Munsell papers (Tobey Press) were selected, prepared, or purchased by him, brought to the NBS, and measured on the dates indicated in the Index to Appendix D of this report, and listed in Table I together with a "sample number" in parentheses to identify the materials in this report.

The transparent materials of this report are classed in two parts:- Part 1. The transmitting materials consisting of processed, unexposed, films of various emulsion layers; of dye-on-film base samples; and color compensating filters; and Part 2. Color transparencies of dyed papers and cardboards, a U. S. Army shirt, and several lamp sources. When received from Dr. O'Neill, the films had been processed and numbered. Accompanying the color transparencies was a notebook containing information on them; such as, exposure number, kind of Ansco film, identification of the object, Weston lightmeter reading, aperture, shutter speed, date of photography, and occasional notes. The pertinent parts of this information are included in Table I of this report, together with a "sample number" in parentheses which will be used to identify these materials whenever they are used either in the text, the tables, or the figures.

According to Dr. O'Neill, the types of films used to photograph the man-made objects were the same as those used to photograph the natural objects of NBS Report 4794, as follows: (1) three one-color, one-emulsion films (red, green, and blue sensitive emulsions used in Ansco Daylight Color); (2) three two-color, two-emulsion films (red and green, green and blue, and blue and red sensitive emulsions used in Ansco Daylight Color); and (3) one three-color, three-emulsion film (Ansco Daylight Color). No three-color, three-emulsion, color negative film was used to photograph the samples of this report.

In this report, these films will be identified as follows: RGB (Ansco Daylight Color), RG (red and green sensitive emulsions used in Ansco Daylight Color), GB (green and blue sensitive emulsions used in Ansco Daylight Color), BR (blue and red sensitive emulsions used in Ansco Daylight Color), R (red sensitive emulsion used in Ansco Daylight Color), G (green sensitive emulsion used in Ansco Daylight Color), B (blue sensitive emulsion used in Ansco Daylight Color). The processed unexposed films also consisted of all of these films. The dye-on-film base samples consisted of the red, green, and blue sensitive films only.

These films were used to photograph seven dyed papers and cardboards, one U. S. Army winter shirt, and three lamp sources. Nearly all (seventy-nine) of the photographs were made with Ansco Daylight Color film but with different shutter speed, aperture setting, or both. Four photographs of two railroad boards were made on green and blue sensitive film. Six photographs of the Army shirt were made on red and green sensitive film, two on green and blue sensitive film, and two on blue sensitive film.

In Dr. O'Neill's report [2], five other films were stated to have been used on other objects, but they were not used in the study of man-made objects of this report. These were: "Magenta layer (color negative)", "Cyan layer (color negative)", "D-342 Special 2-layer film 10", "Ansco Tungsten (3-layer) factor 14", and "Three-layer, three-color film (Anscochrome)".

Table I. Identification of Man-Made Objects and Color Transparencies of some Man-Made Objects.

IA. Transmitting man-made objects.

Sample Number	Exposure Number	Description	Shutter Speed (seconds)	Aperture	Film	Date Taken
		Processed Unexposed Film				
(1)	W-126	Processed Unexposed Film	---	---	RGB	7-24-53
(2)	W-125	Processed Unexposed Film	---	---	RG	7-24-53
(3)	W-130	Processed Unexposed Film	---	---	GB	7-24-53
(4)	W-124	Processed Unexposed Film	---	---	BR	7-24-53
(5)	W-129	Processed Unexposed Film	---	---	R	7-24-53
(6)	W-128	Processed Unexposed Film	---	---	G	7-24-53
(7)	W-127	Processed Unexposed Film	---	---	B	7-24-53
		Dye on Film Base				
(8)	---	Cyan Dye on Film Base	---	---	R	---
(9)	---	Magenta Dye on Film Base	---	---	G	---
(10)	---	Yellow Dye on Film Base	---	---	B	---
(11)	---	Yellow Dye on Film Base	---	---	B	---
		Color Compensating Filters				
(12)	---	Ansco Color Compensating Filter, UV-16P, Yellow	---	---	---	---
(13)	---	Ansco Color Compensating Filter, 23, Yellow	---	---	---	---
(14)	---	Ansco Color Compensating Filter, 24, Yellow	---	---	---	---
(15)	---	Ansco Color Compensating Filter, 25, Yellow	---	---	---	---
(16)	---	Ansco Color Compensating Filter, 26, Yellow	---	---	---	---
(17)	---	Ansco Color Compensating Filter, 33, Magenta	---	---	---	---
(18)	---	Ansco Color Compensating Filter, 34, Magenta	---	---	---	---
(19)	---	Ansco Color Compensating Filter, 35, Magenta	---	---	---	---
(20)	---	Ansco Color Compensating Filter, 43, Cyan	---	---	---	---
(21)	---	Ansco Color Compensating Filter, 44, Cyan	---	---	---	---
(22)	---	Ansco Color Compensating Filter, 45, Cyan	---	---	---	---
(23)	---	Ansco Color Compensating Filter, .025Y, Yellow	---	---	---	---

Table I (Continued)

Sample Number	Exposure Number	Description	Shutter Speed (seconds)	Aperture	Film	Date Taken
(24)	--	Ansco Color Compensating Filter, .05Y, Yellow	---	---	---	---
(25)	--	Ansco Color Compensating Filter, .10Y, Yellow	---	---	---	---
(26)	--	Ansco Color Compensating Filter, .20Y, Yellow	---	---	---	---
(27)	--	Ansco Color Compensating Filter, .30Y, Yellow	---	---	---	---
(28)	--	Ansco Color Compensating Filter, .40Y, Yellow	---	---	---	---
(29)	--	Ansco Color Compensating Filter, .50Y, Yellow	---	---	---	---
(30)	--	Ansco Color Compensating Filter, .025M, Magenta	---	---	---	---
(31)	--	Ansco Color Compensating Filter, .05M, Magenta	---	---	---	---
(32)	--	Ansco Color Compensating Filter, .10M, Magenta	---	---	---	---
(33)	--	Ansco Color Compensating Filter, .20M, Magenta	---	---	---	---
(34)	--	Ansco Color Compensating Filter, .30M, Magenta	---	---	---	---
(35)	--	Ansco Color Compensating Filter, .40M, Magenta	---	---	---	---
(36)	--	Ansco Color Compensating Filter, .50M, Magenta	---	---	---	---
(37)	--	Ansco Color Compensating Filter, .025C, Cyan	---	---	---	---
(38)	--	Ansco Color Compensating Filter, .05C, Cyan	---	---	---	---
(39)	--	Ansco Color Compensating Filter, .10C, Cyan	---	---	---	---
(40)	--	Ansco Color Compensating Filter, .20C, Cyan	---	---	---	---
(41)	--	Ansco Color Compensating Filter, .30C, Cyan	---	---	---	---
(42)	--	Ansco Color Compensating Filter, .40C, Cyan	---	---	---	---
(43)	--	Ansco Color Compensating Filter, .50C, Cyan	---	---	---	---

Table I (Continued)

IB. Reflecting man-made objects.

Sample Number	Exposure Number	Description	Shutter Speed (seconds)	Aperture	Film	Date Taken
		Dyed Papers and Cardboards				
(44)	--	Mimeo Bond Paper, Orange	---	---	---	---
(45)	--	Onion Skin Paper, Blue	---	---	---	---
(46)	--	Onion Skin Paper, Canary Yellow	---	---	---	---
(47)	--	Onion Skin Paper, Pink	---	---	---	---
(48)	--	Railroad Board, Red	---	---	---	---
		U. S. Military Wearing Apparel				
(49)	--	Khaki #1 (cotton) from Army Shade Book Serial No. 5045 at NBS	---	---	---	---
(50)	--	Olive Drab #52 (wool) from Army Shade Book Serial No. 5045 at NBS	---	---	---	---
(51)	--	US Marine Corps Necktie	---	---	---	---
(52)	--	US Marine Corps Overseas Cap (summer)	---	---	---	---
(53)	--	US Marine Corps Pants (summer)	---	---	---	---
(54)	--	US Marine Corps Shirt (summer)	---	---	---	---
(55)	--	US Army Shirt (winter)	---	---	---	---
(56)	--	US Army Eisenhower Jacket (winter)	---	---	---	---
(57)	--	US Marine Corps Overseas Cap (winter)	---	---	---	---
(58)	--	US Marine Corps Blouse (winter)	---	---	---	---
(59)	--	US Marine Corps Pants (winter)	---	---	---	---
(60)	--	US Marine Corps Fatigue Cap	---	---	---	---
(61)	--	US Marine Corps Fatigue Shirt	---	---	---	---
(62)	--	US Marine Corps Fatigue Pants	---	---	---	---
		Painted Pressboard Targets				
(63)	--	Chinese Red #6335 Chi-namel Paint, Chi-namel Paint and Varnish Co.	---	---	---	---
(64)	--	Colony Yellow #317 House Paint, Lowe Brothers	---	---	---	---
(65)	--	Green #173 Tractor Paint, Lowe Brothers	---	---	---	---
(66)	--	Red #139 Tractor Paint, Lowe Brothers	---	---	---	---
(67)	--	Royal Blue Permanent Trim Paint, John W. Masury & Son	---	---	---	---
(68)	--	Seal Brown Supreme House Paint, John W. Masury & Son	---	---	---	---
(69)	--	Verdi Green #6830 Super House Paint, Chi-namel Paint and Varnish Co.	---	---	---	---

Table I (Continued)

Sample Number	Exposure Number	Description	Shutter Speed (seconds)	Aperture	Film	Date Taken
		Munsell Papers (Tobey Press)				
(70)	--	Munsell 5YR 6/12 (Tobey Press)	---	---	---	---
(71)	--	Munsell 5Y 8/12 (Tobey Press)	---	---	---	---
(72)	--	Munsell 5GY 7/10 (Tobey Press)	---	---	---	---
(73)	--	Munsell 5G 5/8 (Tobey Press)	---	---	---	---
(74)	--	Munsell 5BG 4/6 (Tobey Press)	---	---	---	---
(75)	--	Munsell 5B 4/8 (Tobey Press)	---	---	---	---
(76)	--	Munsell 5PB 3/12 (Tobey Press)	---	---	---	---
(77)	--	Munsell 5P 4/12 (Tobey Press)	---	---	---	---
(78)	--	Munsell 5RP 4/12 (Tobey Press)	---	---	---	---
(79)	--	Munsell 5R 4/14 (Tobey Press)	---	---	---	---
(80)	--	Munsell 5R 4/12 (Tobey Press)	---	---	---	---
(81)	--	Munsell 5R 4/10 (Tobey Press)	---	---	---	---
(82)	--	Munsell 5R 4/8 (Tobey Press)	---	---	---	---
(83)	--	Munsell 5R 4/6 (Tobey Press)	---	---	---	---
(84)	--	Munsell 5R 4/4 (Tobey Press)	---	---	---	---
(85)	--	Munsell 5R 4/2 (Tobey Press)	---	---	---	---
(86)	--	Munsell N 9.5/ (Tobey Press)	---	---	---	---
(87)	--	Munsell N 9/ (Tobey Press)	---	---	---	---
(88)	--	Munsell N 8.5/ (Tobey Press)	---	---	---	---
(89)	--	Munsell N 8/ (Tobey Press)	---	---	---	---
(90)	--	Munsell N 7.5/ (Tobey Press)	---	---	---	---
(91)	--	Munsell N 7/ (Tobey Press)	---	---	---	---
(92)	--	Munsell N 6.5/ (Tobey Press)	---	---	---	---
(93)	--	Munsell N 6/ (Tobey Press)	---	---	---	---
(94)	--	Munsell N 5.5/ (Tobey Press)	---	---	---	---
(95)	--	Munsell N 5/ (Tobey Press)	---	---	---	---
(96)	--	Munsell N 4.5/ (Tobey Press)	---	---	---	---
(97)	--	Munsell N 4/ (Tobey Press)	---	---	---	---
(98)	--	Munsell N 3.5/ (Tobey Press)	---	---	---	---
(99)	--	Munsell N 3/ (Tobey Press)	---	---	---	---
(100)	--	Munsell N 2.5/ (Tobey Press)	---	---	---	---
(101)	--	Munsell N 2/ (Tobey Press)	---	---	---	---
(102)	--	Munsell N 1.5/ (Tobey Press)	---	---	---	---
(103)	--	Munsell N 1/ (Tobey Press)	---	---	---	---

Table I (Continued)

IC. Color transparencies of man-made objects.

Sample Number	Exposure Number	Description	Shutter Speed (seconds)	Aperture	Film	Date Taken
		Photographs of Dyed Papers and Cardboard				
(104)	26	Mimeo Bond Paper, Orange Under Exposure	1/400	f/8	RGB	10-13-52
(105)	19	Mimeo Bond Paper, Orange Normal Exposure	1/100	f/8	RGB	10-13-52
(106)	20	Mimeo Bond Paper, Orange Over Exposure	1/50	f/8	RGB	10-13-52
(107)	21	Mimeo Bond Paper, Orange Over Exposure	1/25	f/8	RGB	10-13-52
(108)	22	Mimeo Bond Paper, Orange Over Exposure	1/10	f/8	RGB	10-13-52
(109)	23	Mimeo Bond Paper, Orange Over Exposure	1/5	f/8	RGB	10-13-52
(110)	24	Mimeo Bond Paper, Orange Over Exposure	1/2	f/8	RGB	10-13-52
(111)	25	Mimeo Bond Paper, Orange Over Exposure	1	f/8	RGB	10-13-52
(112)	27	Mimeo Bond Paper, Orange Over Exposure	2	f/8	RGB	10-13-52
(113)	44	Onion Skin Paper, Blue, Under Exposure	1/800	f/8	RGB	10-13-52
(114)	37	Onion Skin Paper, Blue, Normal Exposure	1/200	f/8	RGB	10-13-52
(115)	38	Onion Skin Paper, Blue, Over Exposure	1/100	f/8	RGB	10-13-52
(116)	39	Onion Skin Paper, Blue, Over Exposure	1/50	f/8	RGB	10-13-52
(117)	40	Onion Skin Paper, Blue, Over Exposure	1/25	f/8	RGB	10-13-52
(118)	41	Onion Skin Paper, Blue, Over Exposure	1/10	f/8	RGB	10-13-52
(119)	42	Onion Skin Paper, Blue, Over Exposure	1/5	f/8	RGB	10-13-52
(120)	43	Onion Skin Paper, Blue, Over Exposure	1/2	f/8	RGB	10-13-52
(121)	45	Onion Skin Paper, Blue, Over Exposure	1	f/8	RGB	10-13-52
(122)	35	Onion Skin Paper, Canary Yellow, Under Exposure	1/800	f/8	RGB	10-13-52
(123)	28	Onion Skin Paper, Canary Yellow, Normal Exposure	1/200	f/8	RGB	10-13-52
(124)	29	Onion Skin Paper, Canary Yellow, Over Exposure	1/100	f/8	RGB	10-13-52
(125)	30	Onion Skin Paper, Canary Yellow, Over Exposure	1/50	f/8	RGB	10-13-52
(126)	31	Onion Skin Paper, Canary Yellow, Over Exposure	1/25	f/8	RGB	10-13-52
(127)	32	Onion Skin Paper, Canary Yellow, Over Exposure	1/10	f/8	RGB	10-13-52
(128)	33	Onion Skin Paper, Canary Yellow, Over Exposure	1/5	f/8	RGB	10-13-52

Table I (Continued)

Sample Number	Exposure Number	Description	Shutter Speed (seconds)	Aperture	Film	Date Taken
(129)	34	Onion Skin Paper, Canary Yellow, Over Exposure	1/2	f/8	RGB	10-13-52
(130)	36	Onion Skin Paper, Canary Yellow, Over Exposure	1	f/8	RGB	10-13-52
(131)	17	Onion Skin Paper, Pink, Under Exposure	1/800	f/8	RGB	10-13-52
(132)	10	Onion Skin Paper, Pink, Normal Exposure	1/200	f/8	RGB	10-13-52
(133)	11	Onion Skin Paper, Pink, Over Exposure	1/100	f/8	RGB	10-13-52
(134)	12	Onion Skin Paper, Pink, Over Exposure	1/50	f/8	RGB	10-13-52
(135)	13	Onion Skin Paper, Pink, Over Exposure	1/25	f/8	RGB	10-13-52
(136)	14	Onion Skin Paper, Pink, Over Exposure	1/10	f/8	RGB	10-13-52
(137)	15	Onion Skin Paper, Pink, Over Exposure	1/5	f/8	RGB	10-13-52
(138)	16	Onion Skin Paper, Pink, Over Exposure	1/2	f/8	RGB	10-13-52
(139)	18	Onion Skin Paper, Pink, Over Exposure	1	f/8	RGB	10-13-52
(140)	8	Railroad Board, Red, Under Exposure	1/400	f/8	RGB	10-13-52
(141)	1	Railroad Board, Red, Normal Exposure	1/100	f/8	RGB	10-13-52
(142)	2	Railroad Board, Red, Over Exposure	1/50	f/8	RGB	10-13-52
(143)	3	Railroad Board, Red, Over Exposure	1/25	f/8	RGB	10-13-52
(144)	4	Railroad Board, Red, Over Exposure	1/10	f/8	RGB	10-13-52
(145)	5	Railroad Board, Red, Over Exposure	1/5	f/8	RGB	10-13-52
(146)	6	Railroad Board, Red, Over Exposure	1/2	f/8	RGB	10-13-52
(147)	7	Railroad Board, Red, Over Exposure	1	f/8	RGB	10-13-52
(148)	9	Railroad Board, Red, Over Exposure	2	f/8	RGB	10-13-52
(149)	W-132	Railroad Board, Blue, Normal Exposure	1/200	f/5.6	GB	7- 2-53
(150)	W-133	Railroad Board, Blue, Over Exposure	1/200	f/4	GB	7- 2-53
(151)	W-134	Railroad Board, Tuscan, Normal Exposure	1/200	f/16	GB	7- 2-53
(152)	W-135	Railroad Board, Tuscan, Over Exposure	1/200	f/8	GB	7- 2-53
		Photographs of U.S. Army Shirt				
(153)	W-141	Olive Drab Army Shirt Normal Exposure	1/50	f/5.6	GB	7- 2-53
(154)	W-142	Olive Drab Army Shirt Over Exposure	1/50	f/4	GB	7- 2-53
(155)	W-171	Olive Drab Army Shirt Normal Exposure	1/100	f/11	RG	7- 3-53
(156)	W-172	Olive Drab Army Shirt Over Exposure	1/100	f/5.6	RG	7- 3-53

Table I (Continued)

Sample Number	Exposure Number	Description	Shutter Speed (seconds)	Aperture	Film	Date Taken
(157)	W-173	Olive Drab Army Shirt, Over Exposure	1/100	f/4	RG	7- 3-53
(158)	W-198	Olive Drab Army Shirt, Under Exposure	1/200	f/11	RG	7- 3-53
(159)	W-199	Olive Drab Army Shirt, Normal Exposure	1/200	f/5.6	RG	7- 3-53
(160)	W-200	Olive Drab Army Shirt, Over Exposure	1/200	f/4	RG	7- 3-53
(161)	W-291	Olive Drab Army Shirt, No Filter Normal Exposure	1/50	f/11	RGB	7- 3-53
(162)	W-292	Olive Drab Army Shirt, Red Filter	1/50	f/2.8	RGB	7- 3-53
(163)	W-293	Olive Drab Army Shirt, Yellow Filter	1/50	f/8	RGB	7- 3-53
(164)	W-294	Olive Drab Army Shirt, Green Filter	1/100	f/2.8	RGB	7- 3-53
(165)	W-295	Olive Drab Army Shirt, Blue Filter	1/50	f/2.8	RGB	7- 3-53
(166)	W-296	Olive Drab Army Shirt, No Filter Over Exposure	1/50	f/8	RGB	7- 3-53
(167)	W-297	Olive Drab Army Shirt, No Filter Over Exposure	1/50	f/5.6	RGB	7- 3-53
(168)	W-430	Olive Drab Army Shirt, Normal Exposure	1/50	f/11	B	7-11-53
(169)	W-431	Olive Drab Army Shirt, Over Exposure	1/50	f/5.6	B	7-11-53
		Photographs of Lamp Sources				
(170)	W-1862	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Under Exposure	1/50	f/22	RGB	3- 5-54
(171)	W-1861	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Under Exposure	1/25	f/22	RGB	3- 5-54
(172)	W-1858	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Normal Exposure	1/25	f/16	RGB	3- 5-54
(173)	W-1859	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Over Exposure	1/25	f/11	RGB	3- 5-54
(174)	W-1860	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Over Exposure	1/25	f/8	RGB	3- 5-54
(175)	W-1865	Light Table, 19 Fluorescent Lamps, 6-1/2 Inch Working Distance, 40 mm Extension Tube, Under Exposure	1/25	f/14	RGB	3- 5-54
(176)	W-1863	Light Table, 19 Fluorescent Lamps, 6-1/2 Inch Working Distance, 40 mm Extension Tube, Normal Exposure	1/25	f/10	RGB	3- 5-54
(177)	W-1864	Light Table, 19 Fluorescent Lamps, 6-1/2 Inch Working Distance, 40 mm Extension Tube, Over Exposure	1/10	f/11	RGB	3- 5-54
(178)	W-1866	Light Table, 19 Fluorescent Lamps, 4-1/2 Inch Working Distance, 80 mm Extension Tube, Normal Exposure	1/5	f/11	RGB	3- 5-54

Table I (Continued)

Sample Number	Exposure Number	Description	Shutter Speed (seconds)	Aperture	Film	Date Taken
(179)	W-1869	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats Out, Under Exposure	1/10	f/22	RGB	3- 5-54
(180)	W-1867	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats Out, Normal Exposure	1/5	f/22	RGB	3- 5-54
(181)	W-1868	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats Out, Over Exposure	1/2	f/22	RGB	3- 5-54
(182)	W-1870	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats 3/4 In, Normal Exposure	1	f/16	RGB	3- 5-54
(183)	W-1871	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats 1/2 In, Normal Exposure	1	f/22	RGB	3- 5-54
(184)	W-1872	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats 1/4 In, Normal Exposure	1/2	f/22	RGB	3- 5-54
(185)	W-1873	Light Table, 12 Lumiline Lamps, 6-1/2 Inch Working Distance, 40mm Extension Tube, All Rheostats Out, Under Exposure	1/25	f/11	RGB	3- 5-54
(186)	W-1874	Light Table, 12 Lumiline Lamps, 6-1/2 Inch Working Distance, 40mm Extension Tube, All Rheostats 3/4 In, Under Exposure	1	f/16	RGB	3- 5-54
(187)	W-1875	Light Table, 12 Lumiline Lamps, 6-1/2 Inch Working Distance, 40mm Extension Tube, All Rheostats 3/4 In, Normal Exposure	1	f/4	RGB	3- 5-54
(188)	W-1878	Light Table, Neon Lamp, 15 Inch Working Distance, No Extension Tube, Under Exposure	1/25	f/16	RGB	3- 5-54
(189)	W-1876	Light Table, Neon Lamp, 15 Inch Working Distance, No Extension Tube, Normal Exposure	1/25	f/11	RGB	3- 5-54
(190)	W-1877	Light Table, Neon Lamp, 15 Inch Working Distance, No Extension Tube, Over Exposure	1/25	f/5.6	RGB	3- 5-54

Table I (Continued)

Sample Number	Exposure Number	Description	Shutter Speed (seconds)	Aperture	Film	Date Taken
(191)	W-1881	Light Table, Neon Lamp, 6-1/2 Inch Working Distance, 40mm Extension Tube, Under Exposure	1/10	f/16	RGB	3- 5-54
(192)	W-1879	Light Table, Neon Lamp, 6-1/2 Inch Working Distance, 40mm Extension Tube, Normal Exposure	1/25	f/5.6	RGB	3- 5-54
(193)	W-1880	Light Table, Neon Lamp, 6-1/2 Inch Working Distance, 40mm Extension Tube, Over Exposure	1	f/16	RGB	3- 5-54
(194)	W-1884	Light Table, Neon Lamp, 4-1/2 Inch Working Distance, 80mm Extension Tube, Under Exposure	1	f/22	RGB	3- 5-54
(195)	W-1882	Light Table, Neon Lamp, 4-1/2 Inch Working Distance, 80mm Extension Tube, Normal Exposure	1	f/16	RGB	3- 5-54
(196)	W-1883	Light Table, Neon Lamp, 4-1/2 Inch Working Distance, 80mm Extension Tube, Over Exposure	1	f/8	RGB	3- 5-54

III. Preparation of Samples

The reflecting materials such as the dyed papers and cardboards, the U. S. military wearing apparel, the painted pressboards and the Munsell papers (Tobey Press) were placed against the integrating sphere of the spectrophotometer and held there with the usual spring fastener furnished with the instrument. The color transparencies could not be managed in this manner without additional precautions to hold the films accurately and firmly in place during the measurements.

As reported in NBS Report 4794, two devices were designed (JCS) and constructed for the measurement of the color transparencies. The first device illustrated in Figure 1 is used to assist in trimming the color transparencies to proper size for measurement. This rectangular transparent plastic box is described in the previous report. The second device, illustrated in Figure 2 * is used to hold the photograph firmly in place during the measurement. This holding device is also explained in the previous report. Placement data of the three directional indicator scales (H, V, and S) are shown in Appendix C of this report for the one hundred and thirty-six transparencies (including those that had been measured in the center of the sample).

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* This device was constructed in the machine shop of the NBS Photometry and Colorimetry Section by Mr. G. H. Limparis.

Figure 1. Suction device to hold color transparency accurately in place while being trimmed to 2-1/4 x 2-1/4 inch size required for sample holder.

- - - - -

Figure 2. Positioning device to hold photographic transparency firmly in place and to note accurately the three dimensional placement of the film during measurement. This is especially important for the measurement of a mottled sample.

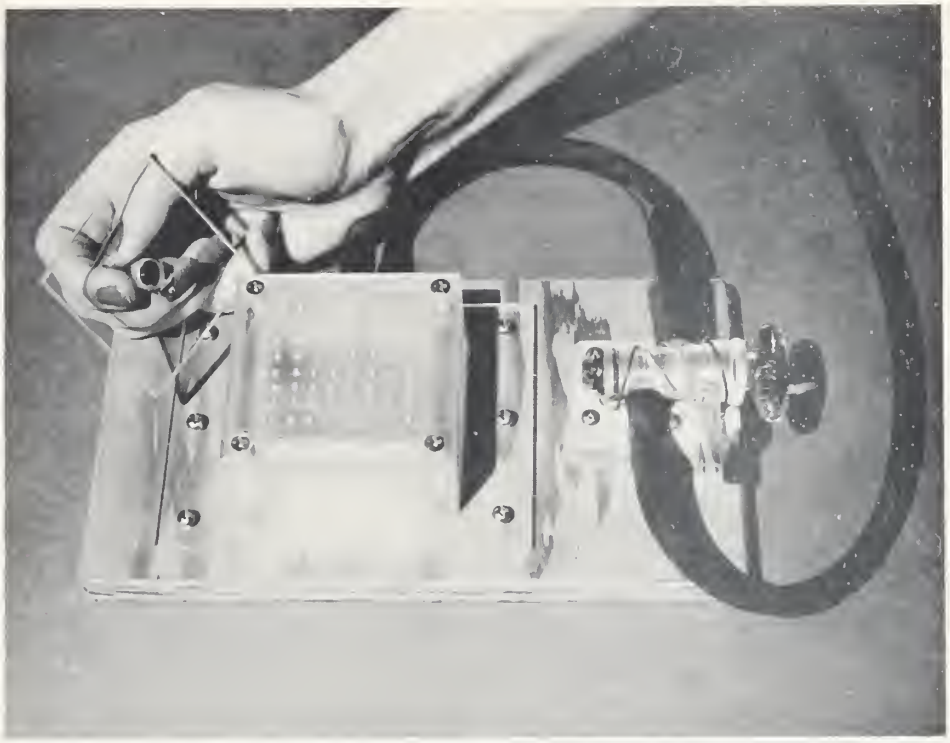

FIGURE 1

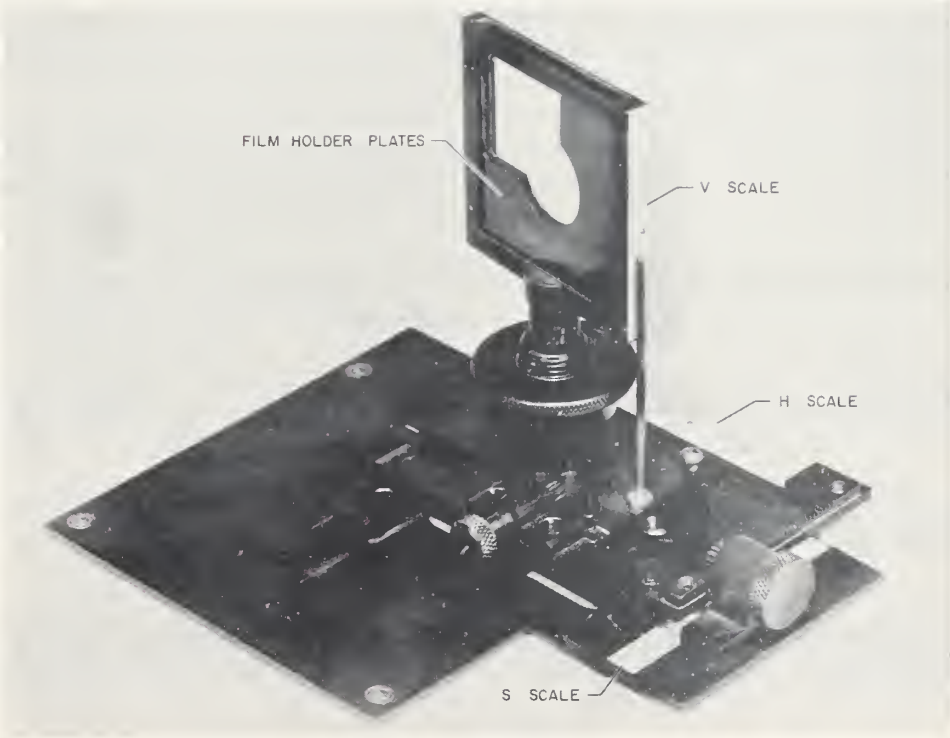

FIGURE 2

IV. Spectrophotometric Measurements

Measurements of spectral transmittance were made on the one hundred and thirty-six color transparencies, processed unexposed films, dye-on-film base samples, and color compensating filters on a General Electric recording spectrophotometer [11, 12] for the visible spectrum 400 to 750 millimicrons with slits approximating 10 millimicrons of spectral width.

The yellow dye-on-film base sample No. (10) was measured on the spectrophotometer described above. In addition, the same sample, designated as No. (11) was measured on a similar spectrophotometer having slits approximating 4 millimicrons of spectral width for the visible spectrum 400 to 750 millimicrons.

Similar measurements of spectral directional reflectance with included specular component were made on the same instrument of the dyed papers and cardboards and the Munsell pigmented papers (Tobey Press) for the same spectral region and slit width.

The U. S. military wearing apparel and the painted pressboard samples were measured on the same spectrophotometer with included specular component and slits of 10 millimicrons in the visible spectrum (400 to 750 millimicrons) and of 20 millimicrons in the near infrared spectrum (730 to 1080 millimicrons).

Except for the recording of the measurements on the spectral directional reflectance for the fourteen U. S. military wearing apparel samples and for the five of the dyed papers and cardboards and for the spectral transmittance measurements of the forty-five color transparencies of these dyed papers and cardboards, all of the recordings were made with calibration curves (didymium, zero, and either 100% curve for transmitting samples or Vitrolite curve for reflecting samples) for making wavelength and photometric scale corrections [13, 14].

All of the transmitting samples and the color transparencies were measured in their original single thicknesses.

The khaki and olive drab textiles were measured in three thicknesses. The U. S. Marine Corps tie, the mimeo bond paper, and the onion skin paper were measured in four thicknesses.

The rest of the military wearing apparel, the railroad board, the painted pressboards, and the Munsell papers (Tobey Press) were measured in single thickness.

All of the reflecting materials were held firmly in place against the integrating sphere of the instrument with a flat wooden block covered with black paper.

V. Spectrophotometric Results

The results of the spectrophotometric measurements of spectral transmittance or spectral directional reflectance are shown in this report on the thirty-nine Ozalid copies of the original recordings from the General Electric recording spectrophotometer. These Ozalid copies are a part of Appendix D of this report; thirty-four of them are for the visible spectrum, 400 to 750 millimicrons, and five of them for the near infrared spectrum, 730 to 1080 millimicrons.

These data were read or corrected as follows:- (1) Values of spectral transmittance were read and corrected at 10 millimicron intervals from 400 to 750 millimicrons for each of the forty-three determinations on the seven processed unexposed films, the four dye-on-film base samples, and the thirty-two color compensating filters. These forty-three sets of spectrophotometric data are listed in Appendix B of this report and are illustrated in Figures 3 to 9. (2) Values of spectral directional reflectance were read at 10 millimicron intervals from 400 to 750 millimicrons for five of the seven dyed papers and cardboards, and read and corrected for the same interval and wavelength region for the thirty-four Munsell paper (Tobey Press) samples. These thirty-nine sets of spectrophotometric data are listed in Appendix B of this report and are illustrated in Figures 10, and 17 to 19. (3) Visible and near infrared spectral directional reflectances were read at 10 millimicron intervals from 400 to 1080 millimicrons for the fourteen U. S. military wearing apparel samples and read and corrected for the same interval and wavelength region for the seven painted pressboard samples. These spectrophotometric data are listed in Appendix B of this report and are illustrated in Figures 11 to 16. (4) Values of spectral transmittance were read at each 10 millimicron interval from 400 to 750 millimicrons for the forty-five photographs of five of the seven dyed papers and cardboards. These spectrophotometric data are listed in Appendix B and are illustrated in Figures 20 to 24. (5) For the rest of the forty-eight color transparencies of two dyed papers, one Army shirt, and three types of lamp sources, the values of spectral transmittance were read and corrected at each 10 millimicron interval from 400 to 750 millimicrons. These spectrophotometric data are listed in Appendix B and illustrated in Figures 25 to 31.

Figure 3. Spectral transmittance of the various combinations of emulsion layers of processed unexposed film and dye-on-film base of Ansco Daylight Color film.

a) Processed unexposed film:

(1) W-126 RGB (Ansco Daylight Color film)
(2) W-125 RG (special Ansco red and green sensitive film)
(3) W-130 GB (special Ansco green and blue sensitive film)
(4) W-124 BR (special Ansco blue and red sensitive film)
(5) W-129 R (special Ansco red sensitive film)
(6) W-128 G (special Ansco green sensitive film)
(7) W-127 B (special Ansco blue sensitive film)

b) Dye-on-Film Base:

(8) Cyan Dye on Film Base
(9) Magenta Dye on Film Base
(10) & (11) Yellow Dye on Film Base (Two determinations on same sample)

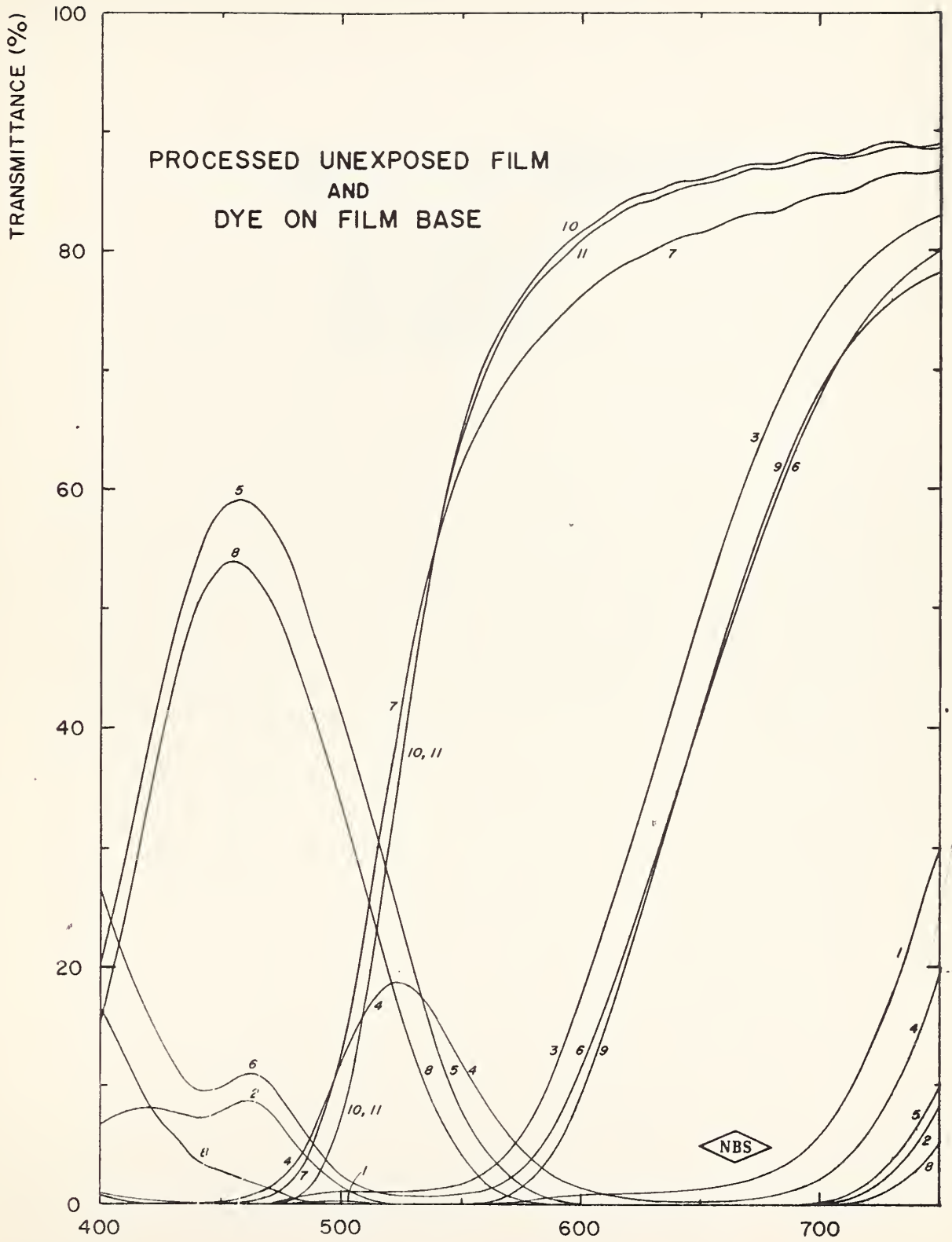
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
PROCESSED UNEXPOSED FILM
AND
DYE ON FILM BASE
NBS

FIGURE 3

Figure 4. Spectral transmittance of five yellow Ansco Color Compensating Filters:

(12) UV-16P, Yellow
(13) 23, Yellow
(14) 24, Yellow
(15) 25, Yellow
(16) 26, Yellow

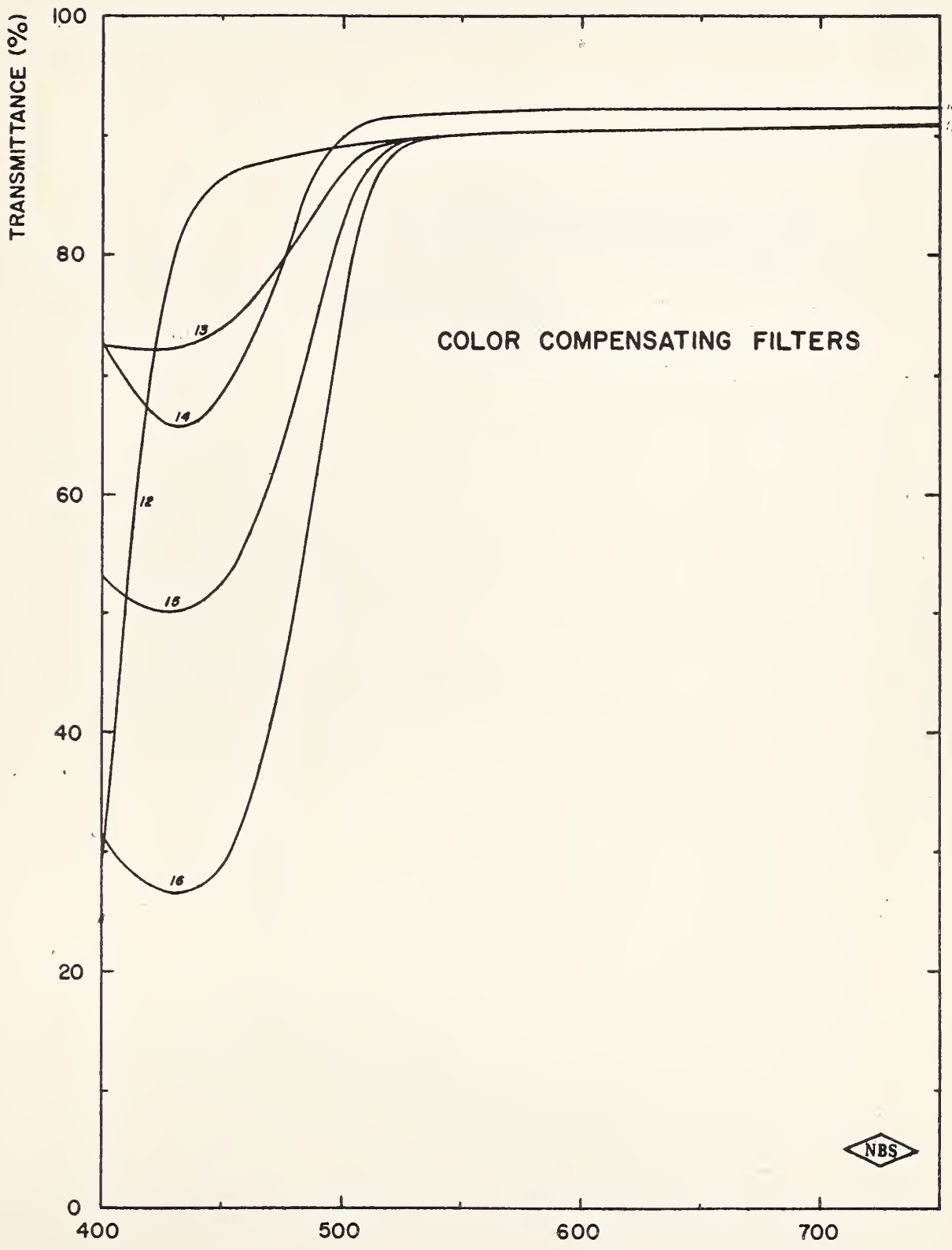
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
COLOR COMPENSATING FILTERS
13
14
12
15
16
NBS

FIGURE 4

Figure 5. Spectral transmittance of three magenta Ansco Color Compensating Filters:

(17) 33, Magenta
(18) 34, Magenta
(19) 35, Magenta

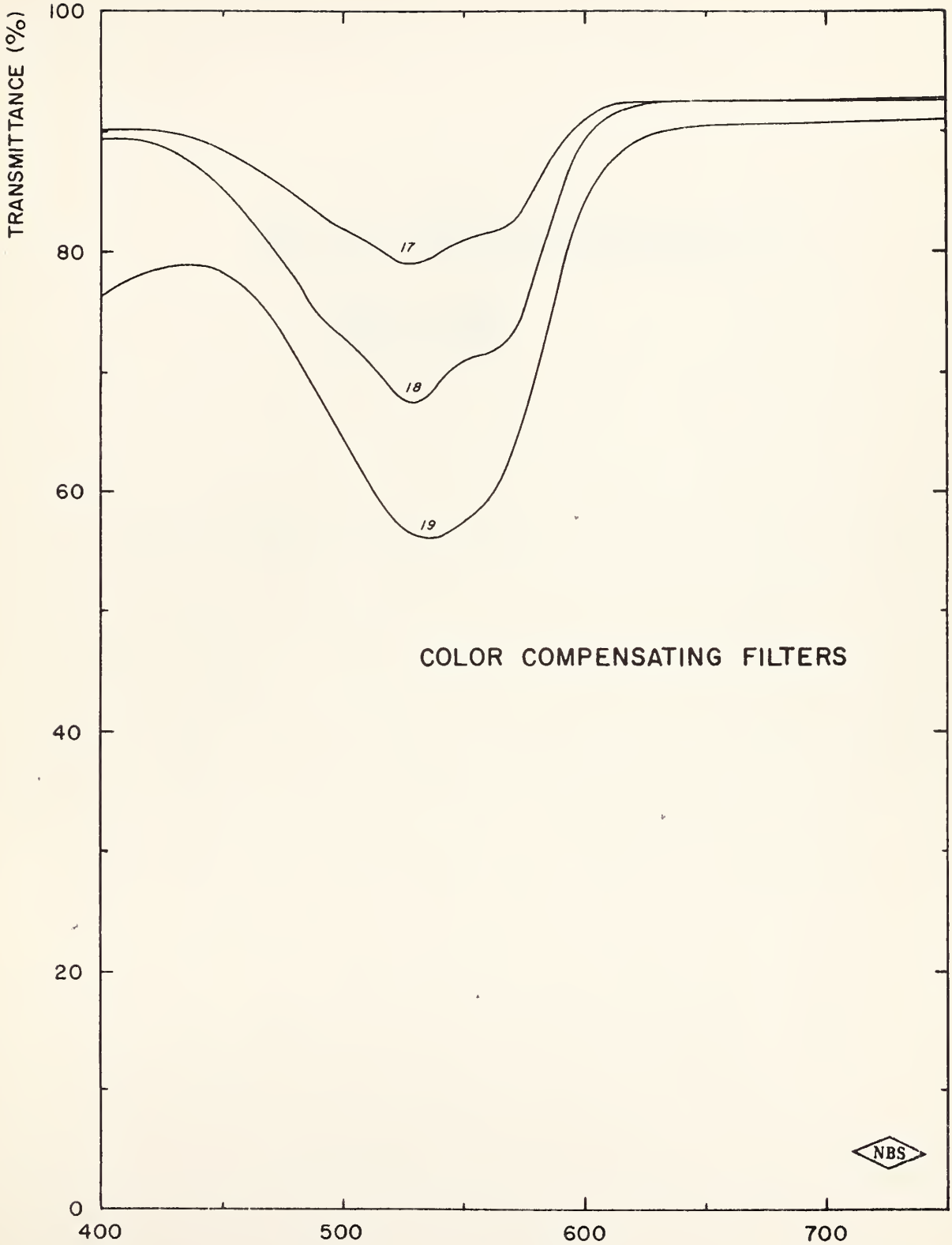
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
17
18
19
COLOR COMPENSATING FILTERS
NBS

FIGURE 5

Figure 6. Spectral transmittance of three cyan Ansco Color Compensating Filters:

(20) 43, Cyan
(21) 44, Cyan
(22) 45, Cyan

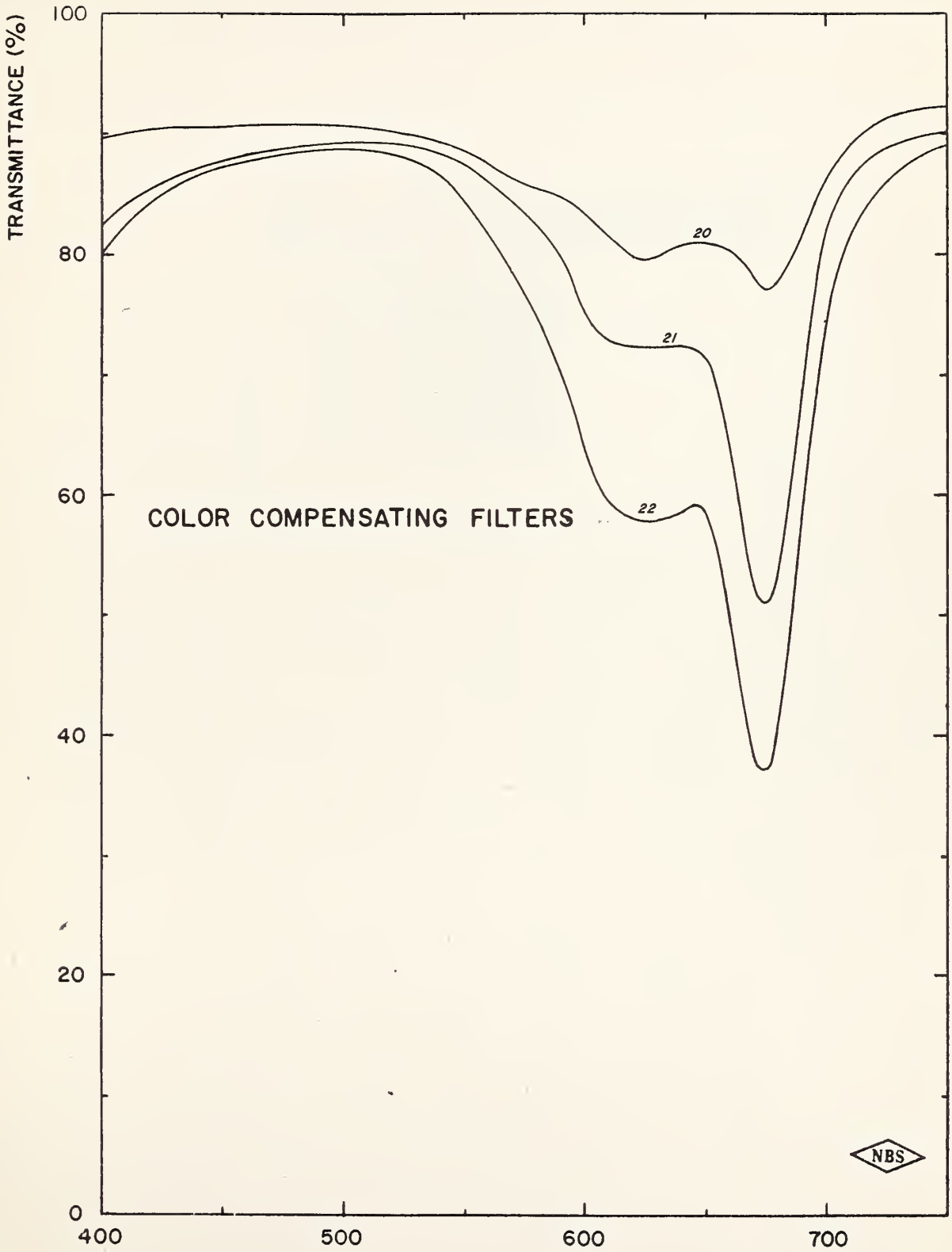
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
20
21
22
COLOR COMPENSATING FILTERS
NBS

FIGURE 6

Figure 7. Spectral transmittance of seven yellow Ansco Color Compensating Filters:

(23) .025Y, Yellow
(24) .05Y, Yellow
(25) .10Y, Yellow
(26) .20Y, Yellow
(27) .30Y, Yellow
(28) .40Y, Yellow
(29) .50Y, Yellow

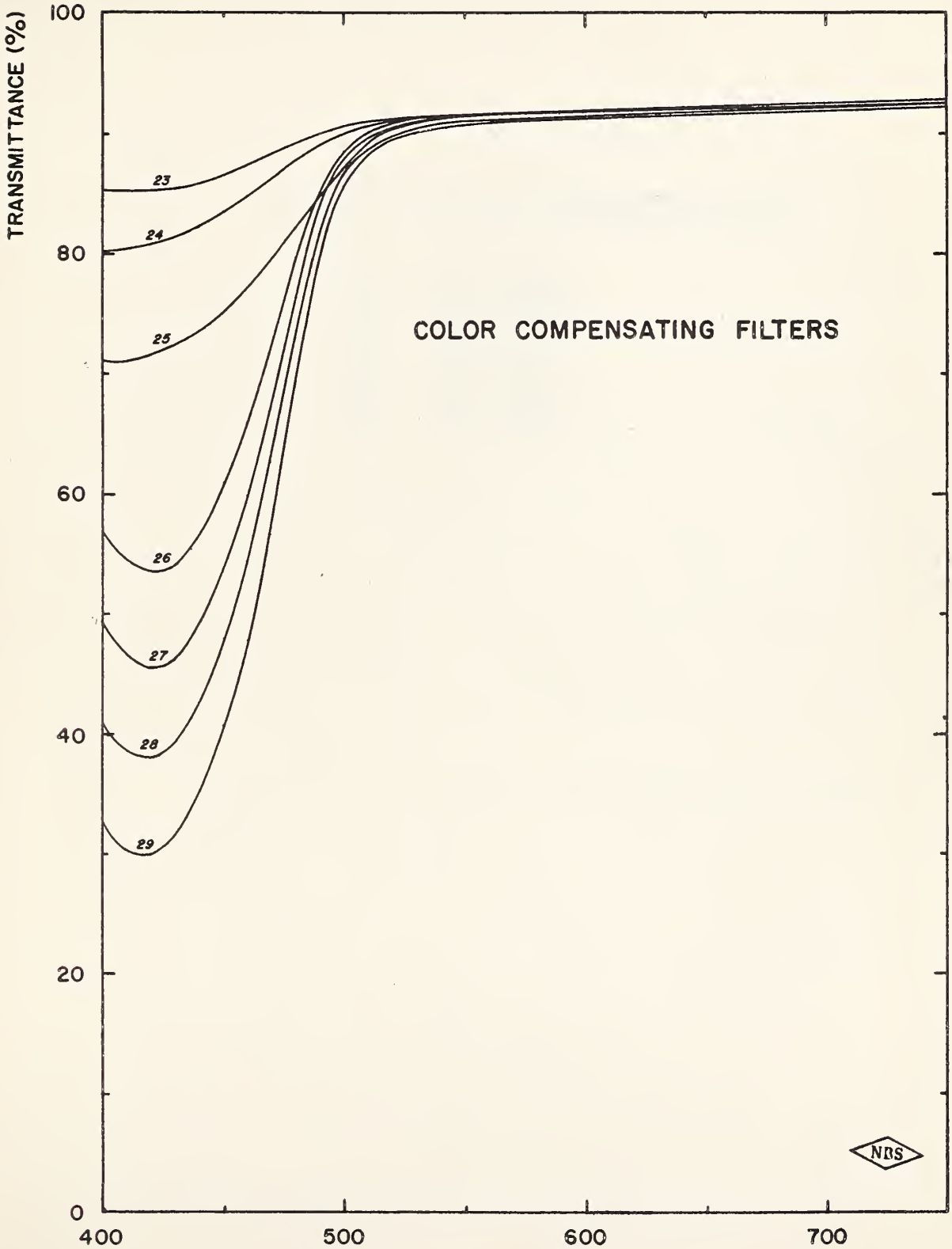
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
23
24
25
26
27
28
29
COLOR COMPENSATING FILTERS
NBS

FIGURE 7

Figure 8. Spectral transmittance of seven magenta Ansco Color Compensating Filters:

(30) .025M, Magenta
(31) .05M, Magenta
(32) .10M, Magenta
(33) .20M, Magenta
(34) .30M, Magenta
(35) .40M, Magenta
(36) .50M, Magenta

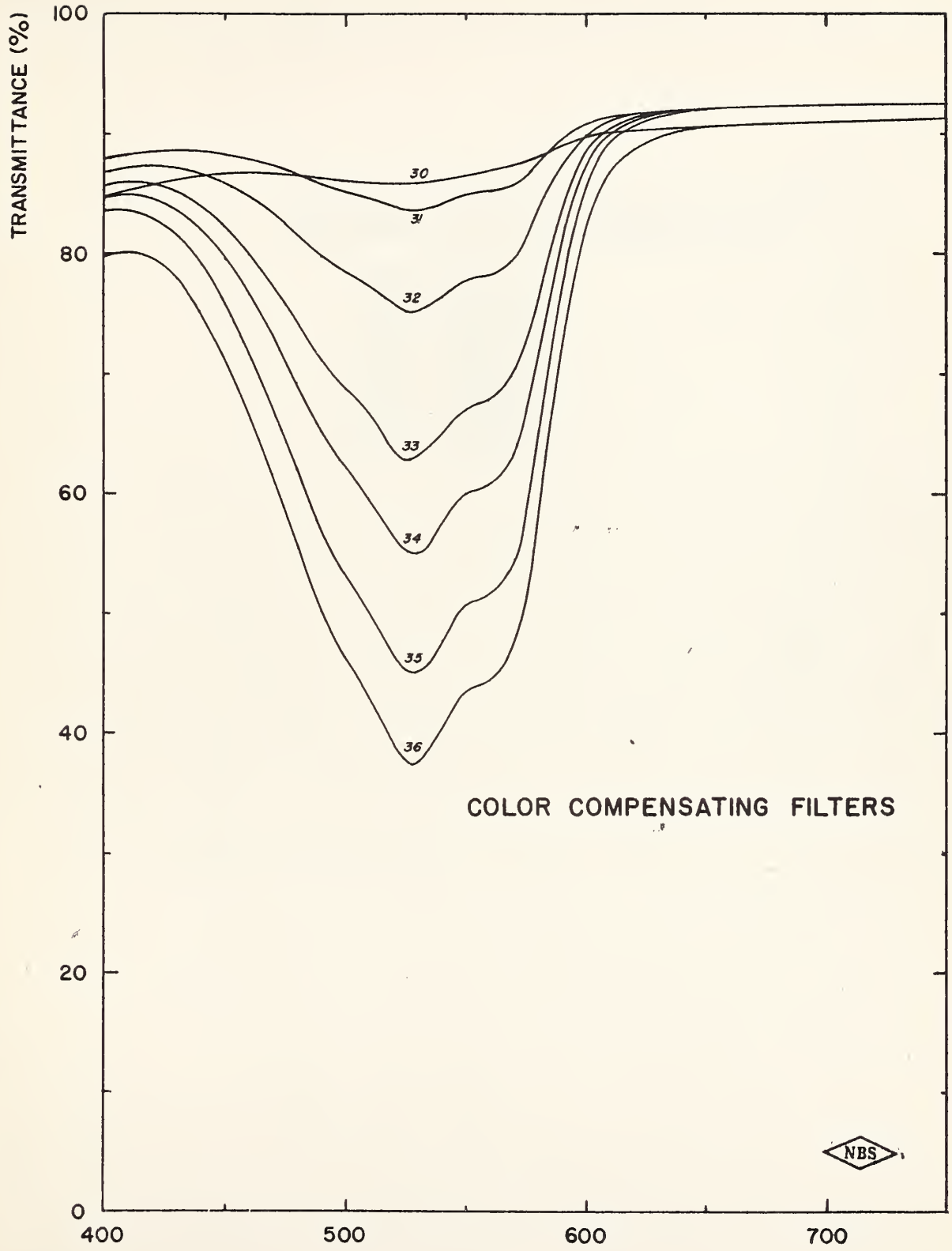
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
30
31
32
33
34
35
36
COLOR COMPENSATING FILTERS
NBS

FIGURE 8

Figure 9. Spectral transmittance of seven cyan Ansco Color Compensating Filters:

(37) .025C, Cyan
(38) .05C, Cyan
(39) .10C, Cyan
(40) .20C, Cyan
(41) .30C, Cyan
(42) .40C, Cyan
(43) .50C, Cyan

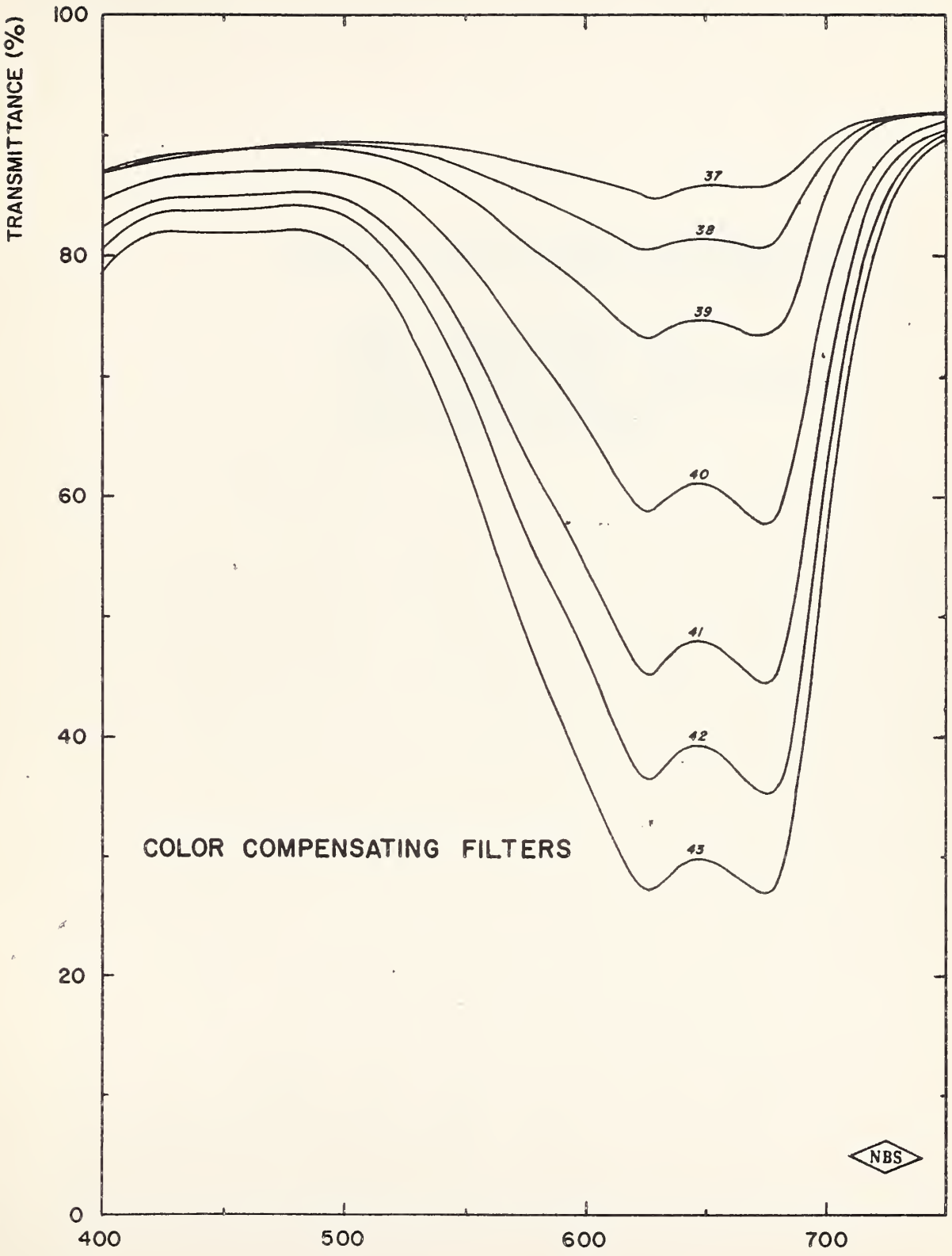
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
37
38
39
40
41
42
43
COLOR COMPENSATING FILTERS
NBS

FIGURE 9

Figure 10. Spectral directional reflectance of five selected dyed papers and cardboards:

(44) Mimeo Bond Paper, Orange
(45) Onion Skin Paper, Blue
(46) Onion Skin Paper, Canary Yellow
(47) Onion Skin Paper, Pink
(48) Railroad Board, Red

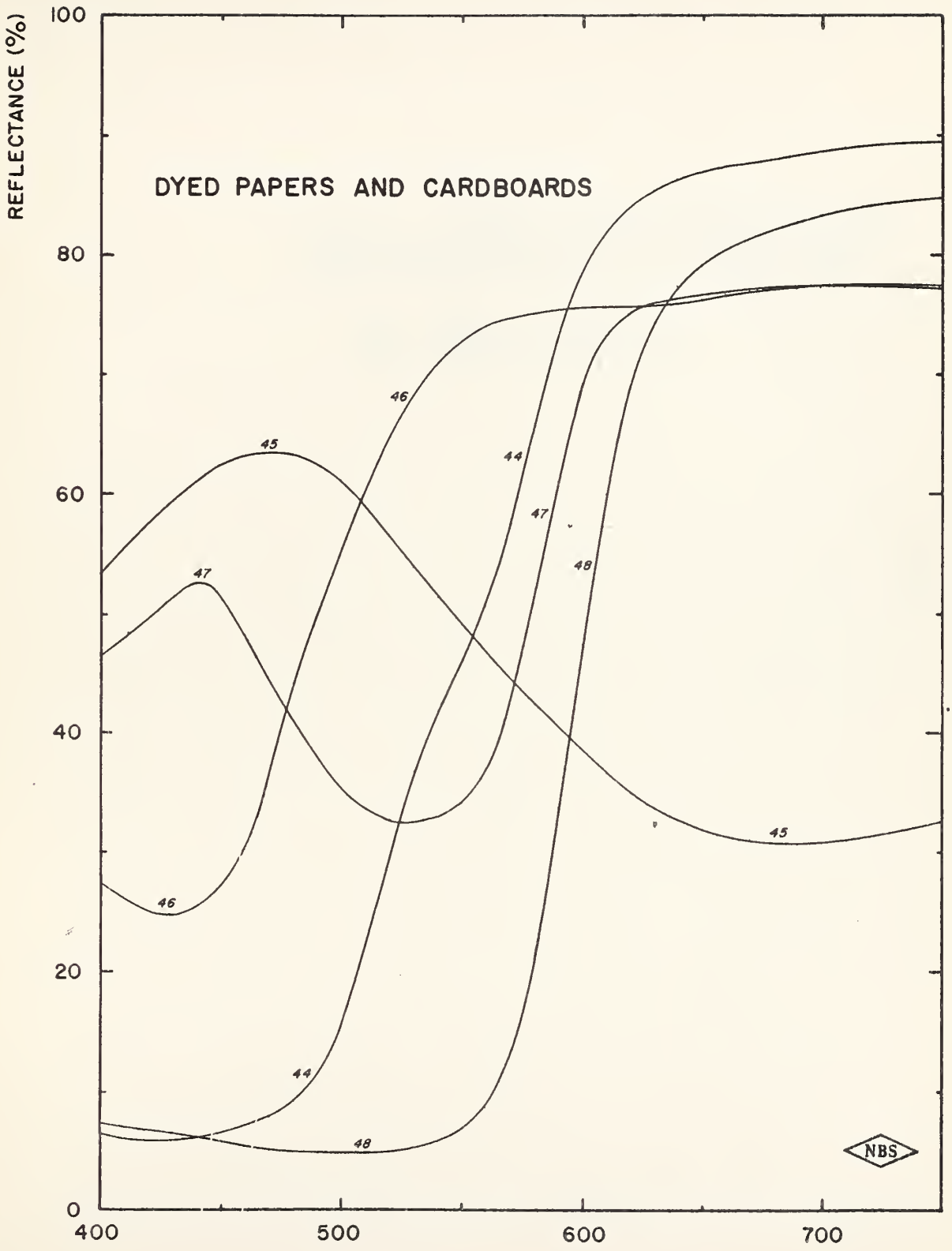
DYED PAPERS AND CARDBOARDS
REFLECTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
45
47
46
44
48
NBS

FIGURE 10

Figure 11. Visible and near infrared spectral directional reflectance of two textile samples from Army Shade Book, Serial No. 5045 at NBS:

(49) Khaki #1 (cotton)
(50) Olive Drab #52 (wool)

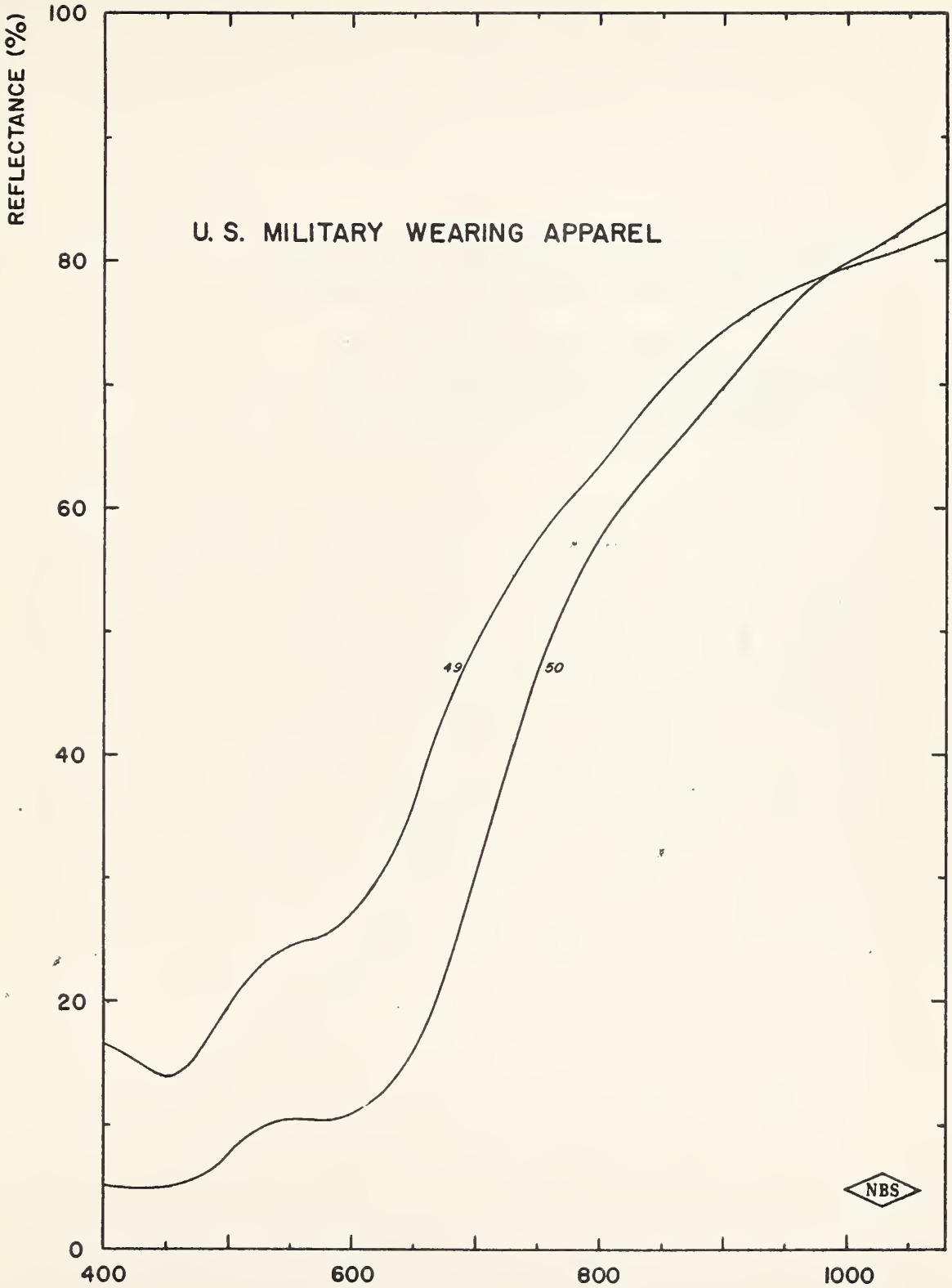
REFLECTANCE (%)
100
80
60
40
20
0
U. S. MILITARY WEARING APPAREL
49
50
NBS
400
600
800
1000
WAVELENGTH (mμ)

FIGURE 11

Figure 12. Visible and near infrared spectral directional reflectance of four textile samples of the U. S. Marine Corps wearing apparel:

(51) US Marine Corps Necktie
(52) US Marine Corps Overseas Cap (summer)
(53) US Marine Corps Pants (summer)
(54) US Marine Corps Shirt (summer)

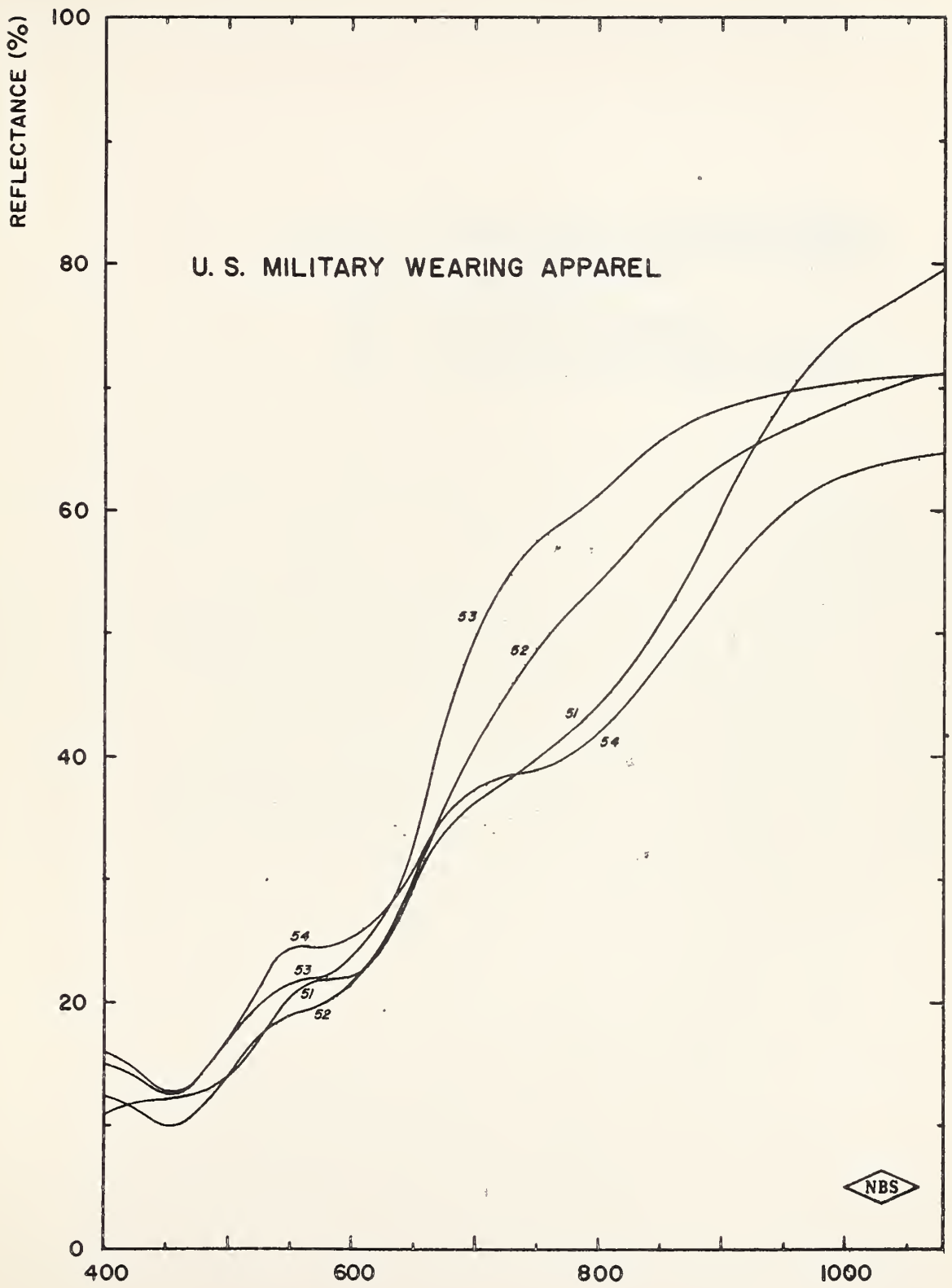
REFLECTANCE (%)
100
80
60
40
20
0
U. S. MILITARY WEARING APPAREL
53
52
51
54
54
53
51
52
NBS
400
600
800
1000
WAVELENGTH (mμ)

FIGURE 12

Figure 13. Visible and near infrared spectral directional reflectance of two textile samples of U. S. Army wearing apparel:

(55) US Army Shirt (winter)
(56) US Army Eisenhower Jacket (winter)

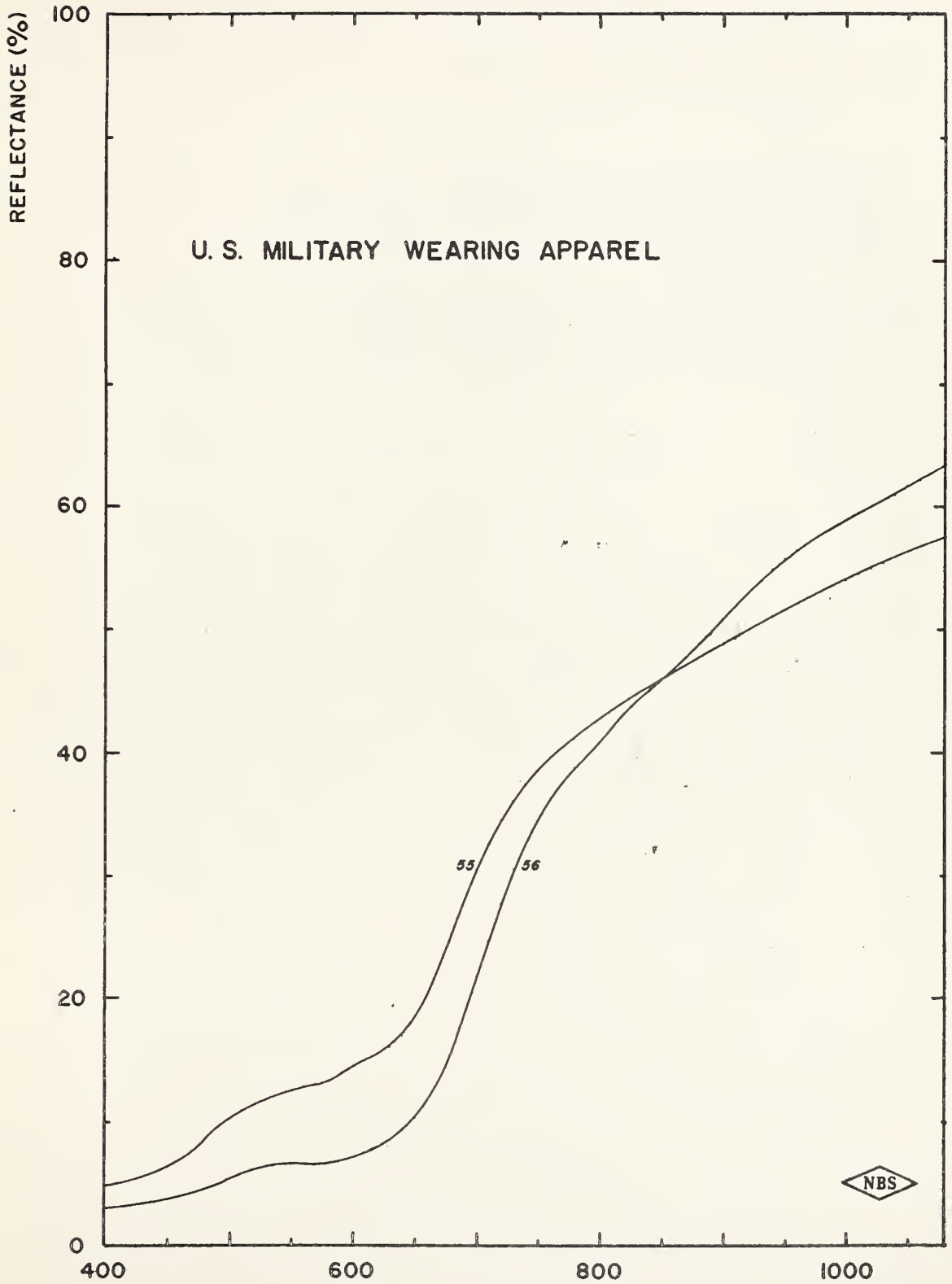
REFLECTANCE (%)
100
80
60
40
20
0
U. S. MILITARY WEARING APPAREL
55
56
NBS
400
600
800
1000
WAVELENGTH (mμ)

FIGURE 13

Figure 14. Visible and near infrared spectral directional reflectance of three textile samples of U. S. Marine Corps wearing apparel:

(57) US Marine Corps Overseas Cap (winter)
(58) US Marine Corps Blouse (winter)
(59) US Marine Corps Pants (winter)

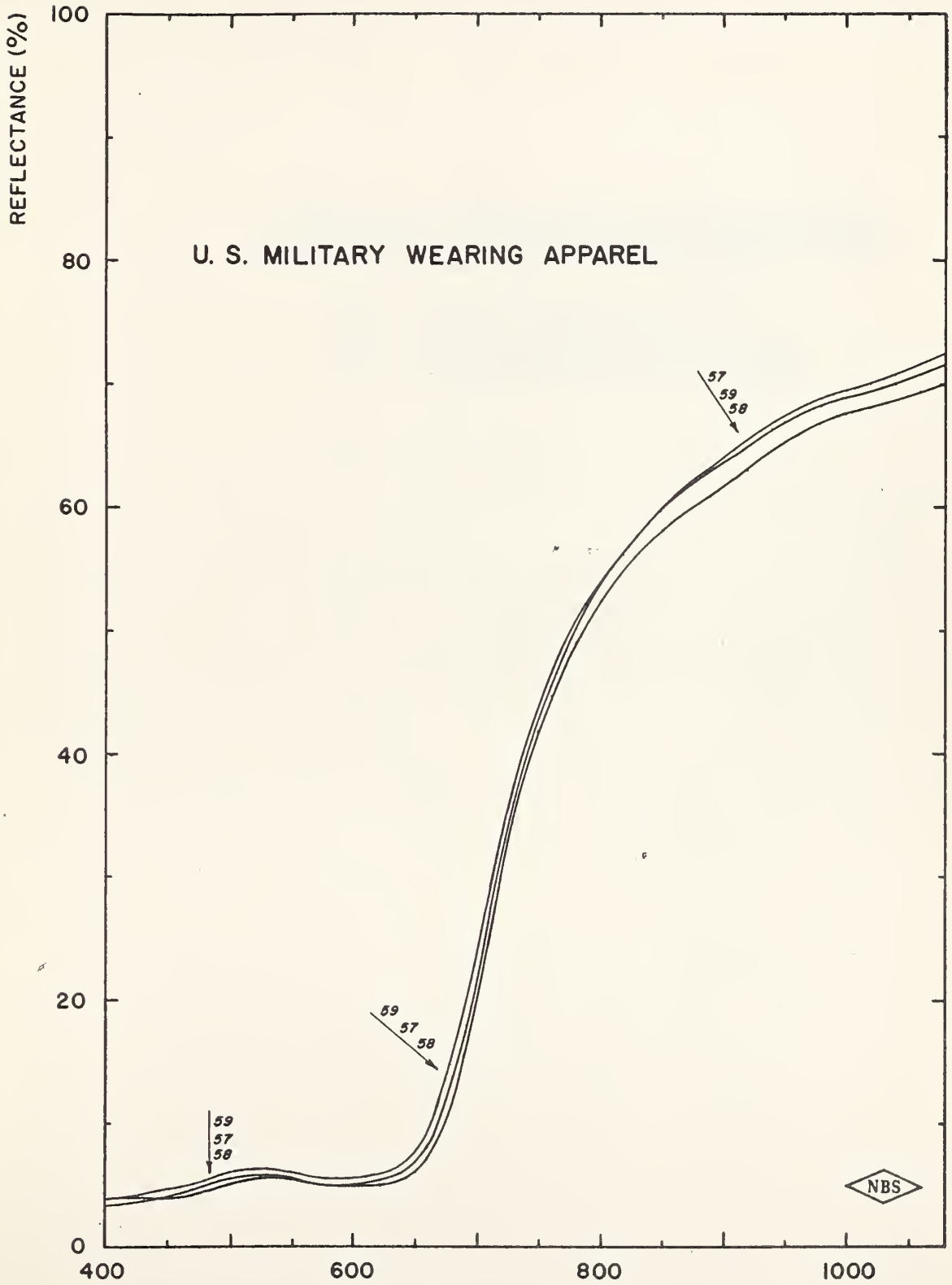
REFLECTANCE (%)
100
80
60
40
20
0
U. S. MILITARY WEARING APPAREL
57
59
58
59
57
58
59
57
58
NBS
400
600
800
1000
WAVELENGTH (mμ)

FIGURE 14

Figure 15. Visible and near infrared spectral directional reflectance of three textile samples of U. S. Marine Corps wearing apparel:

(60) US Marine Corps Fatigue Cap
(61) US Marine Corps Fatigue Shirt
(62) US Marine Corps Fatigue Pants

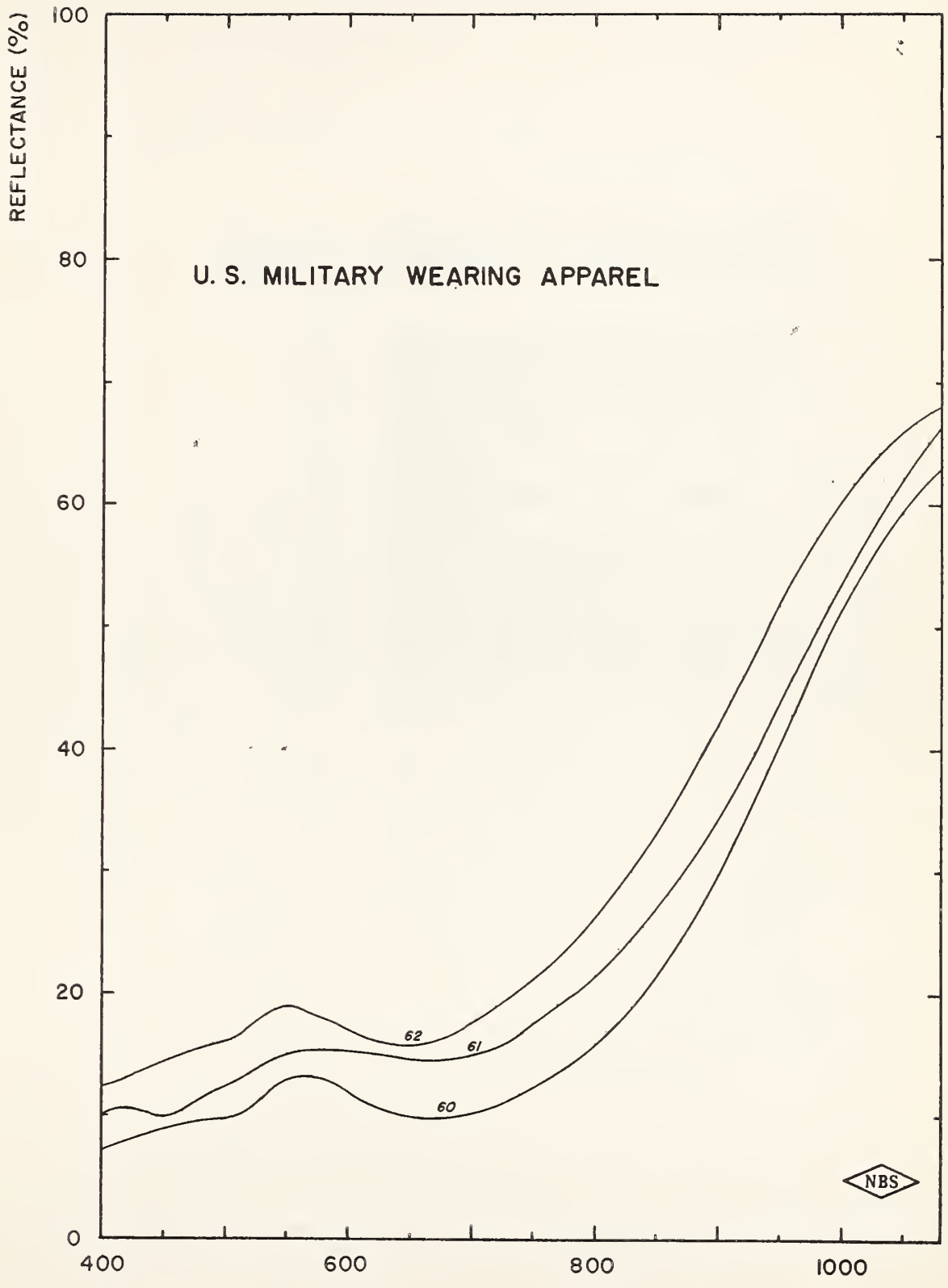
REFLECTANCE (%)
100
80
60
40
20
0
U. S. MILITARY WEARING APPAREL
62
61
60
NBS
400
600
800
1000
WAVELENGTH (mμ)

FIGURE 15

Figure 16. Visible and near infrared spectral directional reflectance of seven samples of paint on pressboard:

(63) Chinese Red #6335 Chi-namel Paint, Chi-namel Paint and Varnish Co.
(64) Colony Yellow #317 House Paint, Lowe Brothers
(65) Green #173 Tractor Paint, Lowe Brothers
(66) Red #139 Tractor Paint, Lowe Brothers
(67) Royal Blue Permanent Trim Paint, John W. Masury & Son
(68) Seal Brown Supreme House Paint, John W. Masury & Son
(69) Verdi Green #6830 Super House Paint, Chi-namel Paint and Varnish Co.

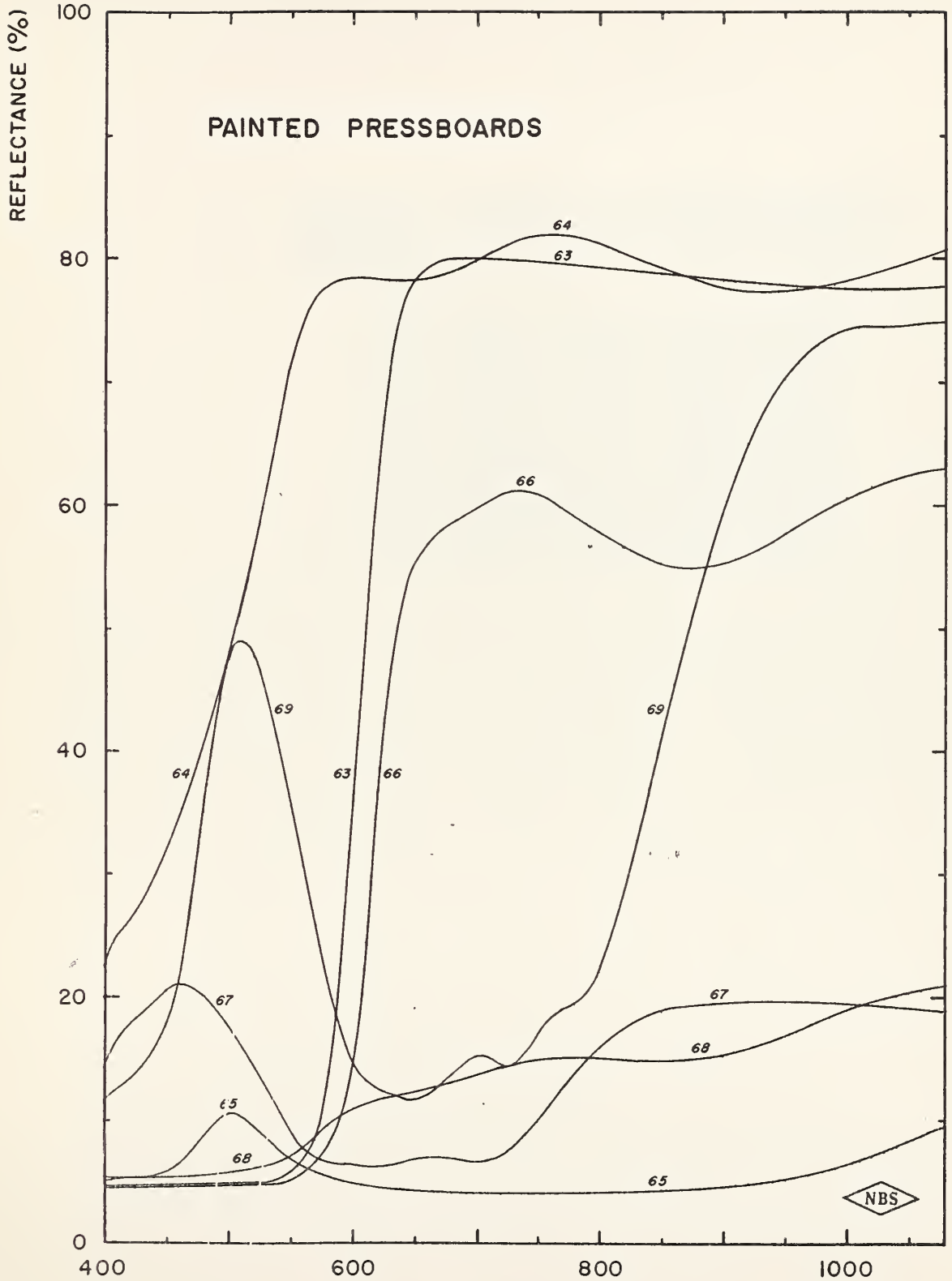
PAINTED PRESSBOARDS
REFLECTANCE (%)
100
80
60
40
20
0
400
600
800
1000
WAVELENGTH (mμ)
64
63
66
69
67
68
65
NBS

FIGURE 16

Figure 17. Spectral directional reflectance of ten samples of commercially prepared Munsell samples:

(70) Munsell 5YR 6/12 (Tobey Press)
(71) Munsell 5Y 8/12 (Tobey Press)
(72) Munsell 5GY 7/10 (Tobey Press)
(73) Munsell 5G 5/8 (Tobey Press)
(74) Munsell 5BG 4/6 (Tobey Press)
(75) Munsell 5B 4/8 (Tobey Press)
(76) Munsell 5PB 3/12 (Tobey Press)
(77) Munsell 5P 4/12 (Tobey Press)
(78) Munsell 5RP 4/12 (Tobey Press)
(79) Munsell 5R 4/14 (Tobey Press)

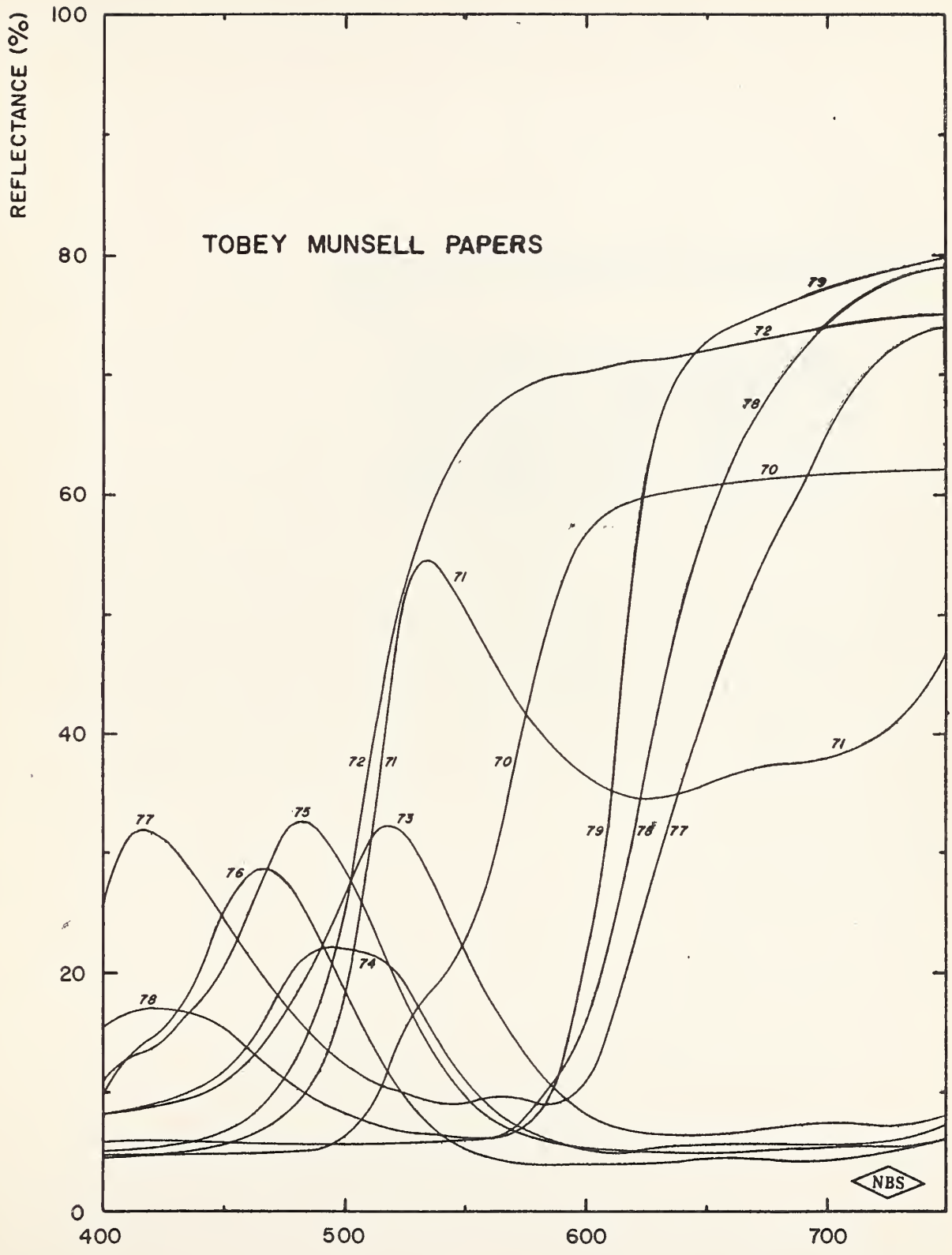
REFLECTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
TOBEY MUNSELL PAPERS
NBS

FIGURE 17

Figure 18. Spectral directional reflectance of seven samples of commercially prepared Munsell samples:

(79) Munsell 5R 4/14 (Tobey Press)
(80) Munsell 5R 4/12 (Tobey Press)
(81) Munsell 5R 4/10 (Tobey Press)
(82) Munsell 5R 4/8 (Tobey Press)
(83) Munsell 5R 4/6 (Tobey Press)
(84) Munsell 5R 4/4 (Tobey Press)
(85) Munsell 5R 4/2 (Tobey Press)

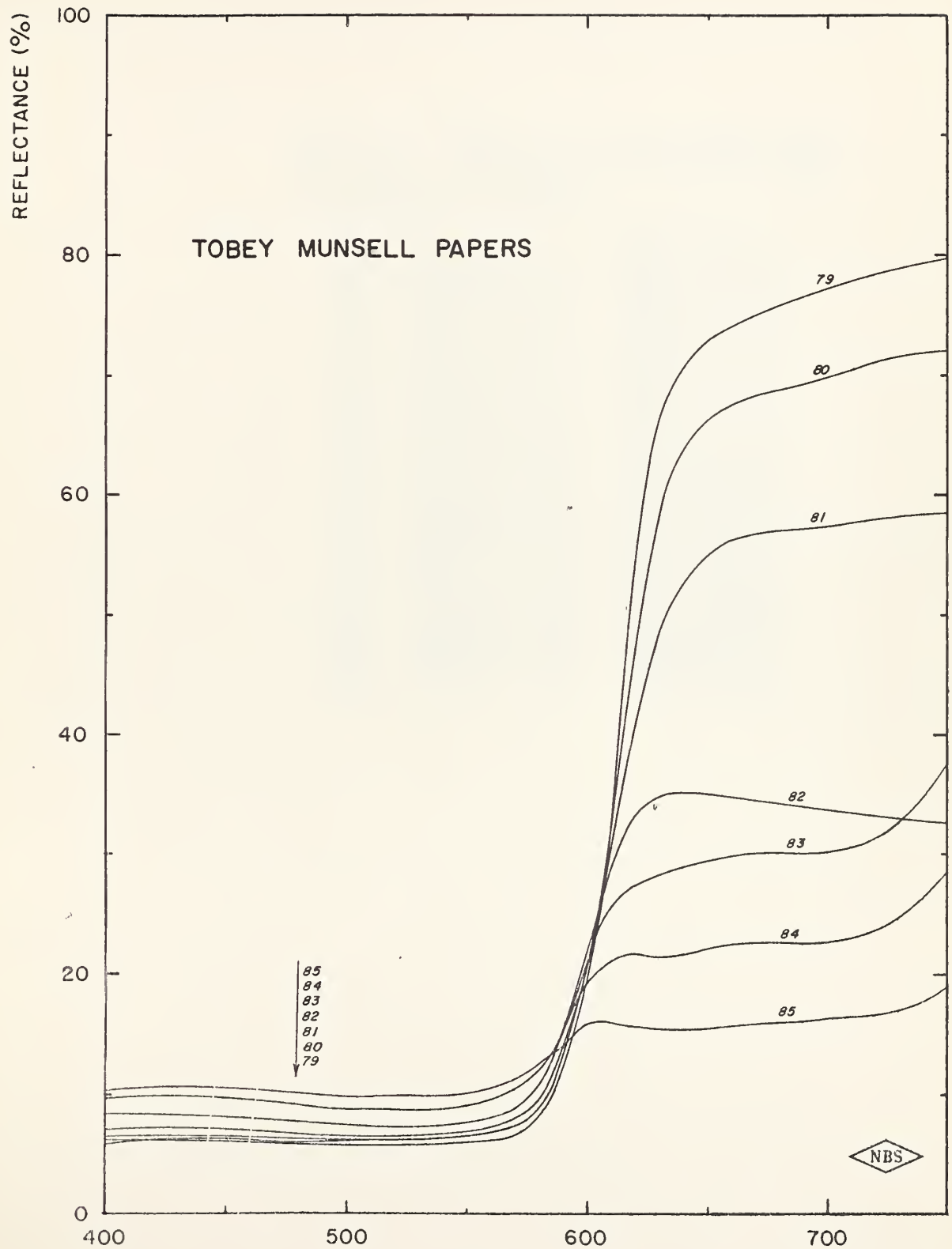
REFLECTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
TOBEY MUNSELL PAPERS
79
80
81
82
83
84
85
85
84
83
82
81
80
79
NBS

FIGURE 18

Figure 19. Spectral directional reflectance of eighteen neutral samples of commercially prepared Munsell samples:

(86) Munsell N 9.5/ (Tobey Press)
(87) Munsell N 9/ (Tobey Press)
(88) Munsell N 8.5/ (Tobey Press)
(89) Munsell N 8/ (Tobey Press)
(90) Munsell N 7.5/ (Tobey Press)
(91) Munsell N 7/ (Tobey Press)
(92) Munsell N 6.5/ (Tobey Press)
(93) Munsell N 6/ (Tobey Press)
(94) Munsell N 5.5/ (Tobey Press)
(95) Munsell N 5/ (Tobey Press)
(96) Munsell N 4.5/ (Tobey Press)
(97) Munsell N 4/ (Tobey Press)
(98) Munsell N 3.5/ (Tobey Press)
(99) Munsell N 3/ (Tobey Press)
(100) Munsell N 2.5/ (Tobey Press)
(101) Munsell N 2/ (Tobey Press)
(102) Munsell N 1.5/ (Tobey Press)
(103) Munsell N 1/ (Tobey Press)

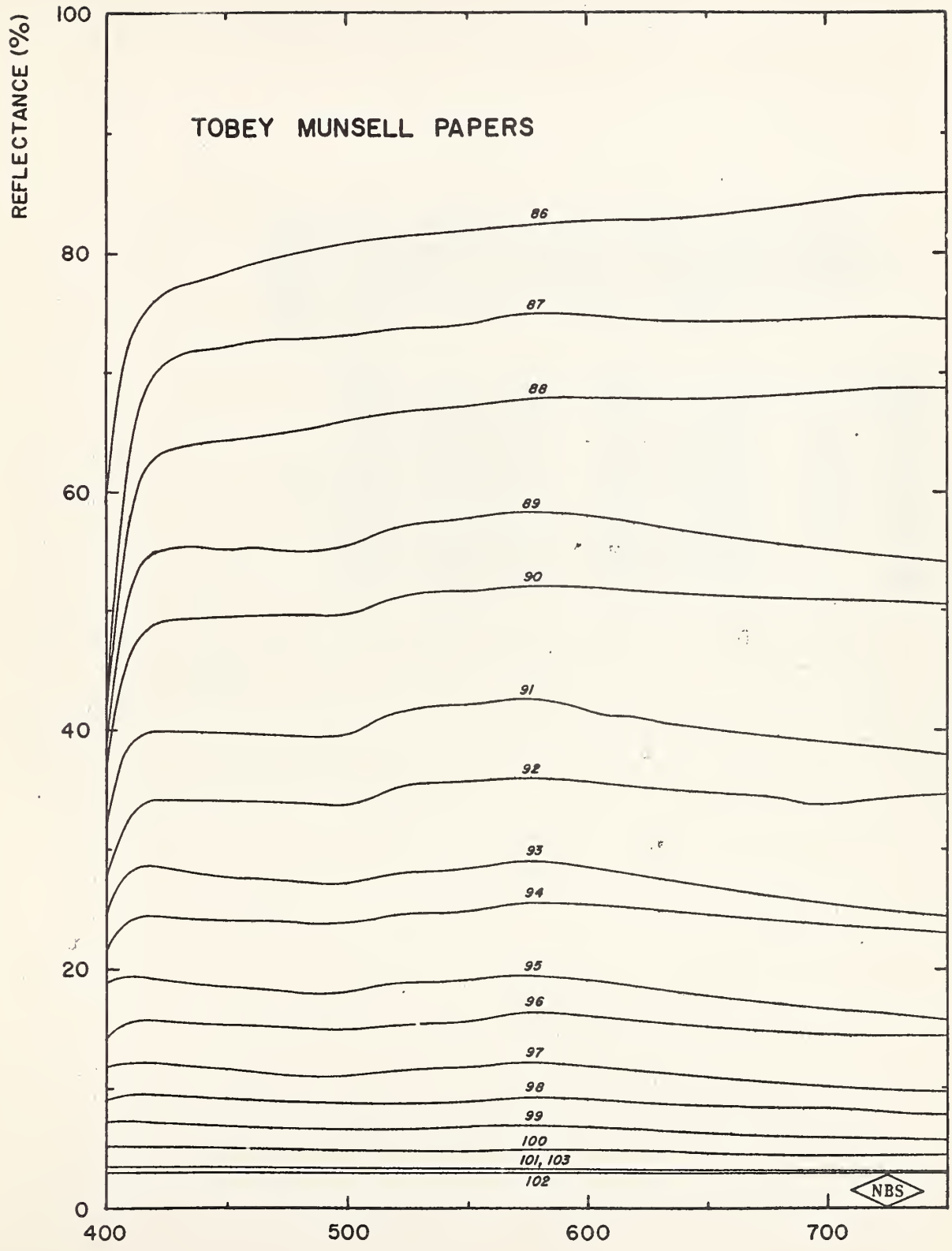
TOBEY MUNSELL PAPERS
REFLECTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101, 103
102
NBS

FIGURE 19

Figure 20. Spectral transmittance of nine color transparencies of a sample of Orange Mimeo Bond Paper (Sample No. 44, Figure 10) on Ansco daylight color film for various shutter speeds at f/8 aperture:

(104)	Exp. No. 26.	Under exposure.	1/400 sec.
(105)	Exp. No. 19.	Normal exposure.	1/100 sec.
(106)	Exp. No. 20.	Over exposure.	1/50 sec.
(107)	Exp. No. 21.	Over exposure.	1/25 sec.
(108)	Exp. No. 22.	Over exposure.	1/10 sec.
(109)	Exp. No. 23.	Over exposure.	1/5 sec.
(110)	Exp. No. 24.	Over exposure.	1/2 sec.
(111)	Exp. No. 25.	Over exposure.	1 sec.
(112)	Exp. No. 27.	Over exposure.	2 sec.

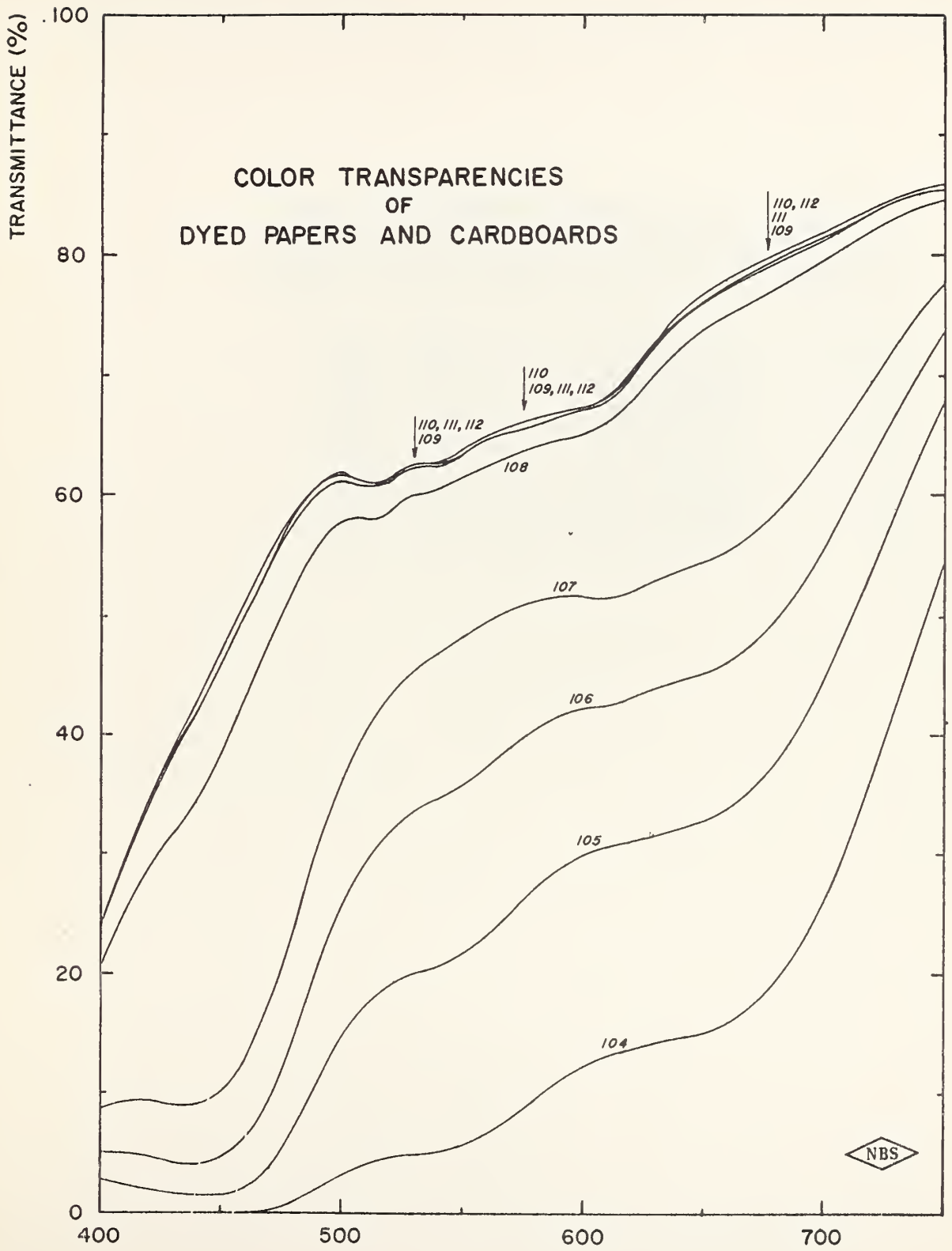
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
110, 112
111
109
110
109, 111, 112
110, 111, 112
109
108
107
106
105
104
NBS

FIGURE 20

Figure 21. Spectral transmittance of nine color transparencies of a sample of Blue Onion Skin Paper (Sample No. 45, Figure 10) on Ansco daylight color film for various shutter speeds at f/8 aperture:

(113)	Exp. No. 44.	Under exposure.	1/800 sec.
(114)	Exp. No. 37.	Normal exposure.	1/200 sec.
(115)	Exp. No. 38.	Over exposure.	1/100 sec.
(116)	Exp. No. 39.	Over exposure.	1/50 sec.
(117)	Exp. No. 40.	Over exposure.	1/25 sec.
(118)	Exp. No. 41.	Over exposure.	1/10 sec.
(119)	Exp. No. 42.	Over exposure.	1/5 sec.
(120)	Exp. No. 43.	Over exposure.	1/2 sec.
(121)	Exp. No. 45.	Over exposure.	1 sec.

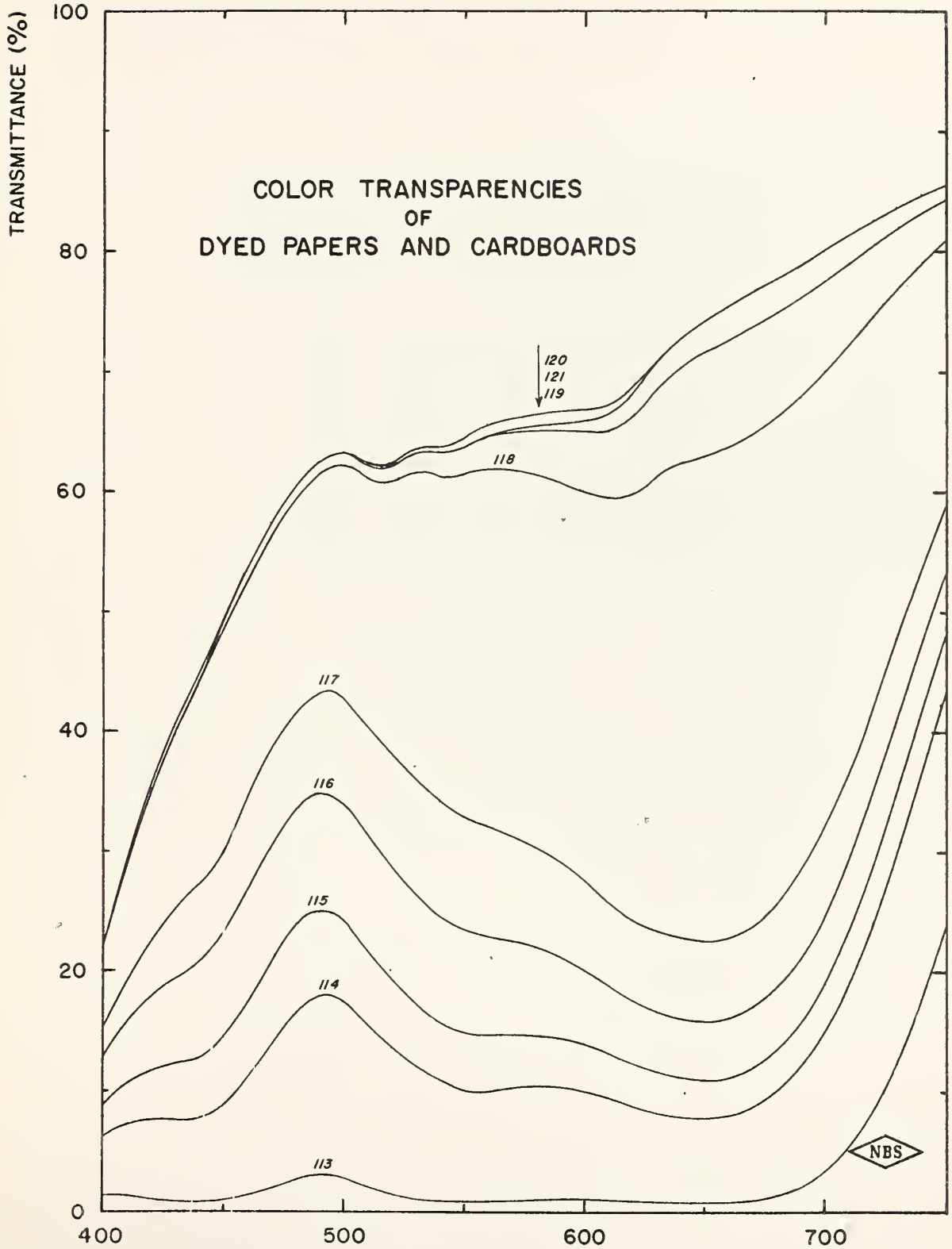
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
120
121
119
118
117
116
115
114
113
NBS

FIGURE 21

Figure 22. Spectral transmittance of nine color transparencies of a sample of Canary Yellow Onion Skin Paper (Sample No. 46, Figure 10) on Ansco daylight color film for various shutter speeds at f/8 aperture:

(122)	Exp. No. 35.	Under exposure.	1/800 sec.
(123)	Exp. No. 28.	Normal exposure.	1/200 sec.
(124)	Exp. No. 29.	Over exposure.	1/100 sec.
(125)	Exp. No. 30.	Over exposure.	1/50 sec.
(126)	Exp. No. 31.	Over exposure.	1/25 sec.
(127)	Exp. No. 32.	Over exposure.	1/10 sec.
(128)	Exp. No. 33.	Over exposure.	1/5 sec.
(129)	Exp. No. 34.	Over exposure.	1/2 sec.
(130)	Exp. No. 36.	Over exposure.	1 sec.

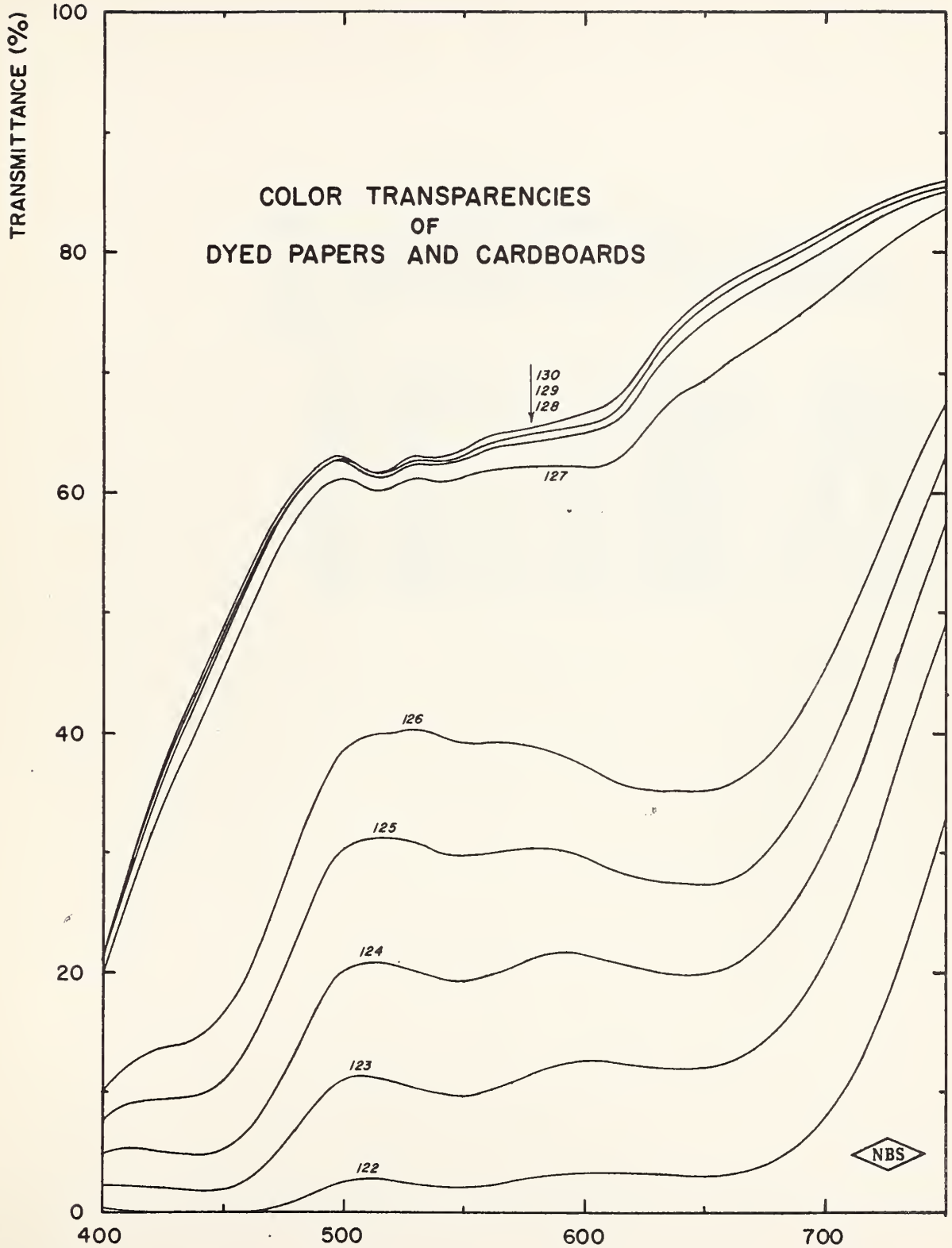
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
130
129
128
127
126
125
124
123
122
NBS

FIGURE 22

Figure 23. Spectral transmittance of nine color transparencies of a sample of Pink Onion Skin Paper (Sample No. 47, Figure 10) on Ansco daylight color film for various shutter speeds at f/8 aperture:

(131)	Exp. No. 17.	Under exposure.	1/800 sec.
(132)	Exp. No. 10.	Normal exposure.	1/200 sec.
(133)	Exp. No. 11.	Over exposure.	1/100 sec.
(134)	Exp. No. 12.	Over exposure.	1/50 sec.
(135)	Exp. No. 13.	Over exposure.	1/25 sec.
(136)	Exp. No. 14.	Over exposure.	1/10 sec.
(137)	Exp. No. 15.	Over exposure.	1/5 sec.
(138)	Exp. No. 16.	Over exposure.	1/2 sec.
(139)	Exp. No. 18.	Over exposure.	1 sec.

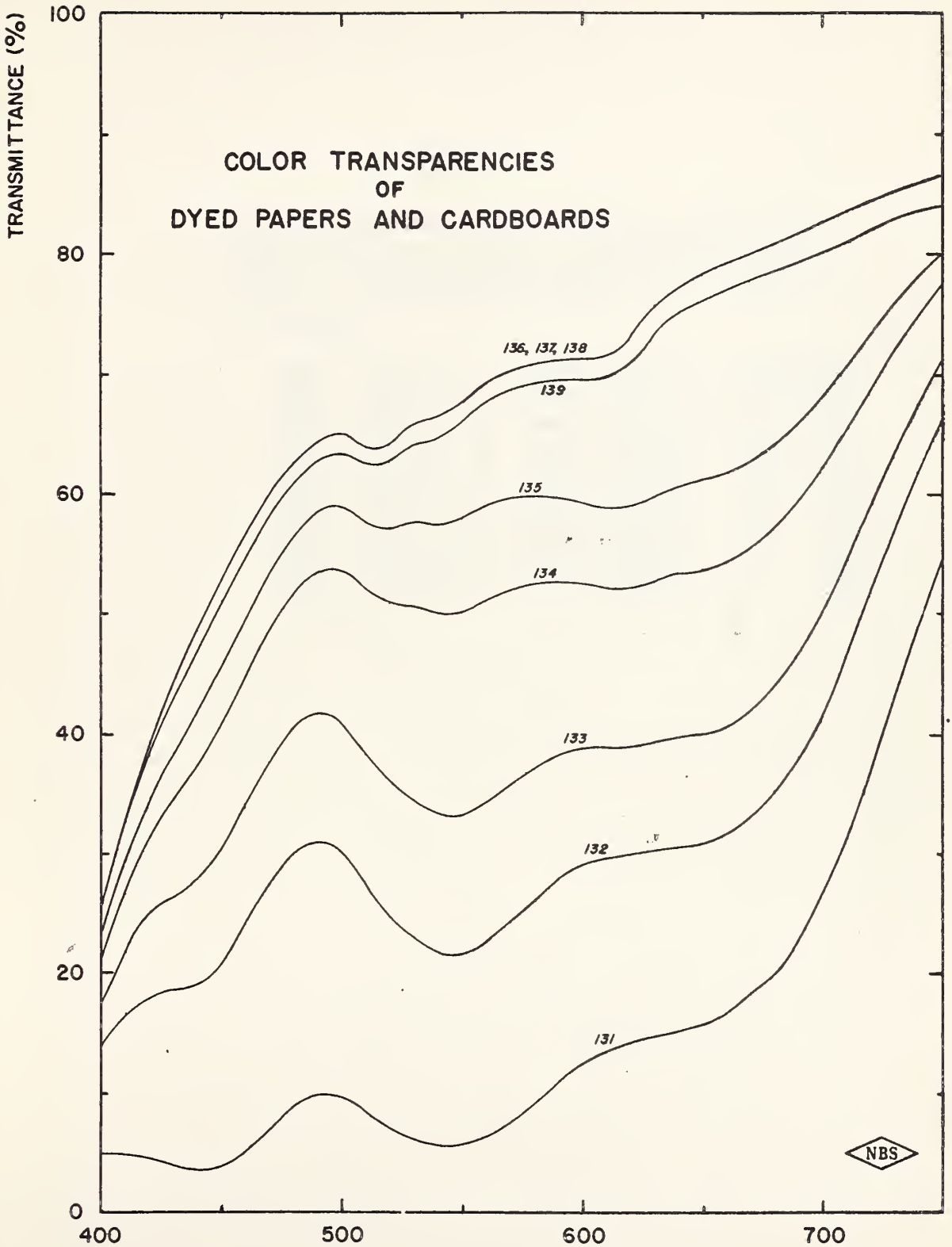
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
136, 137, 138
139
135
134
133
132
131
NBS

FIGURE 23

Figure 24. Spectral transmittance of nine color transparencies of a sample of Red Railroad Board Cardboard (Sample No. 48, Figure 10) on Ansco daylight color film for various shutter speeds at f/8 aperture:

(140)	Exp. No. 8.	Under exposure.	1/400 sec.
(141)	Exp. No. 1.	Normal exposure.	1/100 sec.
(142)	Exp. No. 2.	Over exposure.	1/50 sec.
(143)	Exp. No. 3.	Over exposure.	1/25 sec.
(144)	Exp. No. 4.	Over exposure.	1/10 sec.
(145)	Exp. No. 5.	Over exposure.	1/5 sec.
(146)	Exp. No. 6.	Over exposure.	1/2 sec.
(147)	Exp. No. 7.	Over exposure.	1 sec.
(148)	Exp. No. 9.	Over exposure.	2 sec.

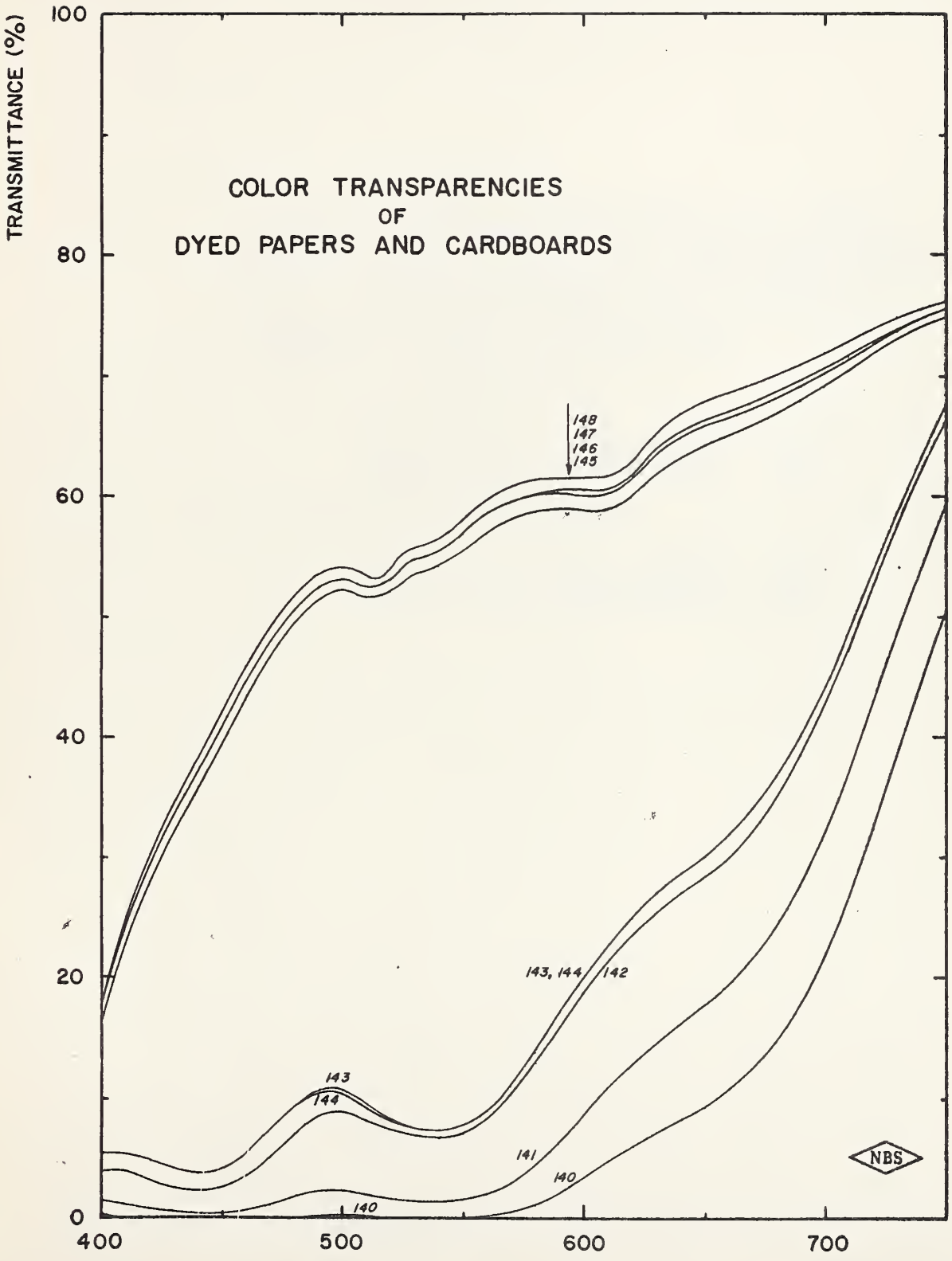
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
148
147
146
145
143, 144
142
143
144
141
140
140
NBS

FIGURE 24

Figure 25. Spectral transmittance of color transparencies of two samples of Blue and Tuscan Railroad Boards (See Curves 1, Blue and 3, Buff, respectively, Page 83, Figure 39, NBS Report 4438 [6]) on special Ansco green and blue sensitive film at different apertures for 1/200 sec. shutter speed:

a) Blue Railroad Board

(149)	W-132	Normal exposure.	f/5.6
(150)	W-133	Over exposure.	f/4

b) Tuscan Railroad Board

(151)	W-134	Normal exposure.	f/16
(152)	W-135	Over exposure.	f/8

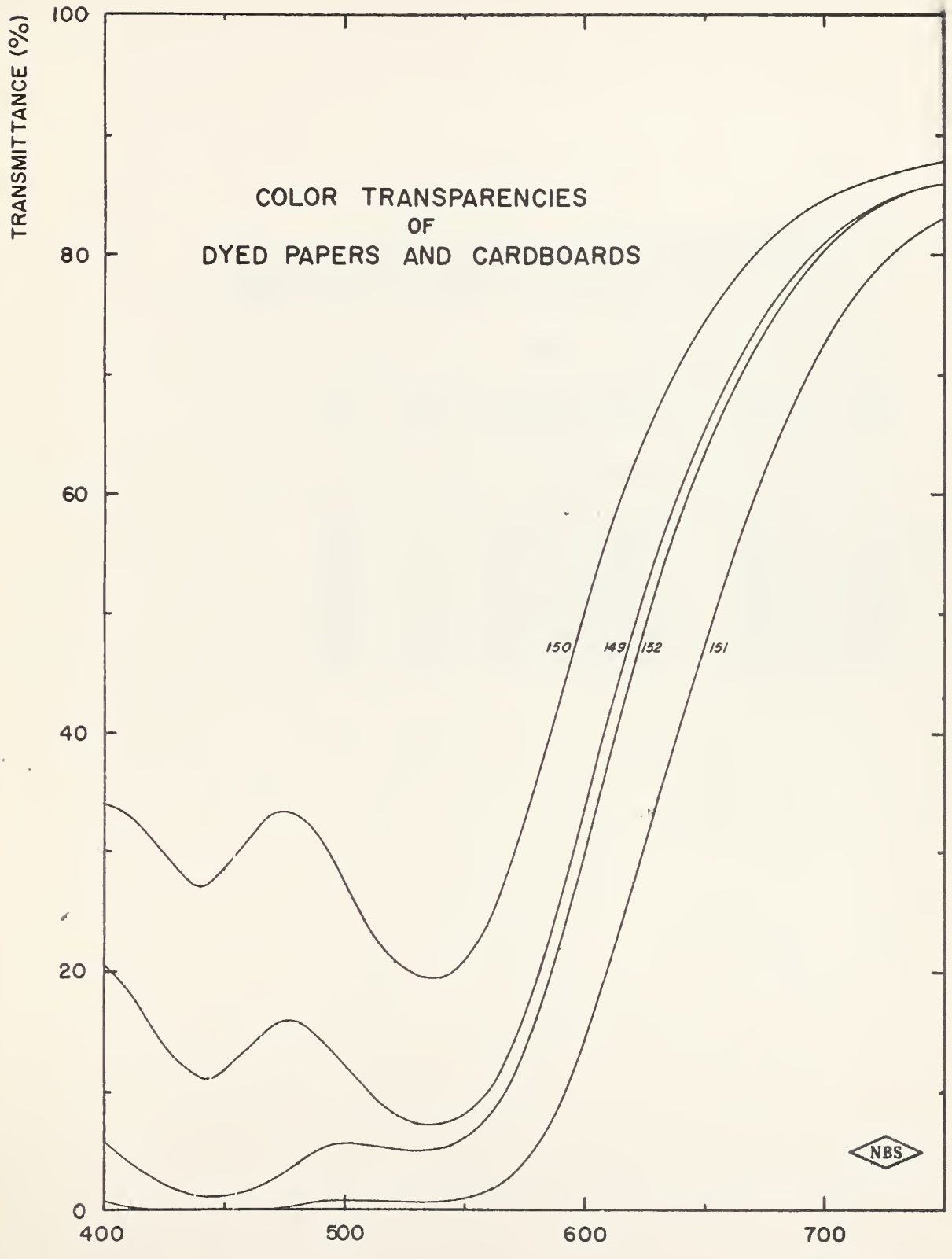
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
150
149
152
151
NBS

FIGURE 25

Figure 26. Spectral transmittance of eight color transparencies of a U. S. Army Olive Drab Winter Shirt (Sample No. 55, Figure 13):

a) On Special Ansco Green and Blue Sensitive Film

(153)	W-141	Normal exposure.	1/50 sec. f/5.6
(154)	W-142	Over exposure.	1/50 sec. f/4

b) On Special Ansco Red and Green Sensitive Film

(155)	W-171	Normal exposure.	1/100 sec. f/11
(156)	W-172	Over exposure.	1/100 sec. f/5.6
(157)	W-173	Over exposure.	1/100 sec. f/4
(158)	W-198	Under exposure.	1/200 sec. f/11
(159)	W-199	Normal exposure.	1/200 sec. f/5.6
(160)	W-200	Over exposure.	1/200 sec. f/4

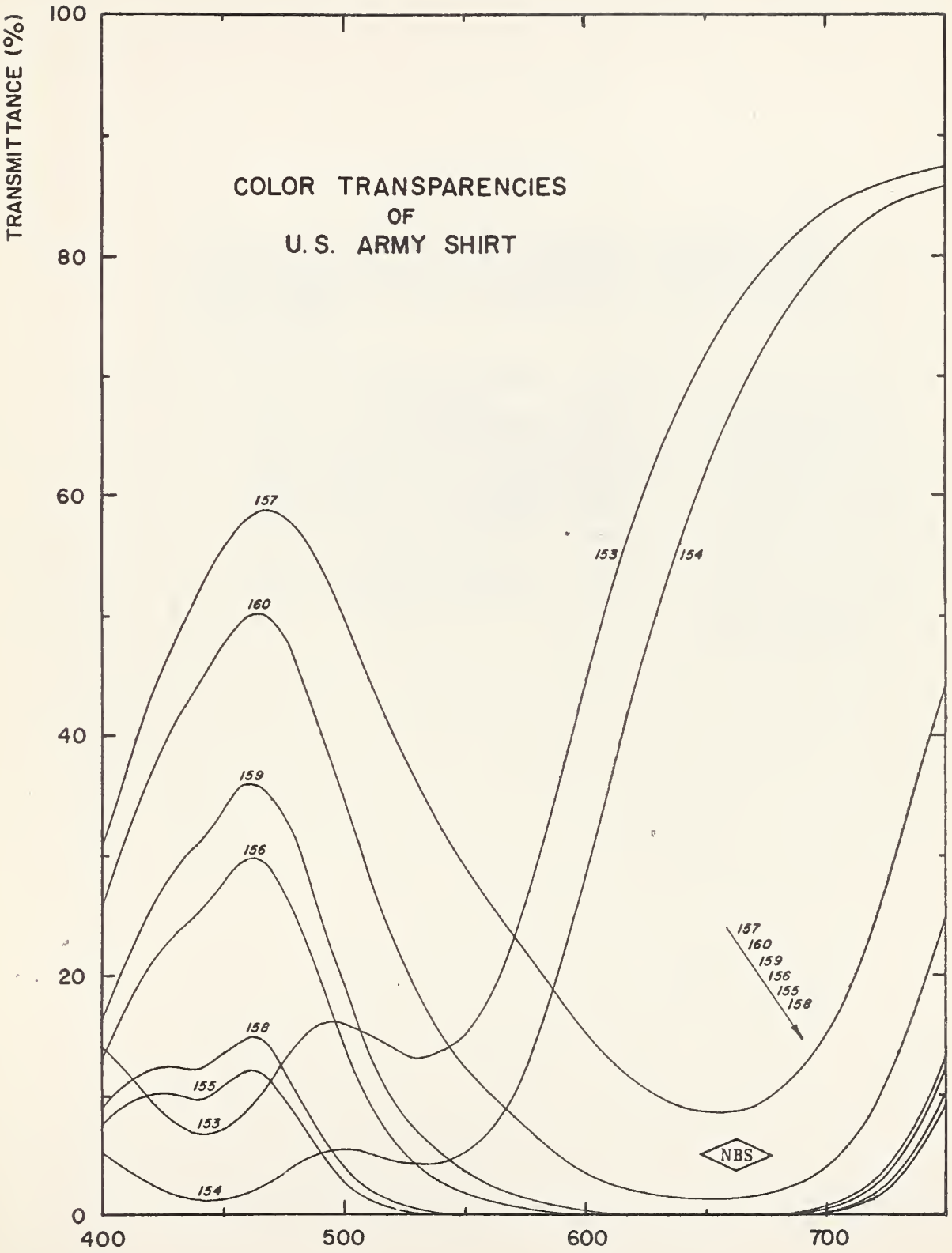
COLOR TRANSPARENCIES
OF
U. S. ARMY SHIRT
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
157
160
159
156
155
158
153
154
NBS

FIGURE 26

Figure 27. Spectral transmittance of seven color transparencies of a U. S. Army Olive Drab Winter Shirt (Sample No. 55, Figure 13) on Ansco daylight color film:

(161)	W-291 No filter. Normal exposure.	1/50 sec. f/11
(162)	W-292 With red filter.	1/50 sec. f/2.8
(163)	W-293 With yellow filter.	1/50 sec. f/8
(164)	W-294 With green filter.	1/100 sec. f/2.8
(165)	W-295 With blue filter.	1/50 sec. f/2.8
(166)	W-296 No filter. Over exposure.	1/50 sec. f/8
(167)	W-297 No filter. Over exposure.	1/50 sec. f/5.6

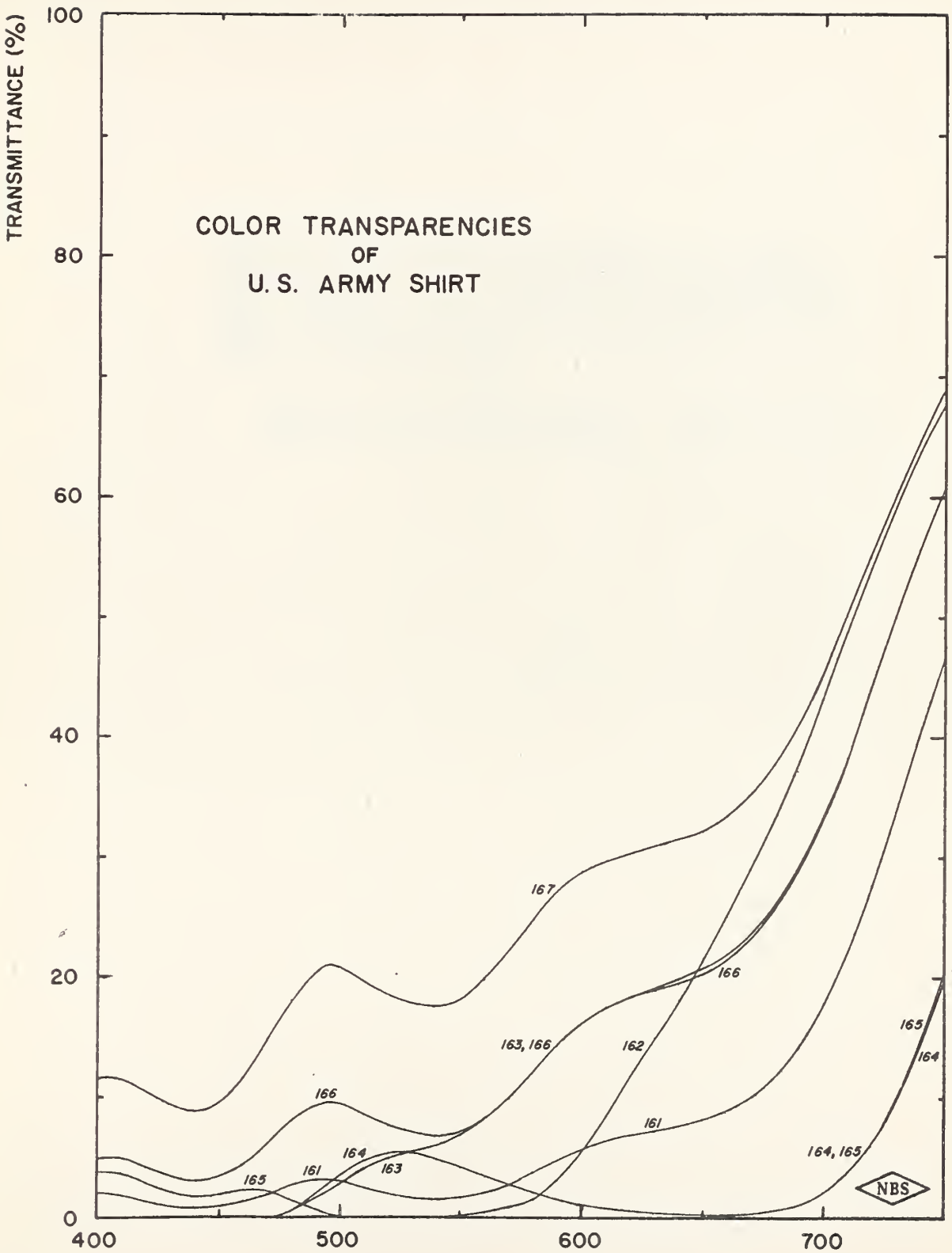
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
COLOR TRANSPARENCIES
OF
U. S. ARMY SHIRT
167
166
163, 166
162
166
165
164
161
164, 165
165
161
164
163
NBS

FIGURE 27

Figure 28. Spectral transmittance of two color transparencies of a U. S. Army Olive Drab Winter Shirt (Sample No. 55, Figure 13) on special Ansco blue sensitive film, for various apertures at 1/50 sec. shutter speed:

(168) W-430 Normal exposure. 1/50 sec. f/11
(169) W-431 Over exposure. 1/50 sec. f/5.6

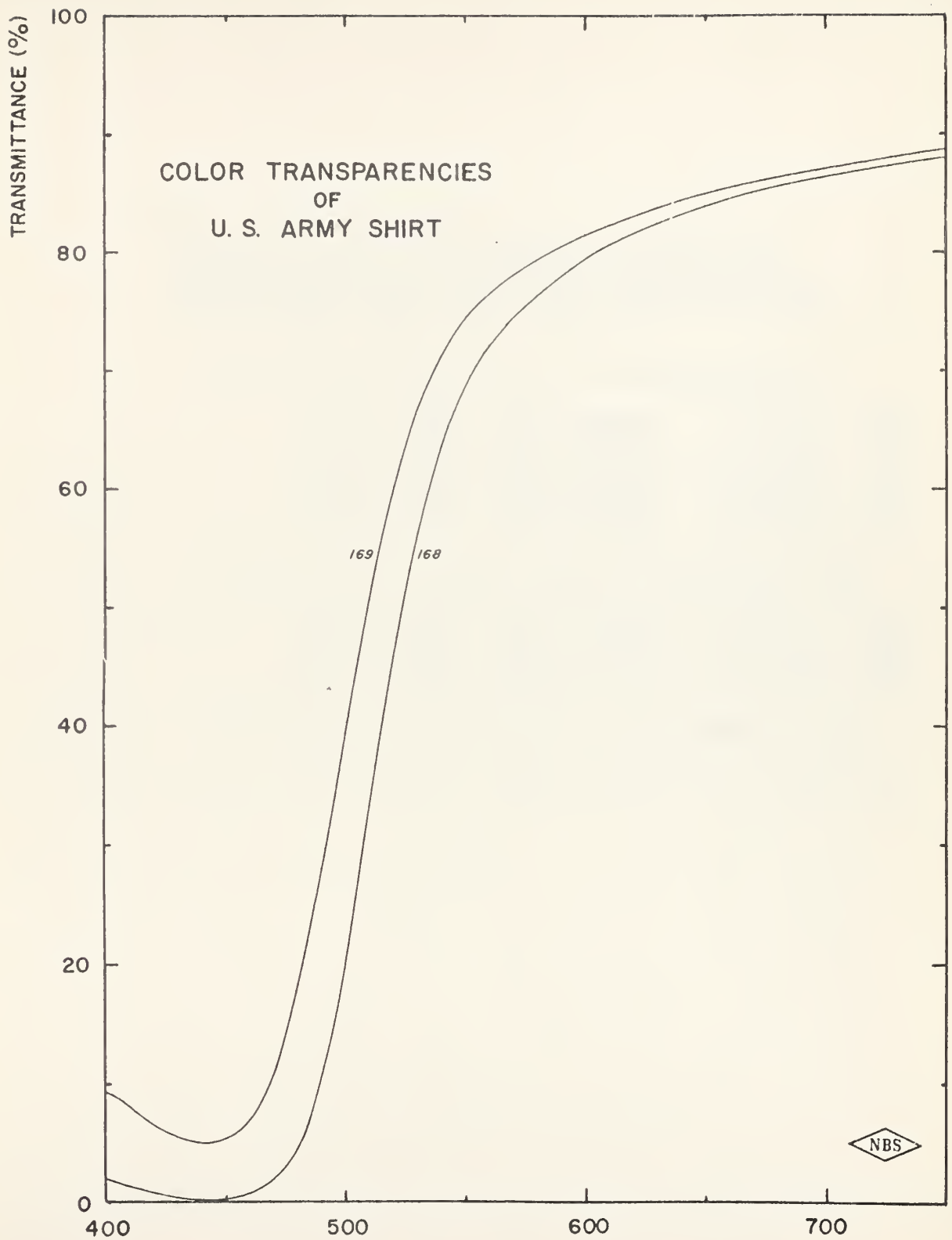
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
COLOR TRANSPARENCIES
OF
U. S. ARMY SHIRT
169
168
NBS

FIGURE 28

Figure 29. Spectral transmittance of nine color transparencies on Ansco daylight color film of nineteen fluorescent lamps behind a diffusing glass on the O'Neill-Nagel light table [3]:

a) 15 inch working distance, no extension tube

(170)	W-1862	Under exposure.	1/50 sec.	f/22
(171)	W-1861	Under exposure.	1/25 sec.	f/22
(172)	W-1858	Normal exposure.	1/25 sec.	f/16
(173)	W-1859	Over exposure.	1/25 sec.	f/11
(174)	W-1860	Over exposure.	1/25 sec.	f/8

b) 6-1/2 inch working distance, 40mm extension tube

(175)	W-1865	Under exposure.	1/25 sec.	f/14
(176)	W-1863	Normal exposure.	1/25 sec.	f/10
(177)	W-1864	Over exposure.	1/10 sec.	f/11

c) 4-1/2 inch working distance, 80mm extension tube

(178)	W-1866	Normal exposure.	1/5 sec.	f/11

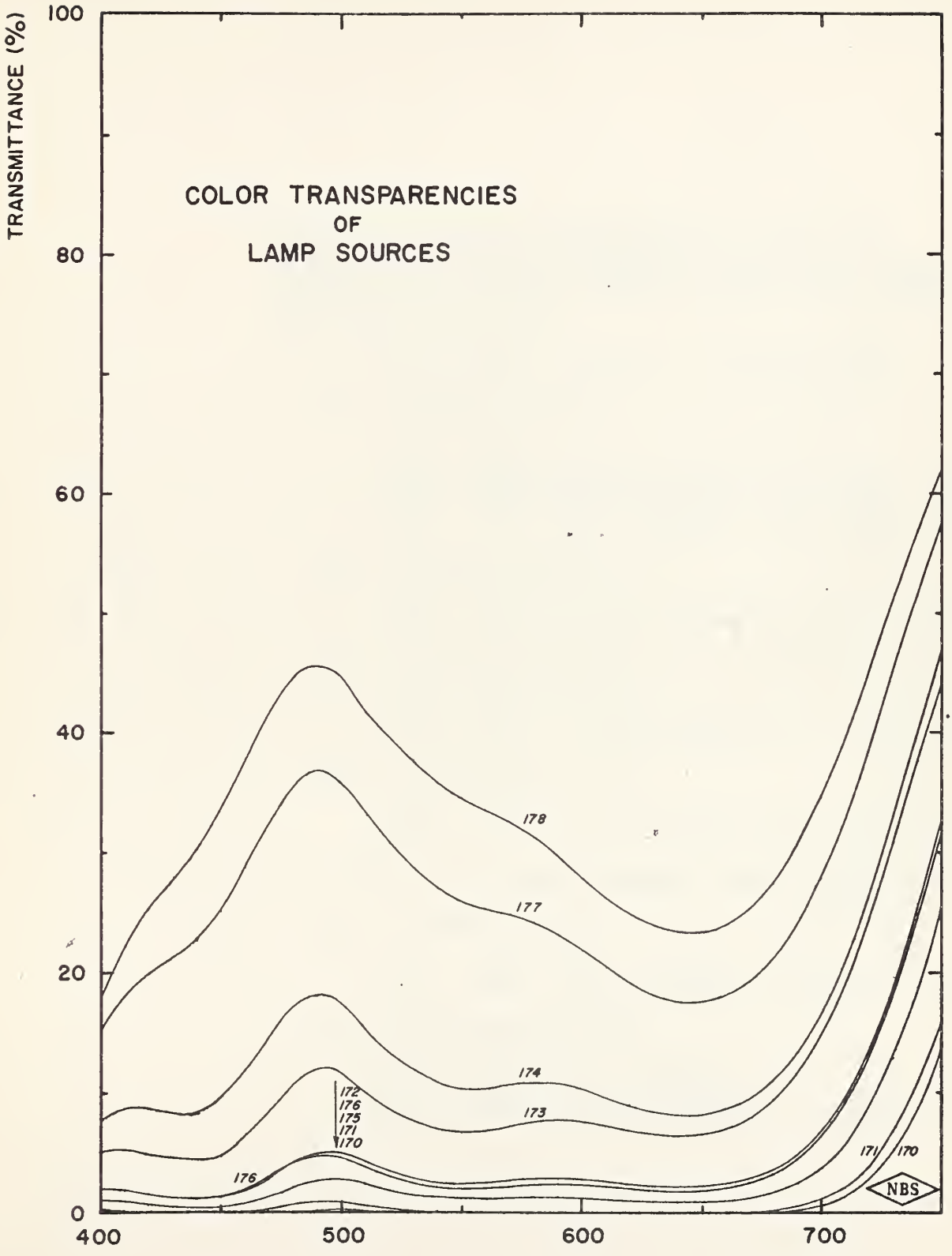
COLOR TRANSPARENCIES
OF
LAMP SOURCES
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
178
177
174
173
172
176
175
171
170
176
171
170
NBS

FIGURE 29

Figure 30. Spectral transmittance of nine color transparencies on Ansco daylight color film of twelve Lumiline lamps behind a diffusing glass on the O'Neill-Nagel light table [3] :

a) 15 inch working distance, no extension tube

a1) All rheostats out:

(179) W-1869 Under exposure. 1/10 sec. f/22
(180) W-1867 Normal exposure. 1/5 sec. f/22
(181) W-1868 Over exposure. 1/2 sec. f/22

a2) All rheostats 3/4 in:

(182) W-1870 Normal exposure. 1 sec. f/16

a3) All rheostats 1/2 in:

(183) W-1871 Normal exposure. 1 sec. f/22

a4) All rheostats 1/4 in:

(184) W-1872 Normal exposure. 1/2 sec. f/22

b) 6-1/2 inch working distance, 40mm extension tube

b1) All rheostats out:

(185) W-1873 Under exposure. 1/25 sec. f/11

b2) All rheostats 3/4 in:

(186) W-1874 Under exposure. 1 sec. f/16
(187) W-1875 Normal exposure. 1 sec. f/4

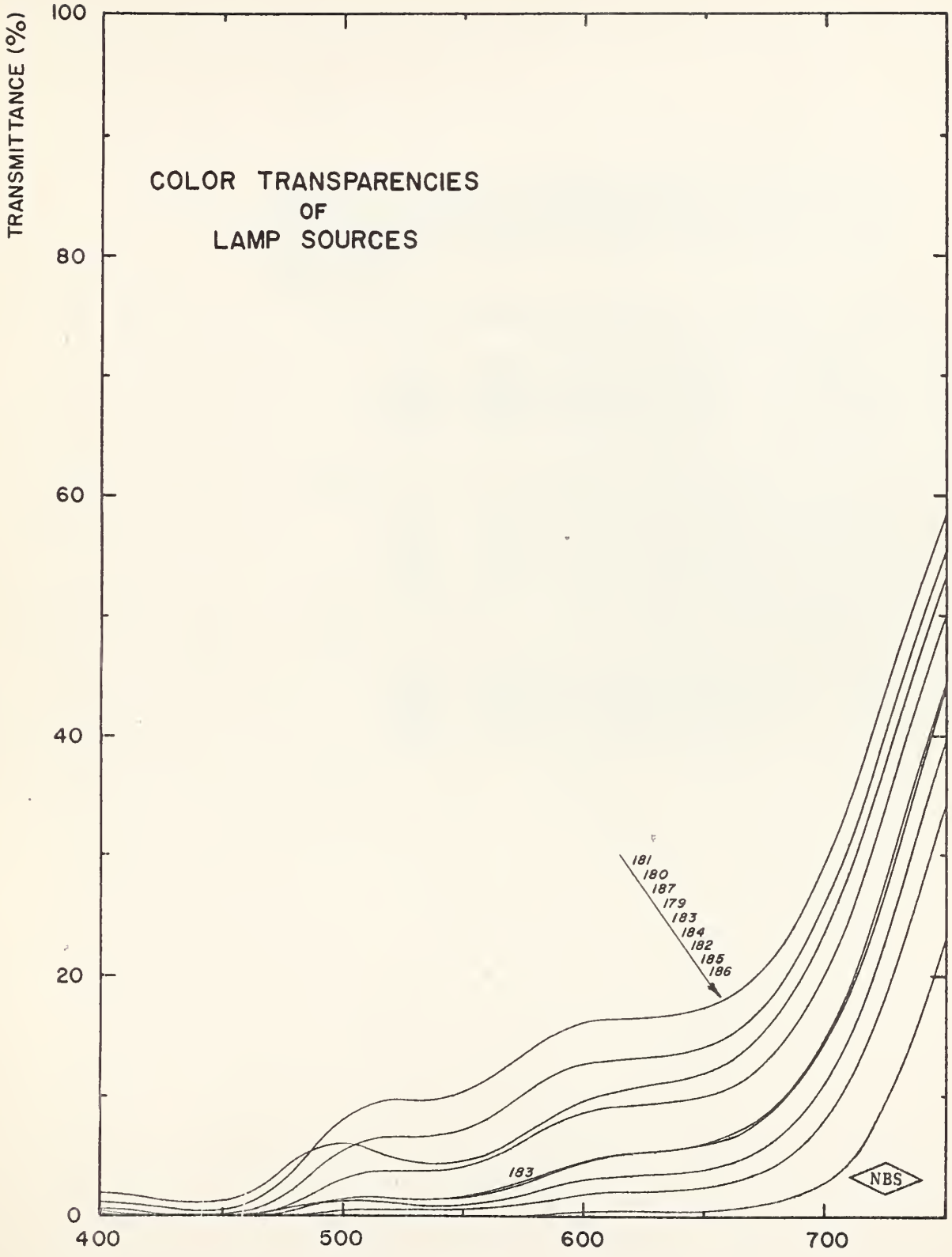
COLOR TRANSPARENCIES
OF
LAMP SOURCES
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
181
180
187
179
183
184
182
185
186
183
NBS

FIGURE 30

Figure 31. Spectral transmittance of nine color transparencies on Ansco daylight color of neon lamp behind diffusing glass on the O'Neill-Nagel light table [3] :

a) 15 inch working distance, no extension tube

(188)	W-1878	Under exposure.	1/25 sec.	f/16
(189)	W-1876	Normal exposure.	1/25 sec.	f/11
(190)	W-1877	Over exposure.	1/25 sec.	f/5.6

b) 6-1/2 inch working distance, 40mm extension tube

(191)	W-1881	Under exposure.	1/10 sec.	f/16
(192)	W-1879	Normal exposure.	1/25 sec.	f/5.6
(193)	W-1880	Over exposure.	1 sec.	f/16

c) 4-1/2 inch working distance, 80mm extension tube

(194)	W-1884	Under exposure.	1 sec.	f/22
(195)	W-1882	Normal exposure.	1 sec.	f/16
(196)	W-1883	Over exposure.	1 sec.	f/8

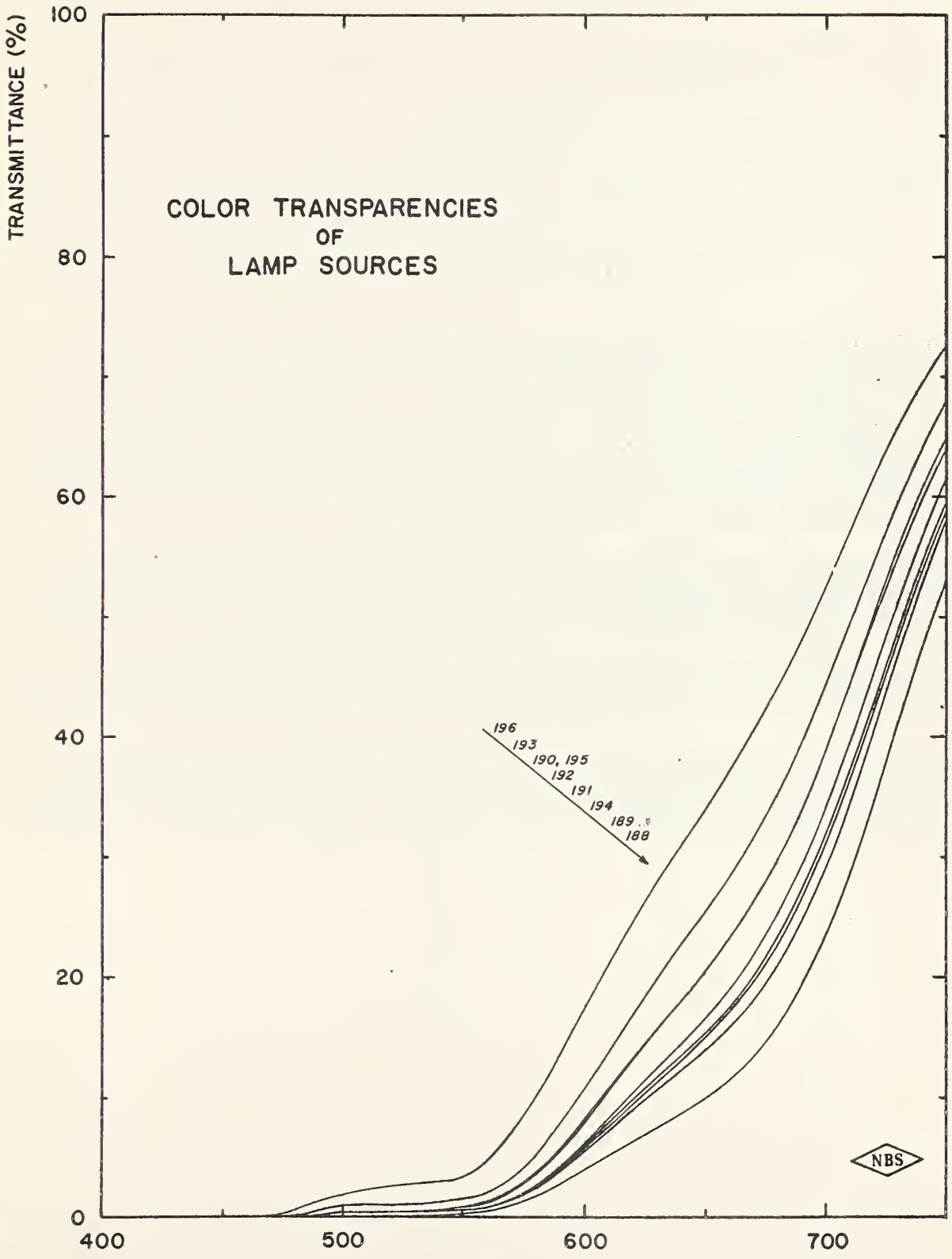
TRANSMITTANCE (%)
100
80
60
40
20
0
400
500
600
700
WAVELENGTH (mμ)
COLOR TRANSPARENCIES
OF
LAMP SOURCES
196
193
190, 195
192
191
194
189
188
NBS

FIGURE 31

VI. Colorimetric Computations

The spectral directional reflectance or the spectral transmittance data of each of the one hundred and ninety-six determinations of specimens related to man-made objects or to color transparencies of man-made objects listed in Appendix B for the visible spectrum (400 to 750 millimicrons) were converted into terms of luminous reflectance or luminous transmittance, Y, and chromaticity coordinates, x and y, of the C.I.E. colorimetry system by integration according to the C.I.E. Standard Observer and Coordinate System [15] for C.I.E. Source C, representative of average daylight. In addition, determinations were derived for each of the 196 specimens of this report of dominant wavelength, λ, and excitation purity, p.

Dominant wavelength and excitation purity are alternate standard specifications for color. They are more or less suggestive of the appearance of the color of the object and thus are sometimes more easily understood than the chromaticity coordinates, x and y, and the daylight transmittance or the daylight reflectance, Y. The dominant wavelengths and excitation purities of this report were determined from the chromaticity data by means of graphs showing the conversion of C.I.E. chromaticity data into these terms [16]. This method is recognized by the American Standards Association [17].

The chromaticity coordinates, daylight transmittances, dominant wavelength, and excitation purity of the 43 transmitting man-made objects are listed in Table II A of this report and are illustrated in Figures 32 and 33.

The chromaticity coordinates, daylight reflectances, dominant wavelength, and excitation purity of the 60 reflecting man-made objects are listed in Table II B and are illustrated in Figures 34 to 37.

The chromaticity coordinates, daylight transmittances, dominant wavelength, and excitation purity of the 93 color transparencies of man-made objects are listed in Table II C and are illustrated in Figures 38 to 41.

Table II

Chromaticity Coordinates, Daylight Transmittance, Dominant Wavelength, and Excitation Purity, for Source C, of the Indicated Samples.

IIA. Transmitting Man-Made Objects

Sample Number	Chromaticity Coordinates x	y	Daylight Transmittance Y(%)	Dominant Wavelength λ(mμ)	Excitation Purity p(%)
			Processed Unexposed Film		
(1)	0.608	0.366	0.3	600.6	93.2
(2)	.145	.044	0.5	462.9	96.8
(3)	.641	.351	8.0	604.8	97.9
(4)	.233	.623	8.6	535.6	68.4
(5)	.141	.144	12.6	477.2	81.2
(6)	.406	.201	6.0	506.3c	64.4
(7)	.494	.489	57.0	578.5	95.6
			Dye on Film Base		
(8)	.138	.120	9.1	475.1	85.8
(9)	.557	.241	4.4	494.6c	76.6
(10)	.504	.486	58.7	579.4	97.5
(11)	.504	.486	58.3	579.4	97.4
			Color Compensating Filters		
(12)	.315	.325	89.9	569.6	3.7
(13)	.323	.337	89.2	571.5	9.1
(14)	.327	.347	91.1	569.7	12.8
(15)	.343	.371	88.2	570.9	23.5
(16)	.374	.419	86.5	571.3	44.6
(17)	.315	.307	84.0	515.0c	4.6
(18)	.319	.297	76.3	519.0c	9.3
(19)	.324	.289	67.2	508.4c	9.9
(20)	.301	.313	87.1	486.5	3.7
(21)	.295	.316	84.0	490.6	5.6
(22)	.281	.312	78.7	489.1	11.1
(23)	.314	.323	91.5	570.0	2.9
(24)	.317	.327	91.3	571.0	4.8
(25)	.324	.338	90.6	571.5	9.6
(26)	.335	.359	90.5	570.4	18.1
(27)	.341	.371	90.0	570.0	23.0
(28)	.348	.381	89.4	570.4	27.6
(29)	.356	.395	88.8	570.5	33.4
(30)	.314	.316	87.4	650.0	1.0
(31)	.314	.312	86.6	504.5c	2.3

Table II (Continued)

Sample Number	Chromaticity Coordinates x	y	Daylight Transmittance Y(%)	Dominant Wavelength λ(mμ)	Excitation Purity p(%)
(32)	0.317	0.306	81.3	510.0c	5.4
(33)	.322	.295	73.3	515.0c	10.8
(34)	.326	.288	68.0	515.0c	14.3
(35)	.332	.277	60.9	514.9c	19.9
(36)	.338	.270	54.9	512.9c	23.8
(37)	.307	.316	88.1	490.0	1.4
(38)	.303	.314	86.3	487.1	2.9
(39)	.296	.312	83.2	487.0	5.6
(40)	.284	.306	76.6	486.1	10.6
(41)	.268	.299	69.3	486.0	17.2
(42)	.257	.293	64.4	485.5	21.7
(43)	.242	.284	57.7	485.0	28.1
	IIB. Reflecting Man-Made Objects				
	Dyed Papers and Cardboards				
(44)	.484	.435	50.7	583.0	78.4
(45)	.266	.291	47.8	483.7	18.9
(46)	.374	.405	69.7	573.1	40.9
(47)	.355	.288	45.7	498.8c	19.8
(48)	.550	.335	20.1	607.0	69.4
	U.S. Military Wearing Apparel				
(49)	.368	.366	24.7	579.7	28.9
(50)	.378	.379	10.3	578.6	35.1
(51)	.371	.362	19.9	581.6	28.5
(52)	.377	.371	19.0	580.4	32.7
(53)	.368	.364	21.6	580.3	28.3
(54)	.368	.372	23.2	578.2	30.4
(55)	.376	.379	12.8	578.4	34.6
(56)	.369	.369	6.7	579.1	30.0
(57)	.329	.345	5.4	572.0	12.8
(58)	.327	.347	5.3	569.7	12.8
(59)	.329	.344	6.0	572.3	12.5
(60)	.331	.352	11.9	570.4	15.2
(61)	.339	.355	14.6	573.6	18.0
(62)	.320	.343	17.6	565.1	9.9

Table II (Continued)

Sample Number	Chromaticity Coordinates x	y	Daylight Transmittance Y(%)	Dominant Wavelength $\Lambda(m\mu)$	Excitation Purity p(%)
			Painted Pressboards		
(63)	0.556	0.330	16.5	609.4	69.5
(64)	.379	.391	68.5	576.5	38.4
(65)	.268	.339	6.8	497.6	14.2
(66)	.514	.321	10.7	613.2	55.8
(67)	.221	.234	10.0	478.8	41.6
(68)	.378	.343	8.2	590.3	25.4
(69)	.256	.400	30.7	511.1	18.6
			Munsell Papers (Tobey Press)		
(70)	.508	.412	31.2	587.7	78.7
(71)	.454	.473	57.4	576.4	80.6
(72)	.383	.487	41.4	566.8	65.5
(73)	.250	.407	18.5	510.6	20.4
(74)	.220	.321	11.4	491.6	33.3
(75)	.196	.248	11.9	483.4	48.8
(76)	.186	.178	7.6	475.6	61.4
(77)	.307	.215	12.4	552.8c	40.1
(78)	.401	.250	11.9	499.9c	43.8
(79)	.526	.314	13.5	618.0	57.1
(80)	.511	.318	13.5	615.0	54.3
(81)	.492	.317	12.5	616.0	49.1
(82)	.455	.320	11.6	612.9	39.8
(83)	.428	.318	11.7	612.6	32.0
(84)	.385	.317	11.9	616.0	20.3
(85)	.349	.318	11.6	610.0	10.8
(86)	.314	.322	82.1	572.4	2.6
(87)	.313	.320	74.1	573.2	1.7
(88)	.315	.322	67.2	575.4	2.9
(89)	.313	.323	57.6	567.4	2.5
(90)	.314	.321	51.5	574.2	2.3
(91)	.314	.323	41.7	570.0	2.8
(92)	.313	.322	35.7	568.9	2.3
(93)	.311	.320	28.4	560.0	1.2
(94)	.314	.320	24.9	578.0	2.0
(95)	.311	.320	19.0	560.0	1.2
(96)	.314	.319	15.8	582.7	1.7
(97)	.311	.318	11.8	571.0	0.2
(98)	.308	.314	9.1	478.0	1.1
(99)	.308	.315	6.8	482.8	0.9

Table II (Continued)

Sample Number	Chromaticity Coordinates x	y	Daylight Transmittance Y(%)	Dominant Wavelength $\Lambda(m\mu)$	Excitation Purity p(%)
(100)	0.307	0.313	4.9	476.6	1.4
(101)	.306	.314	3.4	484.6	1.7
(102)	.307	.312	3.0	470.0	1.7
(103)	.306	.313	3.4	480.0	1.8
	IIC. Color Transparencies of Man-Made Objects				
	Photographs of Dyed Papers and Cardboards				
(104)	.521	.452	7.5	583.8	92.9
(105)	.454	.462	23.0	577.4	77.7
(106)	.424	.454	35.7	575.0	67.4
(107)	.400	.438	46.5	573.5	56.9
(108)	.349	.366	61.8	574.3	23.7
(109)	.340	.352	64.1	575.0	17.6
(110)	.339	.351	64.5	575.0	17.1
(111)	.344	.357	64.1	575.0	20.0
(112)	.340	.353	64.3	574.8	17.9
(113)	.262	.310	1.3	489.4	18.4
(114)	.286	.336	11.3	501.0	7.8
(115)	.280	.325	16.2	494.5	10.6
(116)	.278	.324	24.1	493.8	11.4
(117)	.285	.330	32.7	497.6	8.4
(118)	.324	.346	61.0	567.9	11.8
(119)	.331	.347	64.0	572.5	14.0
(120)	.335	.349	65.0	573.9	15.5
(121)	.334	.347	64.4	574.0	14.7
(122)	.441	.482	2.6	574.4	79.6
(123)	.394	.434	10.7	573.0	54.0
(124)	.374	.424	19.8	570.6	46.0
(125)	.354	.409	29.4	568.0	36.6
(126)	.347	.401	37.9	567.0	32.6
(127)	.334	.352	61.5	572.2	16.0
(128)	.334	.349	63.5	573.1	15.2
(129)	.335	.348	64.0	574.2	15.2
(130)	.336	.348	64.6	574.9	15.4
(131)	.391	.348	8.5	590.5	30.3
(132)	.328	.326	25.5	586.0	7.3
(133)	.323	.331	36.4	576.0	7.4

Table II (Continued)

Sample Number	Chromaticity Coordinates x	y	Daylight Transmittance Y(%)	Dominant Wavelength Λ(mμ)	Excitation Purity p(%)
(134)	0.325	0.342	51.4	570.2	10.8
(135)	.328	.345	58.4	571.2	12.5
(136)	.335	.346	68.3	575.0	14.7
(137)	.335	.346	68.3	575.0	14.7
(138)	.335	.346	68.3	575.0	14.7
(139)	.336	.346	66.6	575.5	15.0
(140)	.657	.336	1.4	609.8	98.1
(141)	.551	.360	4.3	599.8	76.2
(142)	.482	.356	10.5	597.0	56.8
(143)	.443	.360	12.5	592.6	47.4
(144)	.444	.359	12.5	593.1	47.3
(145)	.339	.344	64.8	578.0	15.2
(146)	.336	.347	67.2	575.4	15.2
(147)	.336	.347	67.3	575.4	15.2
(148)	.336	.347	68.4	575.4	15.2
(149)	.447	.298	18.2	492.6c	33.0
(150)	.382	.297	32.6	494.2c	21.4
(151)	.650	.343	6.6	607.1	98.2
(152)	.566	.368	14.9	598.6	82.3
			Photographs of U.S. Army Shirt		
(153)	.477	.363	25.5	594.7	57.2
(154)	.566	.361	13.9	600.2	80.4
(155)	.142	.053	0.8	465.5	95.9
(156)	.142	.102	4.0	472.6	87.2
(157)	.212	.246	28.7	481.8	43.2
(158)	.142	.059	1.1	466.4	94.8
(159)	.146	.118	5.9	473.8	83.5
(160)	.167	.176	14.2	477.8	68.1
(161)	.453	.356	3.3	594.7	48.9
(162)	.676	.324	2.5	613.4	100.0
(163)	.538	.444	9.3	585.7	95.4
(164)	.296	.620	3.0	548.7	78.9
(165)	.152	.038	0.1	458.9	96.4
(166)	.426	.371	10.5	588.0	45.8
(167)	.386	.371	22.1	582.2	35.1
(168)	.477	.493	62.6	576.8	92.2
(169)	.439	.475	69.3	574.8	77.2

Table II (Continued)

Sample Number	Chromaticity Coordinates x	y	Daylight Transmittance Y(%)	Dominant Wavelength $\Lambda(m\mu)$	Excitation Purity p(%)
			Photographs of Lamp Sources		
(170)	0.102	0.388	0.0_2	495.1	72.5
(171)	.090	.337	0.2	494.3	77.6
(172)	.308	.371	2.9	548.0	14.1
(173)	.306	.346	7.7	543.0	7.1
(174)	.285	.328	11.5	496.7	8.5
(175)	.296	.395	1.5	540.0	18.0
(176)	.297	.356	2.5	529.2	8.0
(177)	.280	.324	26.2	494.0	10.6
(178)	.280	.323	34.1	493.6	10.7
(179)	.505	.455	5.4	582.4	89.5
(180)	.481	.460	8.6	580.0	84.4
(181)	.461	.459	11.7	578.4	78.8
(182)	.509	.421	1.7	586.5	81.6
(183)	.534	.435	2.6	586.4	91.9
(184)	.540	.433	2.5	587.1	93.0
(185)	.552	.427	0.9	588.4	94.5
(186)	.669	.331	0.1	611.0	100.0
(187)	.437	.398	6.5	583.7	55.9
(188)	.644	.353	1.7	604.5	99.2
(189)	.635	.360	2.5	602.8	98.8
(190)	.636	.359	3.6	604.1	97.3
(191)	.634	.360	2.7	602.7	98.4
(192)	.638	.357	2.8	603.4	98.6
(193)	.621	.373	5.0	599.8	98.6
(194)	.638	.358	2.6	603.3	99.0
(195)	.634	.361	3.6	602.5	98.7
(196)	.595	.393	8.5	595.2	96.9

Figure 32. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of seven processed unexposed films and four dye-on-film base of Ansco daylight color film.

a) Processed unexposed film:

(1) W-126 RGB (Ansco daylight color film)
(2) W-125 RG (special Ansco red and green sensitive film)
(3) W-130 GB (special Ansco green and blue sensitive film)
(4) W-124 BR (special Ansco blue and red sensitive film)
(5) W-129 R (special Ansco red sensitive film)
(6) W-128 G (special Ansco green sensitive film)
(7) W-127 B (special Ansco blue sensitive film)

b) Dye-on-film base:

(8) Cyan dye on film base
(9) Magenta dye on film base
(10 & (11) Yellow dye on film base (two determinations on same sample)

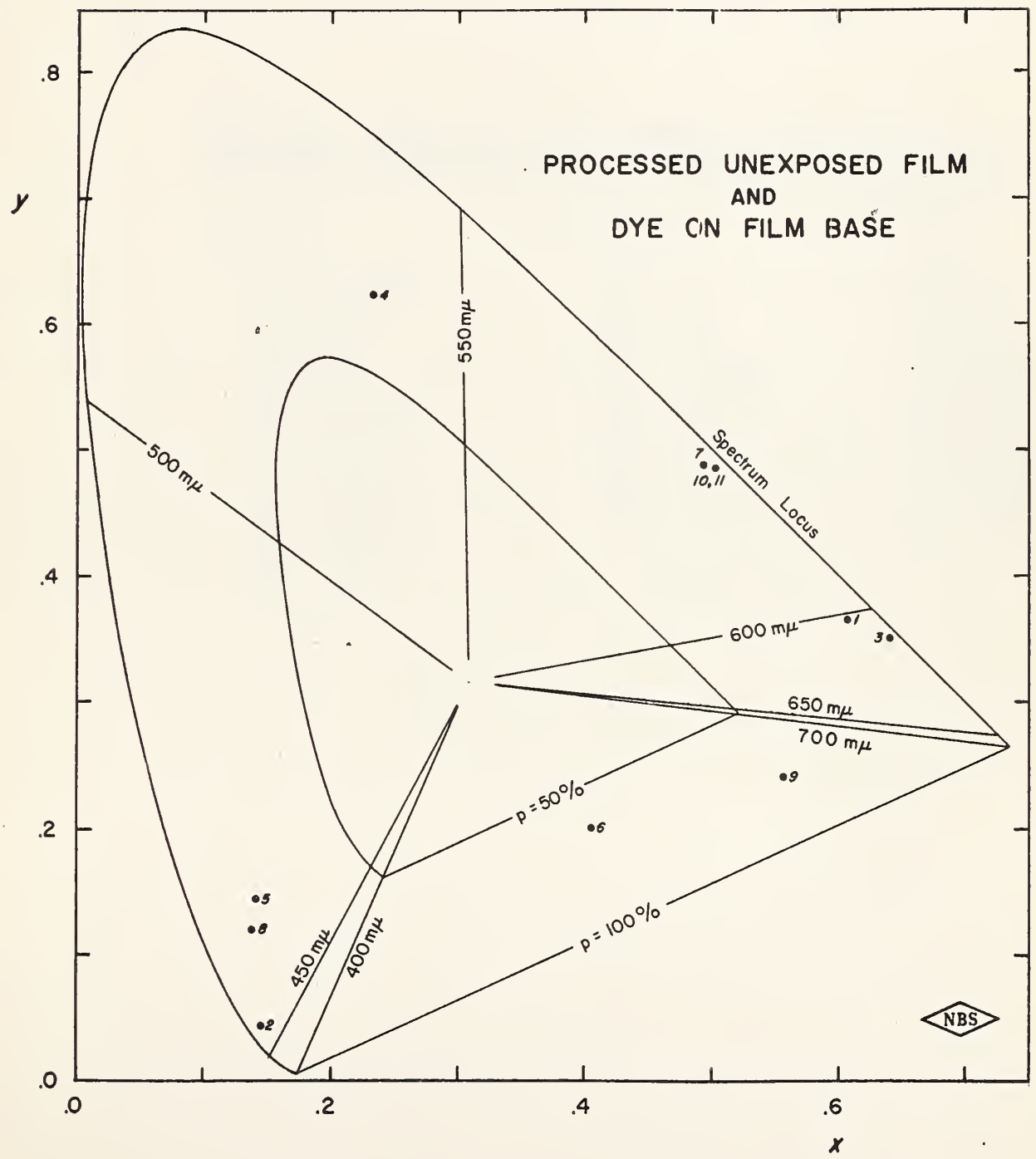
PROCESSED UNEXPOSED FILM
AND
DYE ON FILM BASE
y
x
.0
.2
.4
.6
.8
550mμ
500mμ
600 mμ
650 mμ
700 mμ
Spectrum Locus
1
10,11
3
4
5
6
8
9
2
p=50%
p=100%
450mμ
400mμ
NBS

FIGURE 32

Figure 33. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of thirty-two Ansco color compensating filters:

a) Yellow

(12) UV-16P
(13) 23
(14) 24
(15) 25
(16) 26
(23) .025Y
(24) .05Y
(25) .10Y
(26) .20Y
(27) .30Y
(28) .40Y
(29) .50Y

b) Magenta

(17) 33
(18) 34
(19) 35
(30) .025M
(31) .05M
(32) .10M
(33) .20M
(34) .30M
(35) .40M
(36) .50M

c) Cyan

(20) 43
(21) 44
(22) 45
(37) .025C
(38) .05C
(39) .10C
(40) .20C
(41) .30C
(42) .40C
(43) .50C

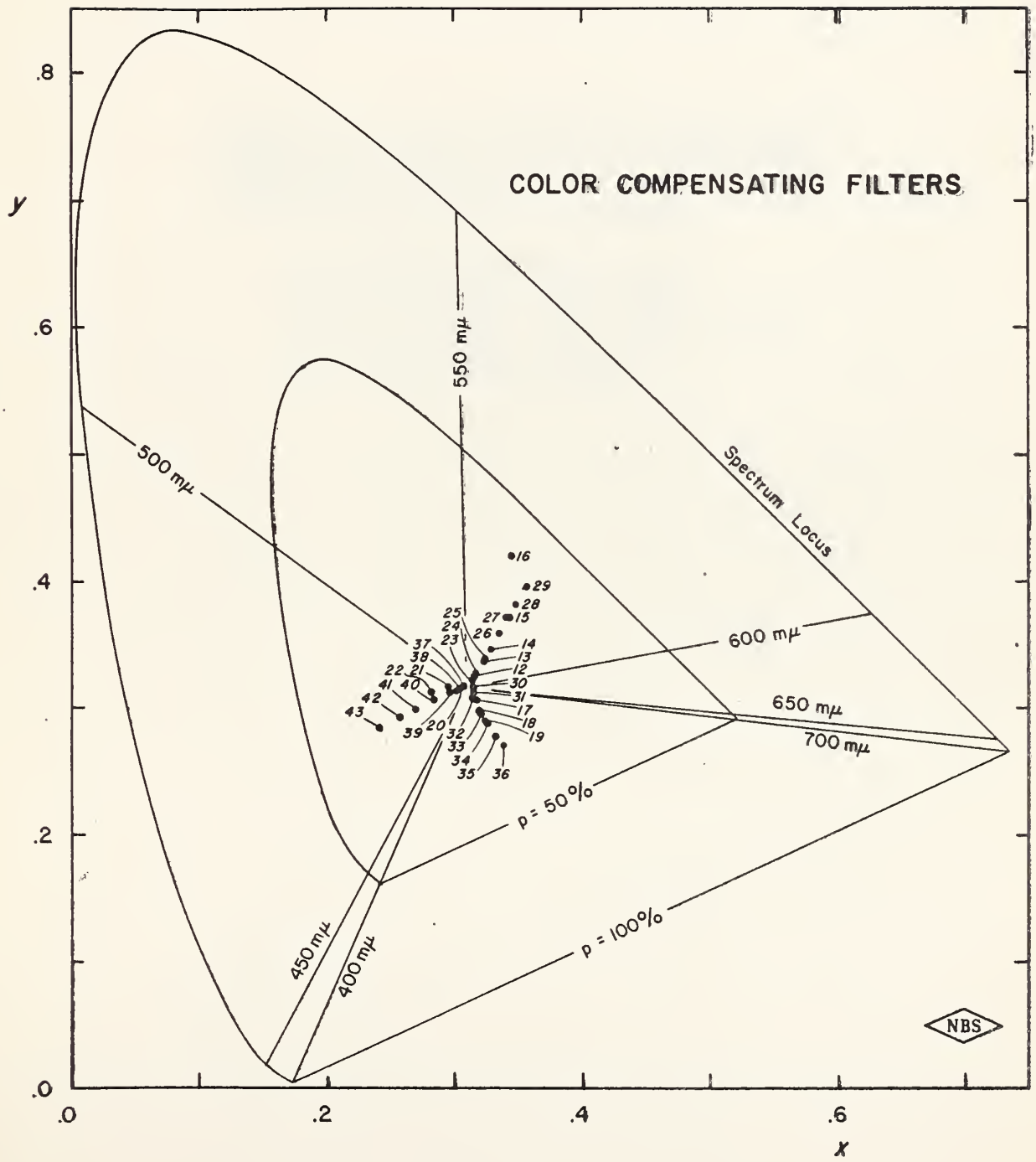
COLOR COMPENSATING FILTERS
y
x
.0
.2
.4
.6
.8
550 mμ
500 mμ
600 mμ
650 mμ
700 mμ
Spectrum Locus
p = 50%
p = 100%
450 mμ
400 mμ
NBS
16
29
28
15
27
25
24
26
23
14
37
38
13
22
21
12
41
40
30
42
31
43
17
18
20
19
39
32
33
34
35
36

FIGURE 33

Figure 34. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of five selected dyed papers and cardboards.

(44) Mimeo Bond Paper, Orange
(45) Onion Skin Paper, Blue
(46) Onion Skin Paper, Canary Yellow
(47) Onion Skin Paper, Pink
(48) Railroad Board, Red

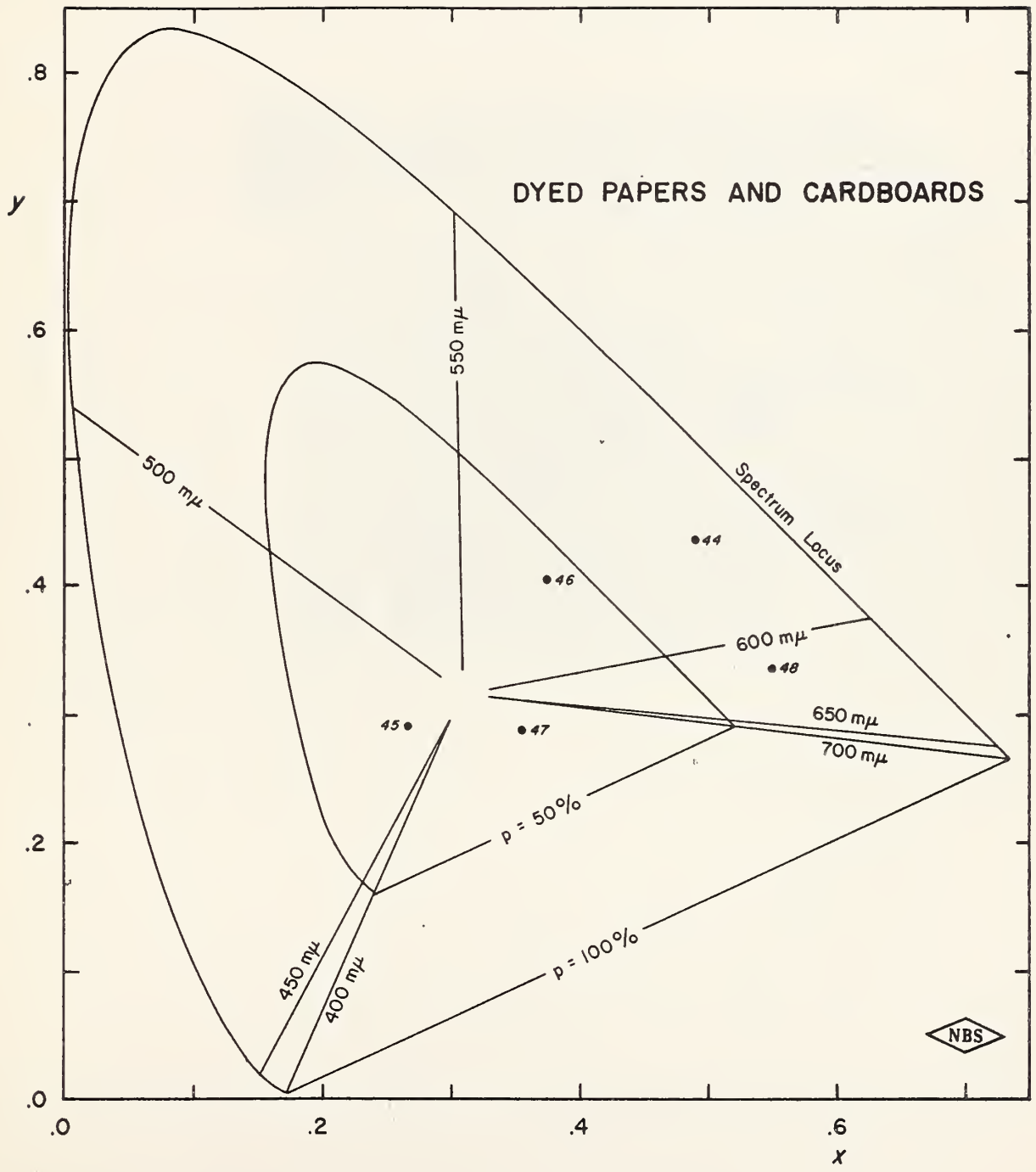
DYED PAPERS AND CARDBOARDS
y
x
.0
.2
.4
.6
.8
550 mμ
500 mμ
Spectrum Locus
600 mμ
650 mμ
700 mμ
p = 50%
p = 100%
450 mμ
400 mμ
44
46
48
45
47
NBS

FIGURE 34

Figure 35. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of fourteen textile samples of U. S. military wearing apparel.

(49) Khaki #1, cotton (Army shade book No. 5045 at NBS)
(50) Olive Drab #52, wool (ditto)
(51) US Marine Corps Necktie
(52) US Marine Corps Overseas Cap (summer)
(53) US Marine Corps Pants (summer)
(54) US Marine Corps Shirt (summer)
(55) US Army Shirt (winter)
(56) US Army Eisenhower jacket (winter)
(57) US Marine Corps Overseas Cap (winter)
(58) US Marine Corps Blouse (winter)
(59) US Marine Corps Pants (winter)
(60) US Marine Corps Fatigue Cap
(61) US Marine Corps Fatigue Shirt
(62) US Marine Corps Fatigue Pants

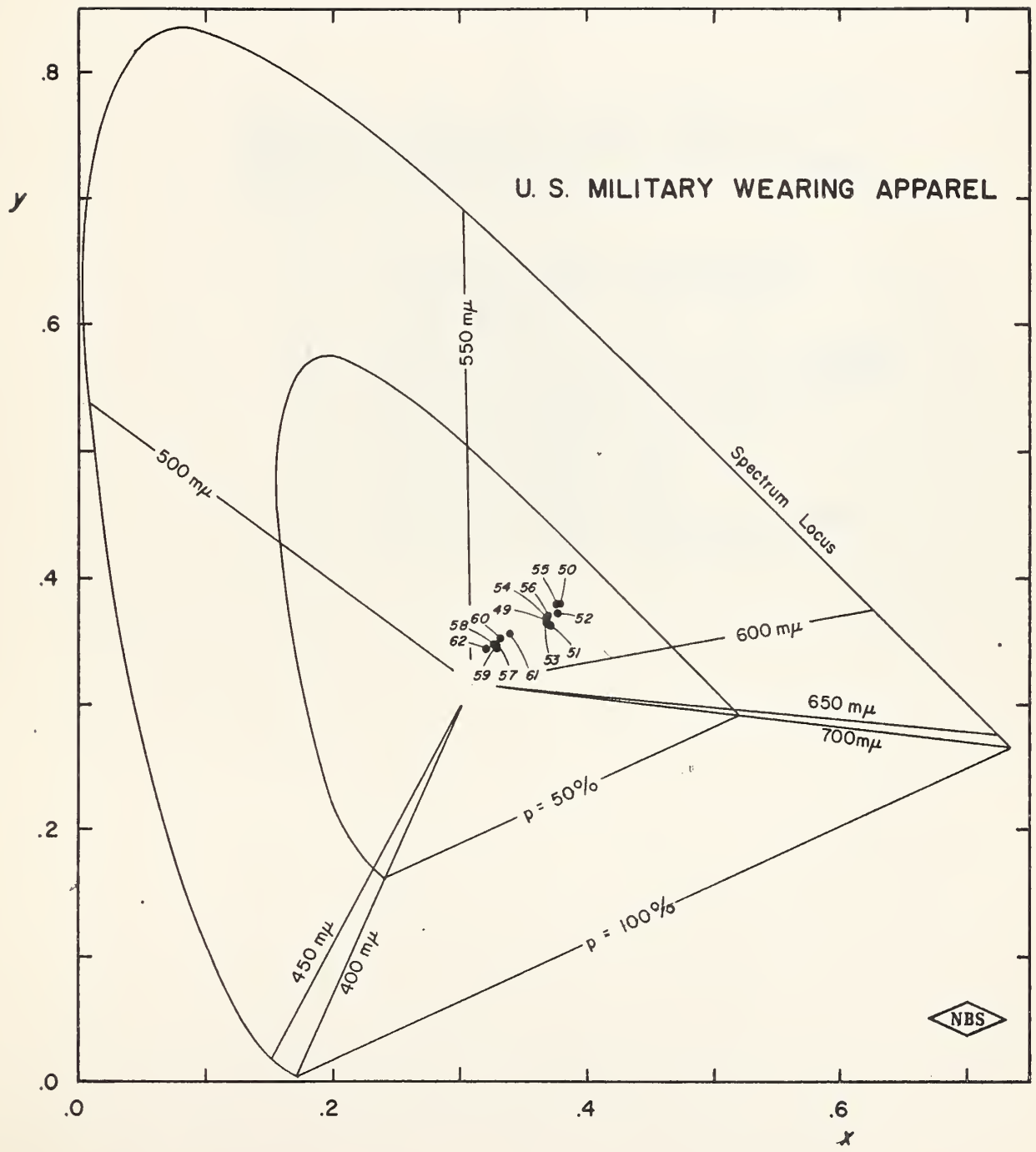
U. S. MILITARY WEARING APPAREL
y
x
.0
.2
.4
.6
.8
550 mμ
500 mμ
600 mμ
650 mμ
700mμ
450 mμ
400 mμ
Spectrum Locus
p = 50%
p = 100%
55 50
54 56
49
52
58 60
62
53 51
59 57 61
NBS

FIGURE 35

Figure 36. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of seven samples of paint on pressboard.

(63) Chinese Red #6335 Chi-namel Paint, Chi-namel Paint and Varnish Co.
(64) Colony Yellow #317 House Paint, Lowe Brothers
(65) Green #173 Tractor Paint, Lowe Brothers
(66) Red #139 Tractor Paint, Lowe Brothers
(67) Royal Blue Permanent Trim Paint, John W. Masury & Son
(68) Seal Brown Supreme House Paint, John W. Masury & Son
(69) Verdi Green #6830 Super House Paint, Chi-namel Paint and Varnish Co.

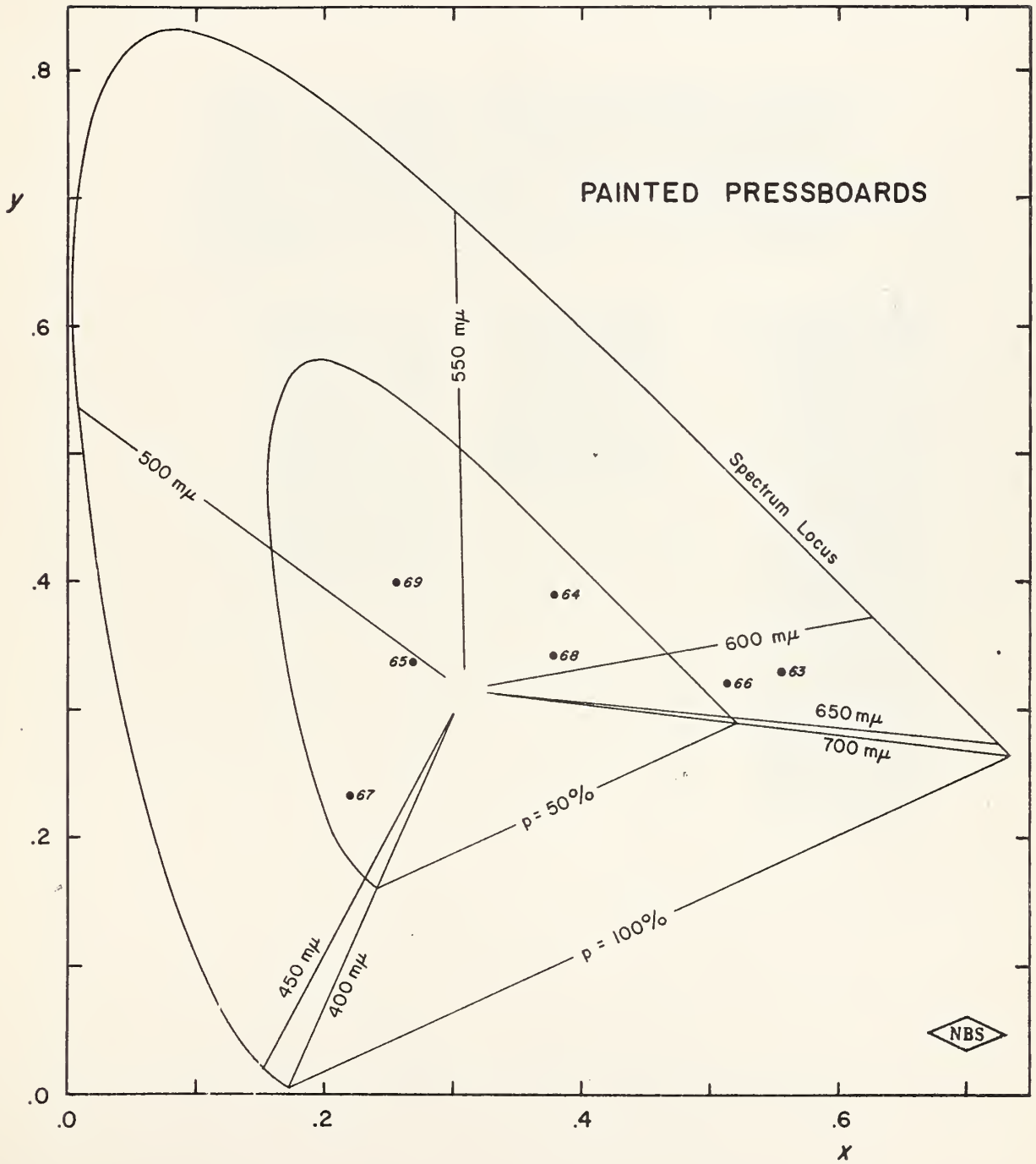
PAINTED PRESSBOARDS
y
x
.0
.2
.4
.6
.8
550 mμ
500 mμ
Spectrum Locus
600 mμ
650 mμ
700 mμ
p = 50%
p = 100%
450 mμ
400 mμ
69
64
65
68
66
63
67
NBS

FIGURE 36

Figure 37. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of thirty-four samples of commercially prepared (Tobey Press) Munsell pigmented papers. (Note expansion of scale of diagram near the illuminant for the eighteen neutrals).

a) Hue Scale

(70) 5YR 6/12
(71) 5Y 8/12
(72) 5GY 7/10
(73) 5G 5/8
(74) 5BG 4/6
(75) 5B 4/8
(76) 5PB 3/12
(77) 5P 4/12
(78) 5RP 4/12
(79) 5R 4/14

b) Chroma Scale

(80) 5R 4/12
(81) 5R 4/10
(82) 5R 4/8
(83) 5R 4/6
(84) 5R 4/4
(85) 5R 4/2

c) Value Scale

(86) N 9.5/
(87) N 9/
(88) N 8.5/
(89) N 8/
(90) N 7.5/
(91) N 7/
(92) N 6.5/
(93) N 6/
(94) N 5.5/
(95) N 5/
(96) N 4.5/
(97) N 4/
(98) N 3.5/
(99) N 3/
(100) N 2.5/
(101) N 2/
(102) N 1.5/
(103) N 1/

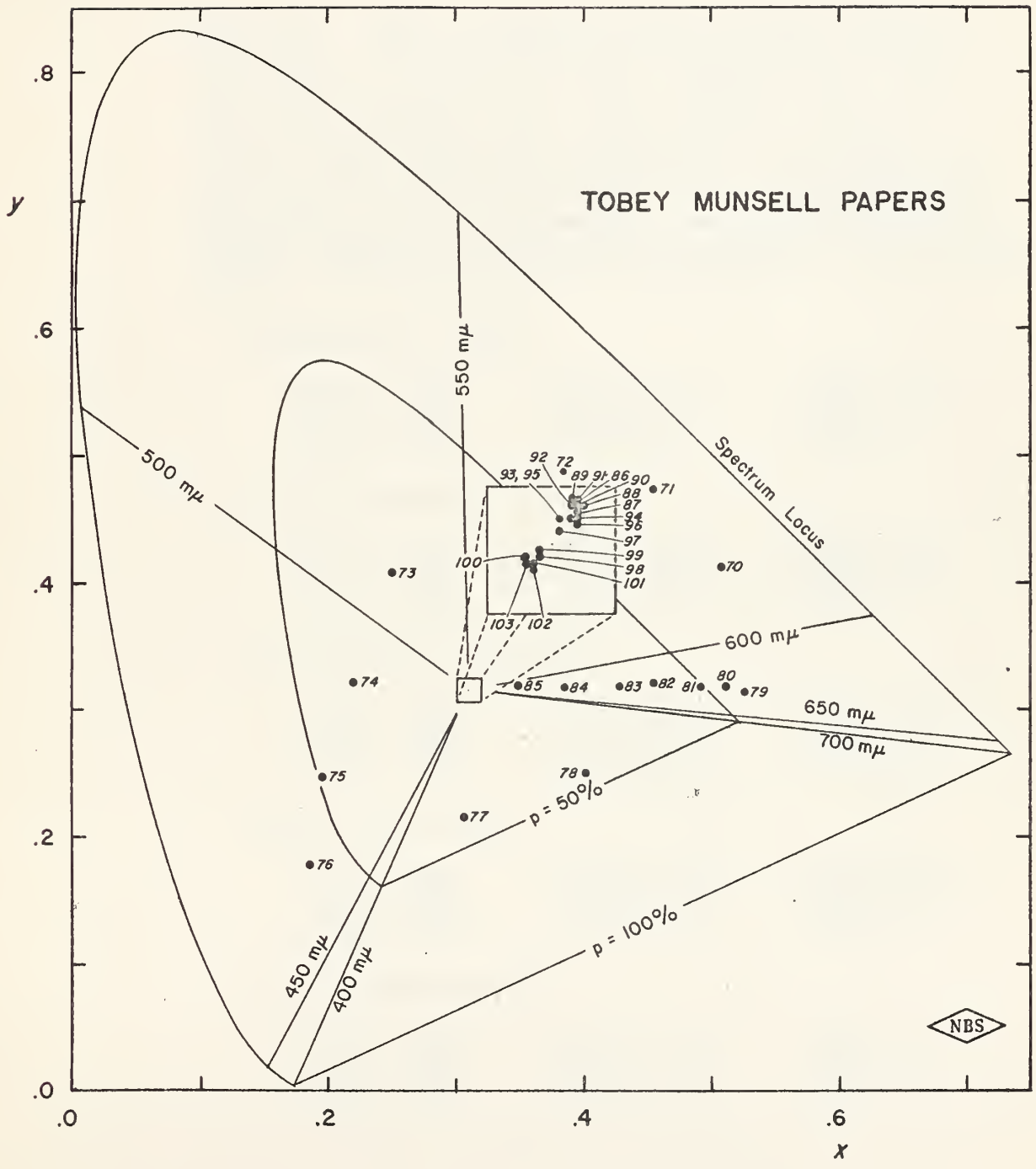
TOBEY MUNSELL PAPERS
Spectrum Locus
550 mμ
500 mμ
600 mμ
650 mμ
700 mμ
450 mμ
400 mμ
p = 50%
p = 100%
NBS
y
x
.0
.2
.4
.6
.8
92
72
93, 95
89
91
86
90
71
88
87
94
96
97
99
98
101
100
103
102
73
70
74
85
84
83
82
81
80
79
75
78
77
76

FIGURE 37

Figure 38. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of forty-five color transparencies of five dyed papers and cardboards on Ansco daylight color film for the indicated shutter speeds (seconds) at f/8 aperture. (Twenty of the forty-five transparencies are plotted on the regular scale of the chromaticity diagram. The remaining twenty-five color transparencies of the over-exposed photographs, indicated by an asterisk, are plotted on the enlarged portion of the diagram near the illuminant.)

a) Orange Mimeo Bond:

(104) 1/400	(107) 1/25	(110)* 1/2
(105) 1/100	(108)* 1/10	(111)* 1
(106) 1/50	(109)* 1/5	(112)* 2

b) Blue Onion Skin:

(113) 1/800	(116) 1/50	(119)* 1/5
(114) 1/200	(117) 1/25	(120)* 1/2
(115) 1/100	(118)* 1/10	(121)* 1

c) Canary Yellow Onion Skin:

(122) 1/800	(125) 1/50	(128)* 1/5
(123) 1/200	(126) 1/25	(129)* 1/2
(124) 1/100	(127)* 1/10	(130)* 1

d) Pink Onion Skin:

(131) 1/800	(134)* 1/50	(137)* 1/5
(132)* 1/200	(135)* 1/25	(138)* 1/2
(133)* 1/100	(136)* 1/10	(139)* 1

e) Red Railroad Board:

(140) 1/400	(143) 1/25	(146)* 1/2
(141) 1/100	(144) 1/10	(147)* 1
(142) 1/50	(145)* 1/5	(148)* 2

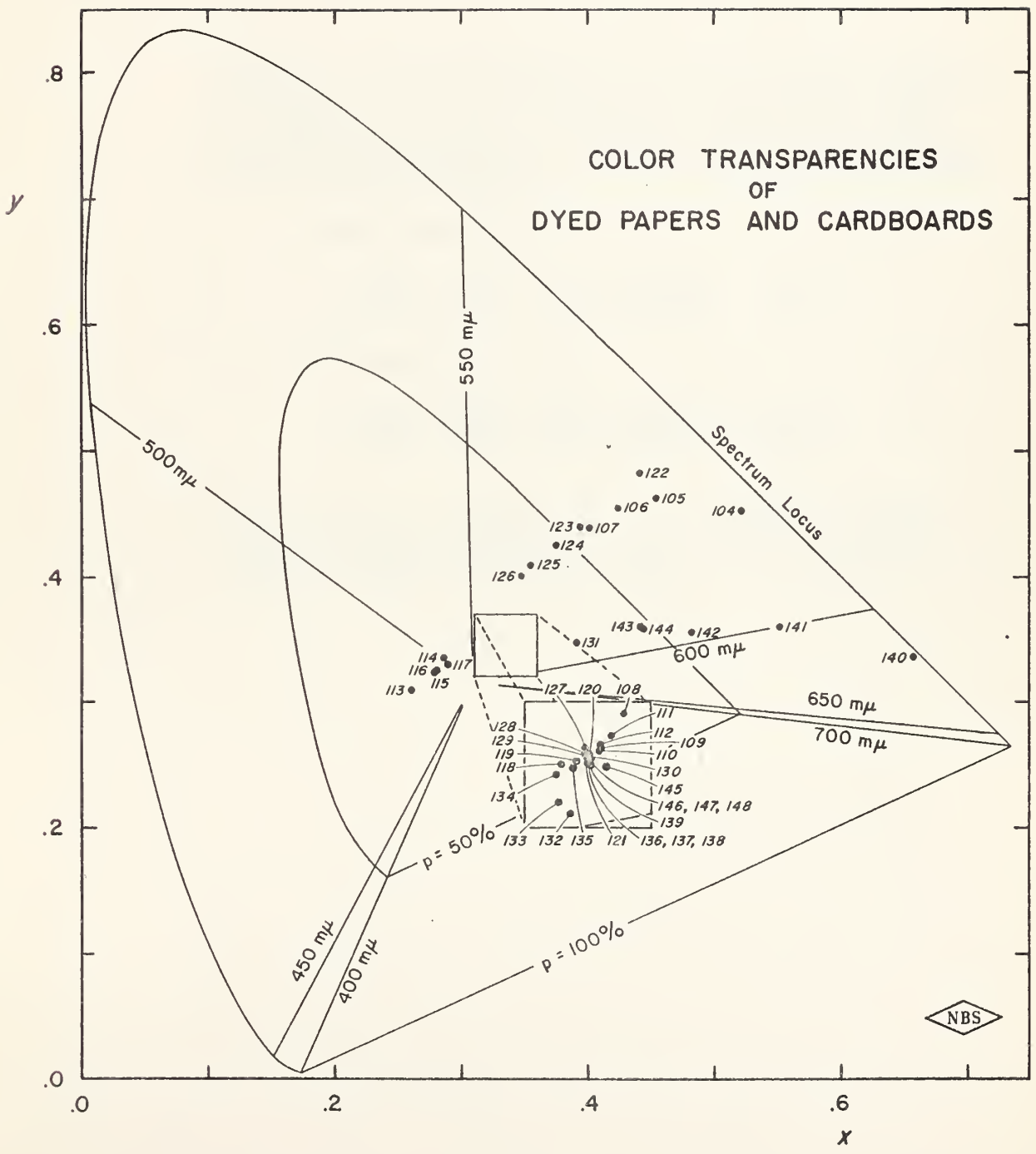
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
y
x
.0
.2
.4
.6
.8
Spectrum Locus
500mμ
550 mμ
600 mμ
650 mμ
700 mμ
450 mμ
400 mμ
p = 50%
p = 100%
NBS
122
105
106
104
123
107
124
125
126
143
144
142
141
131
140
114
116
117
113
115
127
120
108
111
112
109
110
128
129
119
118
130
134
145
146, 147, 148
139
133
132
135
121
136, 137, 138

FIGURE 38

Figure 39. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of four color transparencies of two dyed cardboards on special Ansco green and blue sensitive film at the indicated apertures for 1/200 second shutter speed:

a) Blue Railroad Board

(149) W-132 Normal exposure. f/5.6
(150) W-133 Over exposure. f/4

b) Tuscan Railroad Board

(151) W-134 Normal exposure. f/16
(152) W-135 Over exposure. f/8

(The chromaticity coordinates of the original blue and buff, or tuscan, cardboards, may be seen on Figure 64, page 89, NBS Report 4438 [6] .)

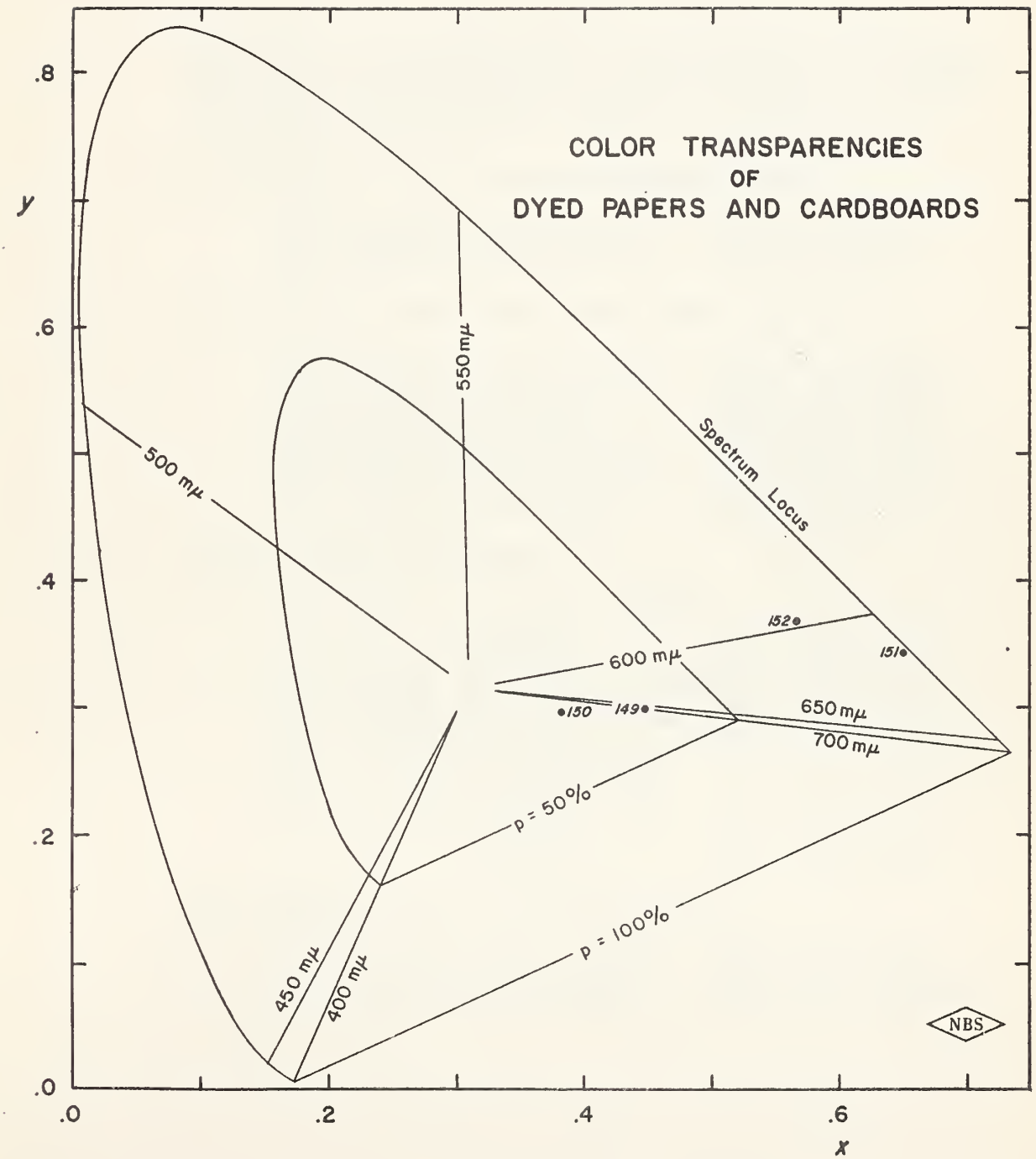
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
y
x
.8
.6
.4
.2
.0
.0
.2
.4
.6
550 mμ
500 mμ
Spectrum Locus
152
151
600 mμ
150
149
650 mμ
700 mμ
p = 50%
p = 100%
450 mμ
400 mμ
NBS

FIGURE 39

Figure 40. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of seventeen color transparencies of a U. S. Army Olive Drab Winter Shirt (Sample No. 55, Figure 13):

a) On Special Ansco Green and Blue Sensitive Film

(153)	W-141	Normal exposure.	1/50 sec., f/5.6
(154)	W-142	Over exposure.	1/50 sec., f/4

b) On Special Ansco Red and Green Sensitive Film

(155)	W-171	Normal exposure.	1/100 sec., f/11
(156)	W-172	Over exposure.	1/100 sec., f/5.6
(157)	W-173	Over exposure.	1/100 sec., f/4
(158)	W-198	Under exposure.	1/200 sec., f/11
(159)	W-199	Normal exposure.	1/200 sec., f/5.6
(160)	W-200	Over exposure.	1/200 sec., f/4

c) On Ansco Daylight Color Film

(161)	W-291	No filter, Normal exposure.	1/50 sec., f/11
(162)	W-292	With red filter.	1/50 sec., f/2.8
(163)	W-293	With yellow filter.	1/50 sec., f/8
(164)	W-294	With green filter.	1/100 sec., f/2.8
(165)	W-295	With blue filter.	1/50 sec., f/2.8
(166)	W-296	No filter, Over exposure.	1/50 sec., f/8
(167)	W-297	No filter, Over exposure.	1/50 sec., f/5.6

d) On Special Ansco Blue Sensitive Film

(168)	W-430	Normal exposure.	1/50 sec., f/11
(169)	W-431	Over exposure.	1/50 sec., f/5.6

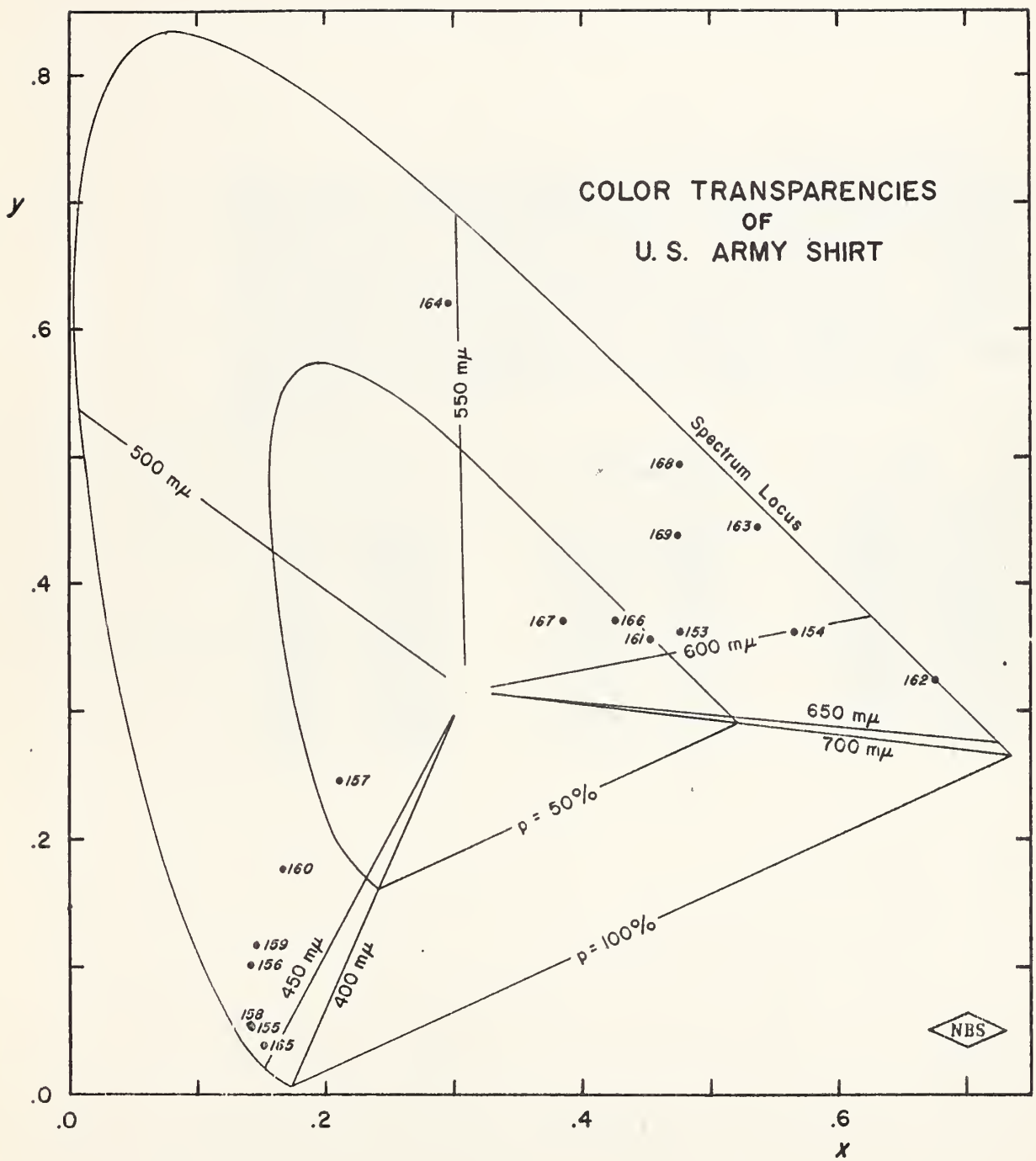
COLOR TRANSPARENCIES
OF
U. S. ARMY SHIRT
Spectrum Locus
500 mμ
550 mμ
600 mμ
650 mμ
700 mμ
450 mμ
400 mμ
p = 50%
p = 100%
164
168
169
163
167
166
161
153
154
162
157
160
159
156
158
155
165
NBS
.0
.2
.4
.6
.8
y
x

FIGURE 40

Figure 41. C.I.E. chromaticity diagram showing dominant wavelength, excitation purity, and chromaticity coordinates, for Source C, of twenty-seven color transparencies on Ansco daylight color film of fluorescent, incandescent, and neon lamp sources in the O'Neill-Nagel light table [3]. (For convenience, the seven samples of the neon lights, indicated by asterisks are plotted on the expanded portion of the diagram near 600 millimicrons on the spectrum locus.) (For details of the photographs of these lamp sources, see Table I.)

a) Fluorescent	b) Incandescent	c) Neon
(170) W-1862	(179) W-1869	(188)* W-1878
(171) W-1861	(180) W-1867	(189)* W-1876
(172) W-1858	(181) W-1868	(190)* W-1877
(173) W-1859	(182) W-1870	(191)* W-1881
(174) W-1860	(183) W-1871	(192)* W-1879
(175) W-1865	(184) W-1872	(193) W-1880
(176) W-1863	(185) W-1873	(194)* W-1884
(177) W-1864	(186) W-1874	(195)* W-1882
(178) W-1866	(187) W-1875	(196) W-1883

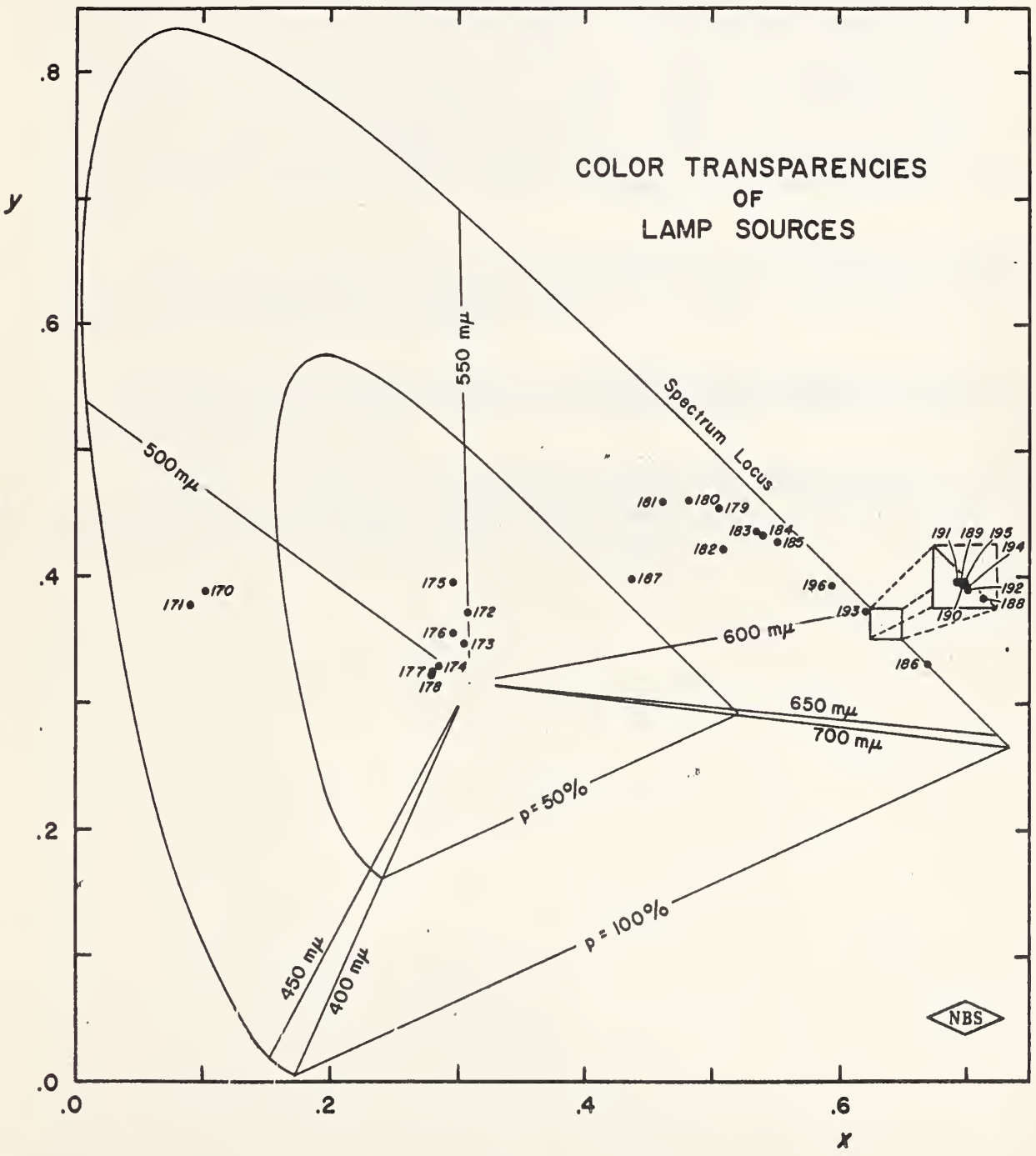
COLOR TRANSPARENCIES
OF
LAMP SOURCES
y
x
.0
.2
.4
.6
.8
Spectrum Locus
550 mμ
500 mμ
600 mμ
650 mμ
700 mμ
450 mμ
400 mμ
p = 50%
p = 100%
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
NBS

FIGURE 41

VII. Munsell Renotations and ISCC-NBS Color Designations

From the daylight transmittance determinations of the one hundred and thirty-six transparent samples and the daylight reflectance determinations of the sixty reflecting samples, and from the chromaticity coordinates for C.I.E. Source C for all of the one hundred and ninety-six samples as described in Part VI of this report, the Munsell renotations (H V/C) were determined by means of graphs of conversion from the C.I.E. system to the Munsell renotation system [18, 19]. These Munsell renotations were then converted into terms of the ISCC-NBS (Inter-Society Color Council - National Bureau of Standards) color designations [20].

The Munsell renotations and the ISCC-NBS color designations for the forty-three transmitting man-made objects are listed in Table IIIA and illustrated in Figures 42 and 43.

The Munsell renotations and the ISCC-NBS color designations for the sixty reflecting man-made objects are listed in Table IIIB and illustrated in Figures 44 to 48.

The Munsell renotations and the ISCC-NBS color designations for the ninety-three color transparencies of man-made objects are listed in Table IIIC and illustrated in Figures 49 to 52.

Table III

Munsell Renotations and ISCC-NBS Color Designations of the Indicated Samples.

IIIA. Transmitting Man-Made Objects

Sample Number	Munsell Renotations	ISCC-NBS Color Designations
	Processed Unexposed Film	
(1)	5.0YR 0.3/1.5	Dark brown
(2)	7.0PB 0.4/14.	Vivid blue
(3)	0.4YR 3.3/13.2	Strong reddish brown
(4)	1.0G 3.4/13.2	Deep yellowish green
(5)	2.5PB 4.1/15.3	Vivid blue
(6)	4.7RP 2.9/11.7	Deep purplish red
(7)	3.3Y 7.9/16.8	Vivid yellow
	Dye on Film Base	
(8)	4.4PB 3.5/15.9	Vivid blue
(9)	2.5R 2.4/12.8	Vivid red
(10)	2.5Y 8.0/18.1	Vivid yellow
(11)	2.5Y 8.0/18.0	Vivid yellow
	Color Compensating Filters	
(12)	3.5GY 9.5/0.4	Colorless
(13)	1.5GY 9.5/1.2	Faint yellow
(14)	3.7GY 9.5/1.6	Pale yellow green
(15)	1.5GY 9.4/3.1	Pale greenish yellow
(16)	1.0GY 9.4/6.3	Light greenish yellow
(17)	0.8RP 9.2/2.5	Pale purplish pink
(18)	0.7RP 8.9/4.0	Pale purplish pink
(19)	1.0RP 8.4/5.4	Light purplish pink
(20)	5.5B 9.4/1.0	Faint blue
(21)	10.0BG 9.2/1.6	Very pale green
(22)	1.6B 9.0/2.9	Very pale blue
(23)	3.0GY 9.6/0.3	Colorless
(24)	1.0GY 9.6/0.5	Faint yellow
(25)	1.0GY 9.5/1.1	Faint yellow
(26)	2.5GY 9.5/2.4	Pale yellow green
(27)	2.5GY 9.5/3.2	Light yellow green
(28)	2.0GY 9.5/3.8	Pale greenish yellow
(29)	2.0GY 9.4/4.7	Pale greenish yellow
(30)	0.5R 9.4/0.7	Faint pink
(31)	2.5RP 9.4/1.6	Pale purplish pink

Table III (Continued)

Sample Number	Munsell Renotations	ISCC-NBS Color Designations
(32)	1.5RP 9.1/2.8	Pale purplish pink
(33)	1.3RP 8.8/4.5	Pale purplish pink
(34)	1.3RP 8.5/5.8	Light purplish pink
(35)	1.4RP 8.1/7.6	Light purplish pink
(36)	1.7RP 7.8/8.8	Light purplish pink
(37)	1.0B 9.4/0.3	Colorless
(38)	5.0B 9.3/0.8	Faint blue
(39)	4.6B 9.2/1.5	Very pale blue
(40)	5.6B 8.9/2.7	Very pale blue
(41)	5.6B 8.5/3.9	Very light greenish blue
(42)	5.7B 8.3/5.1	Very light greenish blue
(43)	5.8B 7.9/6.3	Very light greenish blue
	IIIB. Reflecting Man-Made Objects	
	Dyed Papers and Cardboards	
(44)	8.8YR 7.5/11.9	Strong orange yellow
(45)	8.2B 7.3/4.1	Light greenish blue
(46)	8.2Y 8.6/5.3	Light greenish yellow
(47)	4.7RP 7.2/7.6	Moderate purplish pink
(48)	7.2R 5.0/13.6	Vivid reddish orange
	U.S. Military Wearing Apparel	
(49)	1.2Y 5.5/2.8	Light olive brown
(50)	3.0Y 3.7/2.8	Moderate olive brown
(51)	9.5YR 5.0/2.7	Grayish yellowish brown
(52)	0.8Y 4.9/3.0	Grayish yellowish brown
(53)	0.6Y 5.2/2.7	Grayish yellowish brown
(54)	3.0Y 5.4/2.8	Light olive brown
(55)	3.2Y 4.1/2.6	Moderate olive brown
(56)	2.6Y 3.0/2.0	Moderate olive brown
(57)	0.1GY 2.7/0.8	Olive gray
(58)	1.8GY 2.7/1.0	Olive gray
(59)	10.0Y 2.9/0.9	Olive gray
(60)	1.5GY 4.0/1.4	Grayish olive
(61)	8.3Y 4.4/1.5	Olive gray
(62)	5.9GY 4.8/1.6	Grayish yellow green
	Painted Pressboard	
(63)	7.2R 4.6/13.3	Vivid reddish orange
(64)	3.7Y 8.5/5.1	Light yellow
(65)	0.8BG 3.1/2.9	Dark bluish green
(66)	5.9R 3.8/9.8	Moderate red
(67)	2.1PB 3.7/5.6	Moderate blue

Table III (Continued)

Sample Number	Munsell Renotations	ISCC-NBS Color Designations
(68)	3.3YR 3.3/2.3	Grayish brown
(69)	5.5G 6.1/8.6	Brilliant green
	Munsell Papers (Tobey Press)	
(70)	5.5YR 6.1/11.2	Strong orange
(71)	4.8Y 7.9/11.5	Vivid yellow
(72)	4.5GY 6.9/8.8	Strong yellow green
(73)	5.4G 4.8/7.8	Strong green
(74)	5.2BG 3.9/5.7	Moderate bluish green
(75)	5.0B 4.0/6.8	Moderate greenish blue
(76)	4.5PB 3.2/8.8	Moderate blue
(77)	7.5P 4.1/9.1	Strong purple
(78)	5.3RP 4.0/10.0	Moderate purplish red
(79)	4.9R 4.2/11.8	Strong red
(80)	5.1R 4.2/10.7	Moderate red
(81)	4.9R 4.1/9.5	Moderate red
(82)	4.8R 3.9/7.2	Moderate red
(83)	4.4R 4.0/6.0	Grayish red
(84)	3.9R 4.0/3.9	Grayish red
(85)	4.5R 4.0/1.9	Grayish red
(86)	9.6Y 9.2/0.3	White
(87)	7.1Y 8.8/0.2	White
(88)	4.4Y 8.4/0.3	Light gray
(89)	5.4GY 7.9/0.3	Light gray
(90)	5.5Y 7.6/0.3	Light gray
(91)	2.4GY 6.9/0.3	Light gray
(92)	3.5GY 6.5/0.3	Medium gray
(93)	7.5GY 5.9/0.2	Medium gray
(94)	2.9Y 5.5/0.2	Medium gray
(95)	7.5GY 4.9/0.2	Medium gray
(96)	0.9YR 4.5/0.1	Medium gray
(97)	N 4.0/	Dark gray
(98)	10.0PB 3.5/0.1	Dark gray
(99)	2.6B 3.1/0.1	Dark gray
(100)	5.0PB 2.6/0.2	Dark gray
(101)	5.0B 2.1/0.2	Black
(102)	6.9PB 1.9/0.2	Black
(103)	2.3PB 2.1/0.2	Black

Table III (Continued)

IIIC. Color Transparencies of Man-Made Objects

Sample Number	Munsell Renotations	ISCC-NBS Color Designations
	Photographs of Dyed Papers and Cardboards	
(104)	10.0YR 3.2/8.0	Deep yellowish brown
(105)	4.5Y 5.3/8.0	Light olive
(106)	6.6Y 6.5/7.6	Dark yellow
(107)	8.4Y 7.2/6.8	Moderate greenish yellow
(108)	6.2Y 8.2/2.8	Pale yellow
(109)	4.7Y 8.3/2.1	Pale yellow
(110)	4.8Y 8.3/2.0	Pale yellow
(111)	4.8Y 8.3/2.4	Pale yellow
(112)	5.1Y 8.3/2.1	Pale yellow
(113)	6.5BG 1.0/1.5	Blackish green
(114)	9.4G 3.9/2.2	Grayish green
(115)	3.8BG 4.6/2.3	Grayish green
(116)	4.7BG 5.4/2.7	Moderate bluish green
(117)	2.6BG 6.2/2.6	Light bluish green
(118)	5.2GY 8.1/1.6	Pale yellow green
(119)	9.4Y 8.3/1.6	Pale yellow green
(120)	6.6Y 8.3/1.8	Yellowish gray
(121)	6.1Y 8.3/1.7	Yellowish gray
(122)	8.2Y 1.8/4.1	Dark olive
(123)	9.0Y 3.8/4.0	Moderate olive
(124)	1.4GY 5.0/4.3	Light olive
(125)	3.5GY 5.9/4.3	Moderate yellow green
(126)	5.0GY 6.6/4.3	Moderate yellow green
(127)	9.9Y 8.1/1.8	Pale yellow green
(128)	7.5Y 8.2/1.8	Yellowish gray
(129)	6.0Y 8.3/1.8	Yellowish gray
(130)	5.0Y 8.3/1.8	Yellowish gray
(131)	3.4YR 3.4/2.7	Moderate brown
(132)	5.7YR 5.6/0.9	Light brownish gray
(133)	4.7Y 6.5/0.8	Yellowish gray
(134)	2.3GY 7.5/1.3	Pale yellow green
(135)	1.2GY 8.0/1.5	Pale yellow green
(136)	4.5Y 8.5/1.7	Yellowish gray
(137)	4.5Y 8.5/1.7	Yellowish gray
(138)	4.5Y 8.5/1.7	Yellowish gray

Table III (Continued)

Sample Number	Munsell Renotations	ISCC-NBS Color Designations
(139)	3.8Y 8.4/1.8	Yellowish gray
(140)	3.3YR 1.1/7.8	Deep brown
(141)	2.0YR 2.4/7.3	Deep reddish brown
(142)	0.5YR 4.0/7.0	Dark reddish orange
(143)	2.0YR 4.1/5.4	Strong brown
(144)	2.0YR 4.1/5.3	Strong brown
(145)	1.0Y 8.3/1.9	Yellowish gray
(146)	4.5Y 8.4/1.8	Yellowish gray
(147)	4.5Y 8.4/1.8	Yellowish gray
(148)	4.5Y 8.5/1.8	Yellowish gray
(149)	1.5R 4.8/9.9	Moderate red
(150)	8.1RP 6.2/7.9	Dark purplish pink
(151)	1.1YR 3.0/12.8	Strong reddish brown
(152)	0.7YR 4.4/12.0	Deep reddish orange
	Photographs of U.S. Army Shirt	
(153)	0.4YR 5.6/9.1	Moderate reddish orange
(154)	0.2YR 4.3/11.8	Deep reddish orange
(155)	6.6PB 0.7/13.	Vivid blue
(156)	5.5PB 2.3/13.5	Vivid blue
(157)	9.0B 5.9/8.4	Brilliant greenish blue
(158)	6.5PB 0.9/13.	Vivid blue
(159)	5.1PB 2.8/13.5	Vivid blue
(160)	2.2PB 4.3/12.2	Strong blue
(161)	3.2YR 2.1/3.8	Dark brown
(162)	1.6YR 1.8/10.3	Deep reddish brown
(163)	8.5YR 3.6/9.4	Strong yellowish brown
(164)	8.5GY 2.0/7.9	Very deep yellowish green
(165)	7.5PB 0.1/8.	Deep purplish blue
(166)	5.2YR 3.8/4.2	Moderate brown
(167)	9.2YR 5.2/3.6	Moderate yellowish brown
(168)	4.6R 8.2/15.1	Vivid yellow
(169)	6.4Y 8.6/11.3	Vivid yellow
	Photographs of Lamp Sources	
(170)	1.BG 0.1/1.0	Greenish black
(171)	0.9BG 0.1/1.4	Blackish green
(172)	9.4GY 1.9/2.3	Very dark yellowish green
(173)	1.1G 3.3/1.6	Dark grayish green
(174)	1.3BG 3.9/2.0	Grayish green

Table III (Continued)

Sample Number	Munsell Renotations	ISCC-NBS Color Designations
(175)	0.1G 1.2/2.4	Very dark yellowish green
(176)	2.0G 1.8/2.1	Very dark yellowish green
(177)	4.7BG 5.7/2.6	Light bluish green
(178)	5.2BG 6.3/2.7	Light bluish green
(179)	1.1Y 2.7/6.5	Moderate olive brown
(180)	2.8Y 3.4/6.9	Moderate olive brown
(181)	4.3Y 4.0/6.8	Moderate olive
(182)	9.0YR 1.3/3.6	Dark yellowish brown
(183)	8.8YR 1.8/3.6	Dark yellowish brown
(184)	8.5YR 1.7/5.1	Deep yellowish brown
(185)	8.6YR 0.8/2.7	Dark yellowish brown
(186)	3.0YR 0.7/5.8	Deep brown
(187)	9.2YR 3.0/4.1	Dark yellowish brown
(188)	3.4YR 1.3/7.6	Deep brown
(189)	3.1YR 1.7/8.4	Deep brown
(190)	1.5YR 2.2/9.8	Deep reddish brown
(191)	3.0YR 1.8/8.8	Deep brown
(192)	2.9YR 1.9/9.2	Deep brown
(193)	2.5YR 2.6/10.0	Strong brown
(194)	3.0YR 1.8/8.7	Deep brown
(195)	1.5YR 2.2/9.7	Deep reddish brown
(196)	3.0YR 3.4/11.3	Strong brown

Figure 42. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing the Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of seven processed unexposed films and four dye-on-film base of Ansco daylight color film.

a) Processed unexposed film:

(1) W-126 RGB (Ansco daylight color film)
(2) W-125 RG (special Ansco red and green sensitive film)
(3) W-130 GB (special Ansco green and blue sensitive film)
(4) W-124 BR (special Ansco blue and red sensitive film)
(5) W-129 R (special Ansco red sensitive film)
(6) W-128 G (special Ansco green sensitive film)
(7) W-127 B (special Ansco blue sensitive film)

b) Dye-on-film base:

(8) Cyan dye on film base
(9) Magenta dye on film base
(10) & (11) Yellow dye on film base (two determinations on same sample)

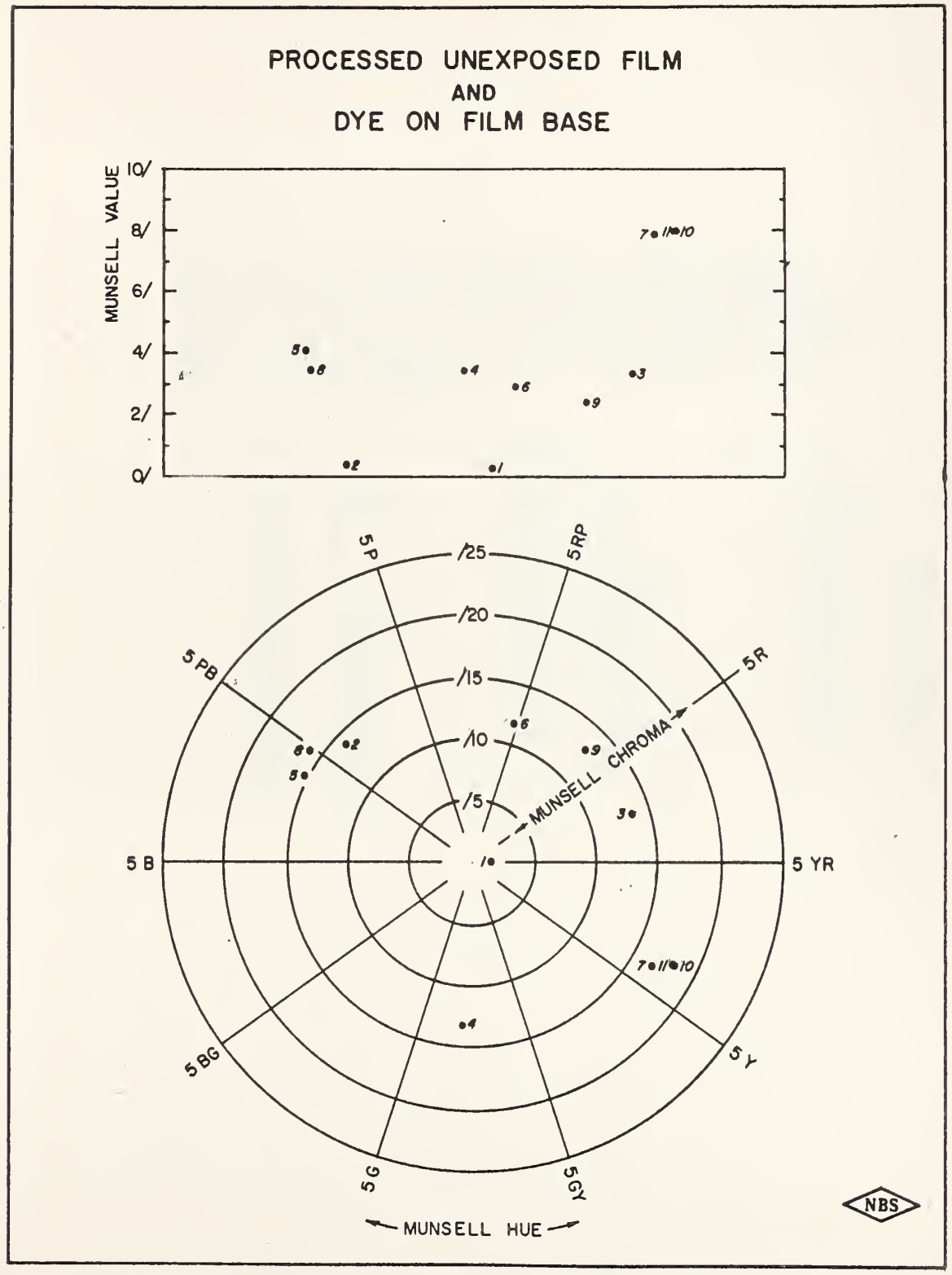
PROCESSED UNEXPOSED FILM
AND
DYE ON FILM BASE
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
7.1/10
5
8
4
6
3
9
2
1
5P
5RP
5R
5PB
5B
5 YR
5BG
5G
5GY
5Y
/25
/20
/15
/10
/5
MUNSELL CHROMA
MUNSELL HUE
NBS

FIGURE 42

Figure 43. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of thirty-two Ansco color compensating filters:

a) Yellow	b) Magenta	c) Cyan
(12) UV-16P	(17) 33	(20) 43
(13) 23	(18) 34	(21) 44
(14) 24	(19) 35	(22) 45
(15) 25	(30) .025M	(37) .025C
(16) 26	(31) .05M	(38) .05C
(23) .025Y	(32) .10M	(39) .10C
(24) .05Y	(33) .20M	(40) .20C
(25) .10Y	(34) .30M	(41) .30C
(26) .20Y	(35) .40M	(42) .40C
(27) .30Y	(36) .50M	(43) .50C
(28) .40Y		
(29) .50Y		

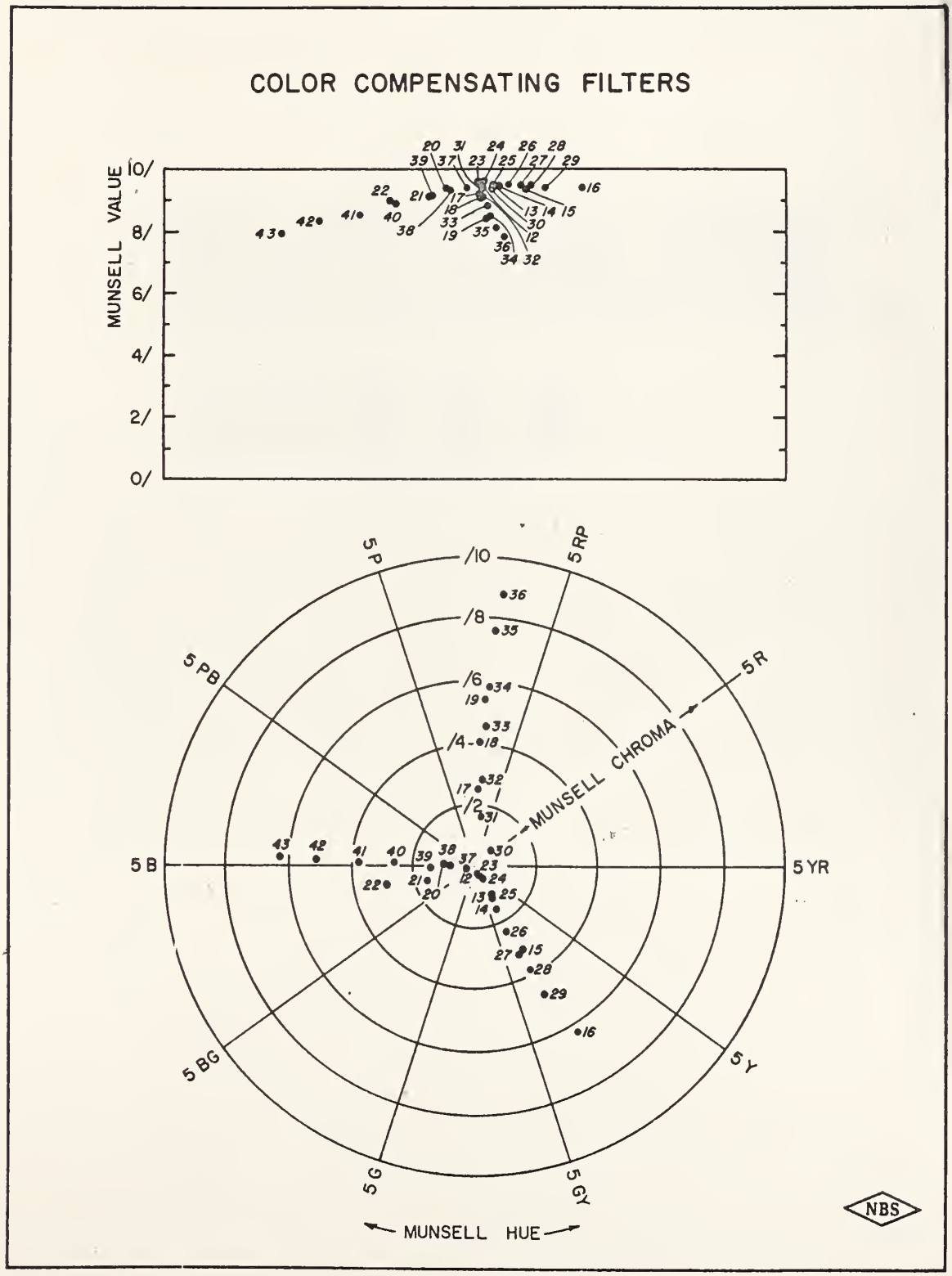
COLOR COMPENSATING FILTERS
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
5P
5RP
5R
5PB
5YR
5B
5BG
5Y
5G
5GY
/10
/8
/6
/4
/2
MUNSELL CHROMA
MUNSELL HUE
NBS

FIGURE 43

Figure 44. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of five selected dyed papers and cardboards.

(44) Mimeo Bond Paper, Orange
(45) Onion Skin Paper, Blue
(46) Onion Skin Paper, Canary Yellow
(47) Onion Skin Paper, Pink
(48) Railroad Board, Red

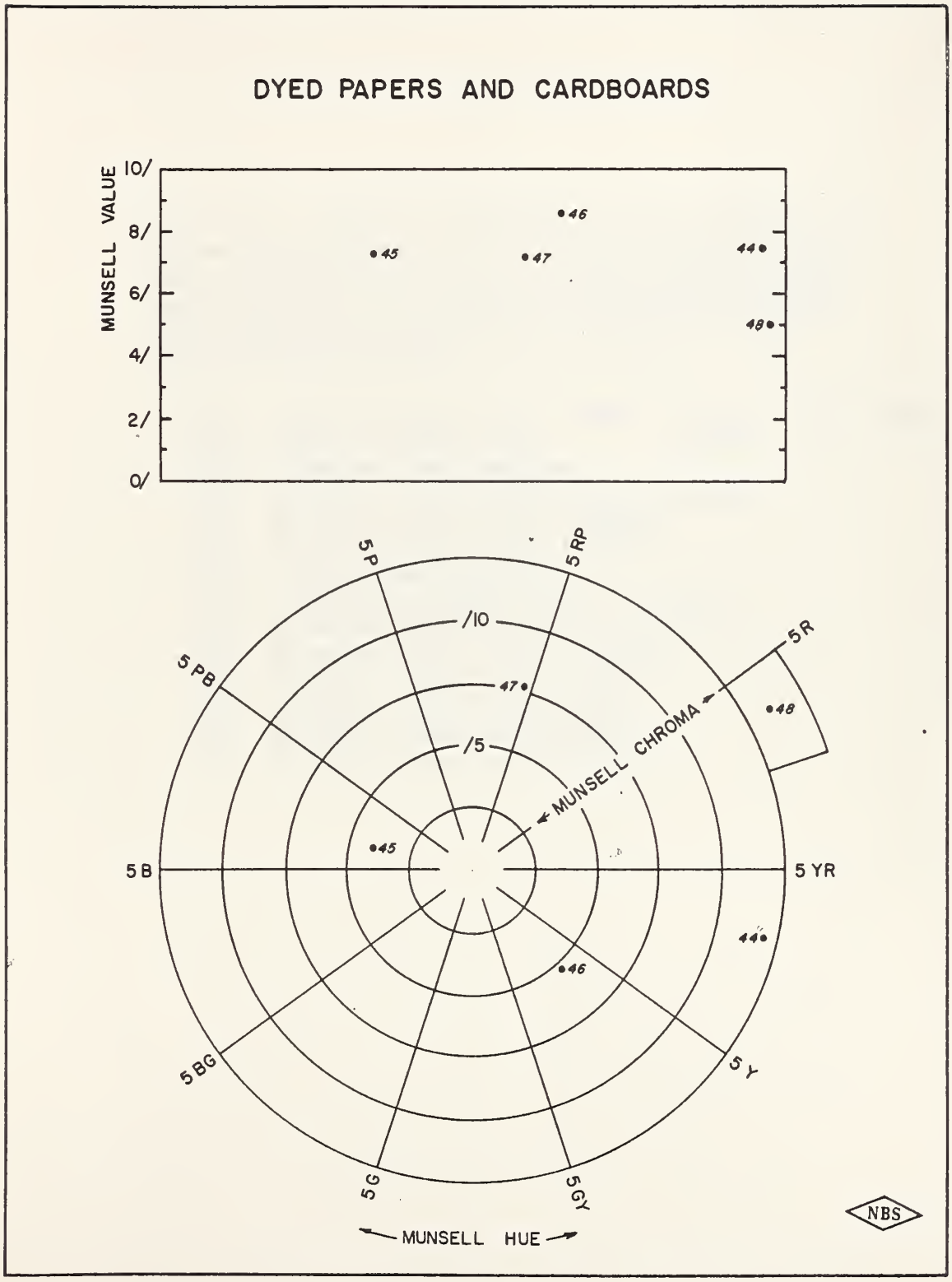
DYED PAPERS AND CARDBOARDS
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
45
46
47
44
48
5P
5RP
5R
5PB
/10
/5
MUNSELL CHROMA
5B
5 YR
5BG
5 Y
5G
5GY
MUNSELL HUE
NBS

FIGURE 44

Figure 45. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of fourteen textile samples of U.S. military wearing apparel.

(49) Khaki #1, cotton (Army shade book No. 5045 at NBS)
(50) Olive Drab #52, wool (ditto)
(51) US Marine Corps Necktie
(52) US Marine Corps Overseas Cap (summer)
(53) US Marine Corps Pants (summer)
(54) US Marine Corps Shirt (summer)
(55) US Army Shirt (winter)
(56) US Army Eisenhower Jacket (winter)
(57) US Marine Corps Overseas Cap (winter)
(58) US Marine Corps Blouse (winter)
(59) US Marine Corps Pants (winter)
(60) US Marine Corps Fatigue Cap
(61) US Marine Corps Fatigue Shirt
(62) US Marine Corps Fatigue Pants

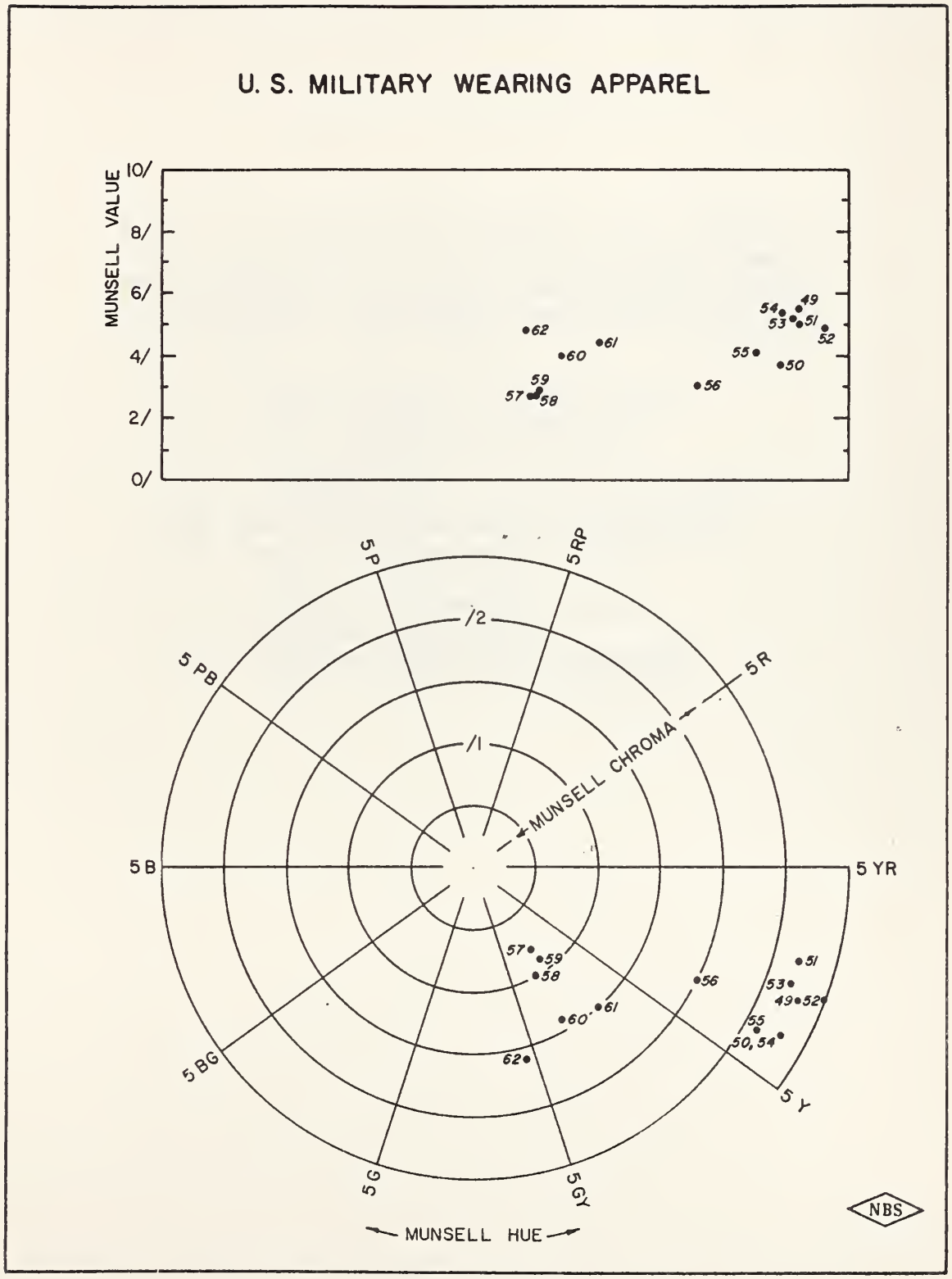
U. S. MILITARY WEARING APPAREL
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
62
61
60
59
57
58
56
55
54
49
53
51
52
50
5P
5RP
5PB
5R
/2
/1
MUNSELL CHROMA
5B
5YR
5BG
5Y
5G
5GY
MUNSELL HUE
NBS

FIGURE 45

Figure 46. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of seven samples of paint on pressboard.

(63) Chinese Red #6335 Chi-namel Paint, Chi-namel Paint and Varnish Co.
(64) Colony Yellow #317 House Paint, Lowe Brothers
(65) Green #173 Tractor Paint, Lowe Brothers
(66) Red #139 Tractor Paint, Lowe Brothers
(67) Royal Blue Permanent Trim Paint, John W. Masury & Son
(68) Seal Brown Supreme House Paint, John W. Masury & Son
(69) Verdi Green #6830 Super House Paint, Chi-namel Paint and Varnish Co.

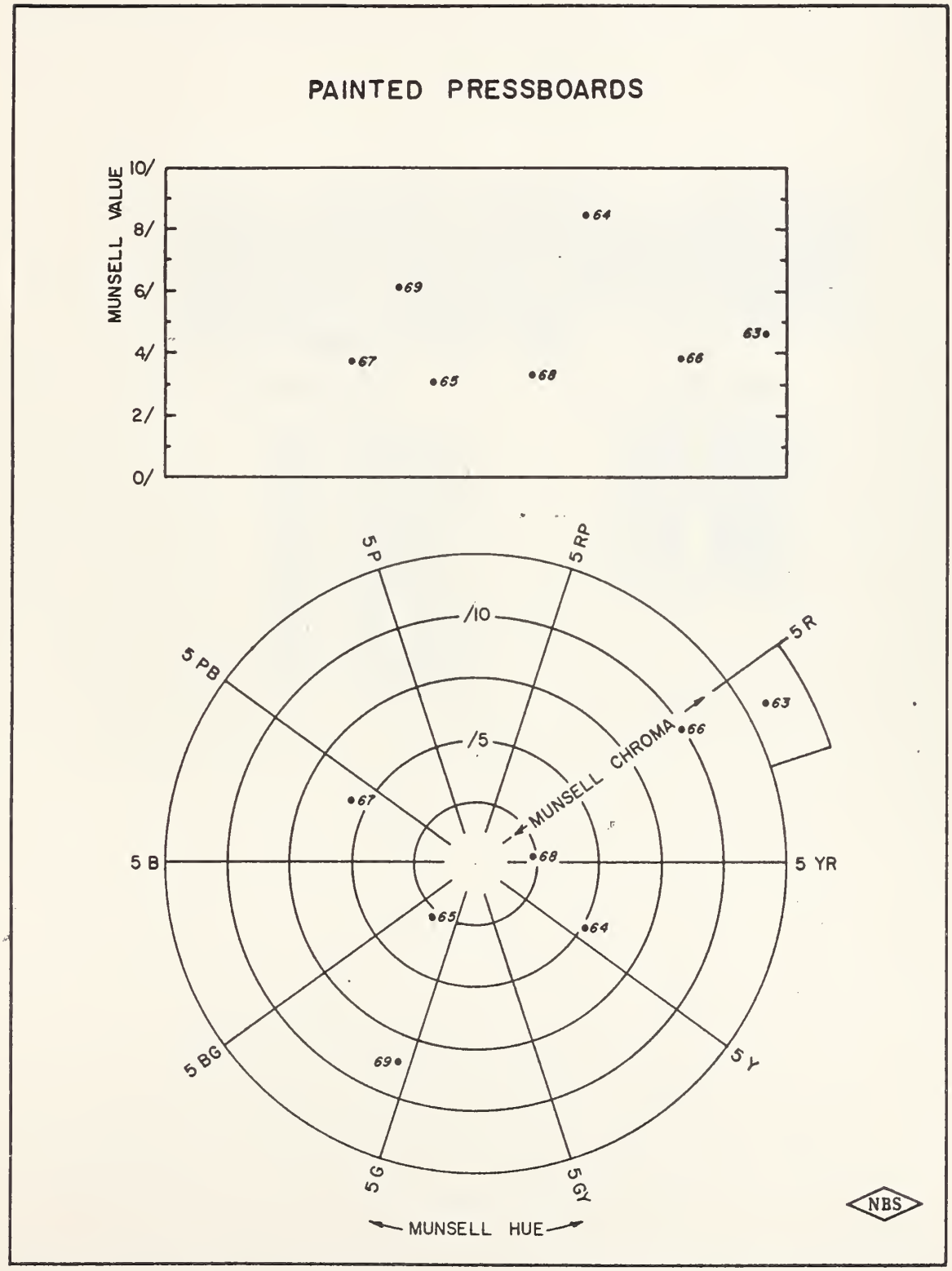
PAINTED PRESSBOARDS
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
64
69
63
67
66
65
68
5P
5RP
/10
5R
5PB
/5
MUNSELL CHROMA
63
66
67
68
5B
5YR
65
64
5BG
69
5Y
5G
5GY
MUNSELL HUE
NBS

FIGURE 46

Figure 47. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of sixteen commercially prepared Munsell pigmented papers (Tobey Press).

a) Hue Scale

(70) 5YR 6/12
(71) 5Y 8/12
(72) 5GY 7/10
(73) 5G 5/8
(74) 5BG 4/6
(75) 5B 4/8
(76) 5PB 3/12
(77) 5P 4/12
(78) 5RP 4/12
(79) 5R 4/14

b) Chroma Scale

(80) 5R 4/12
(81) 5R 4/10
(82) 5R 4/8
(83) 5R 4/6
(84) 5R 4/4
(85) 5R 4/2

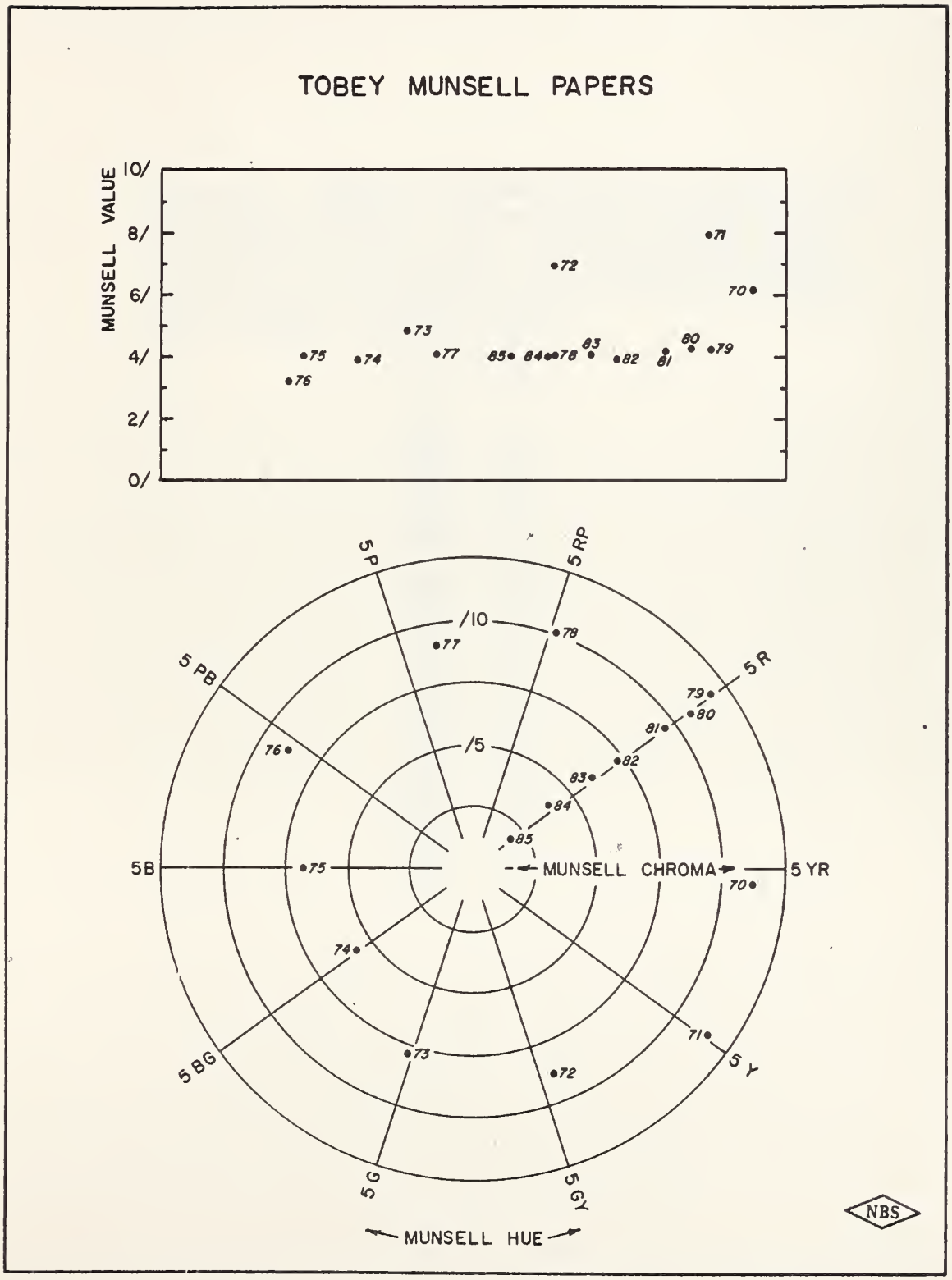
TOBEY MUNSELL PAPERS
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
71
72
70
73
75
74
77
85
84
78
83
82
81
80
79
76
5P
5RP
/10
/5
5PB
5R
5B
MUNSELL CHROMA
5YR
5BG
5Y
5G
5GY
MUNSELL HUE
NBS

FIGURE 47

Figure 48. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of eighteen commercially prepared (Tobey Press) Munsell pigmented papers.

c) Value Scale

(86) N 9.5/
(87) N 9/
(88) N 8.5/
(89) N 8/
(90) N 7.5/
(91) N 7/
(92) N 6.5/
(93) N 6/
(94) N 5.5/
(95) N 5/
(96) N 4.5/
(97) N 4/
(98) N 3.5/
(99) N 3/
(100) N 2.5/
(101) N 2/
(102) N 1.5/
(103) N 1/

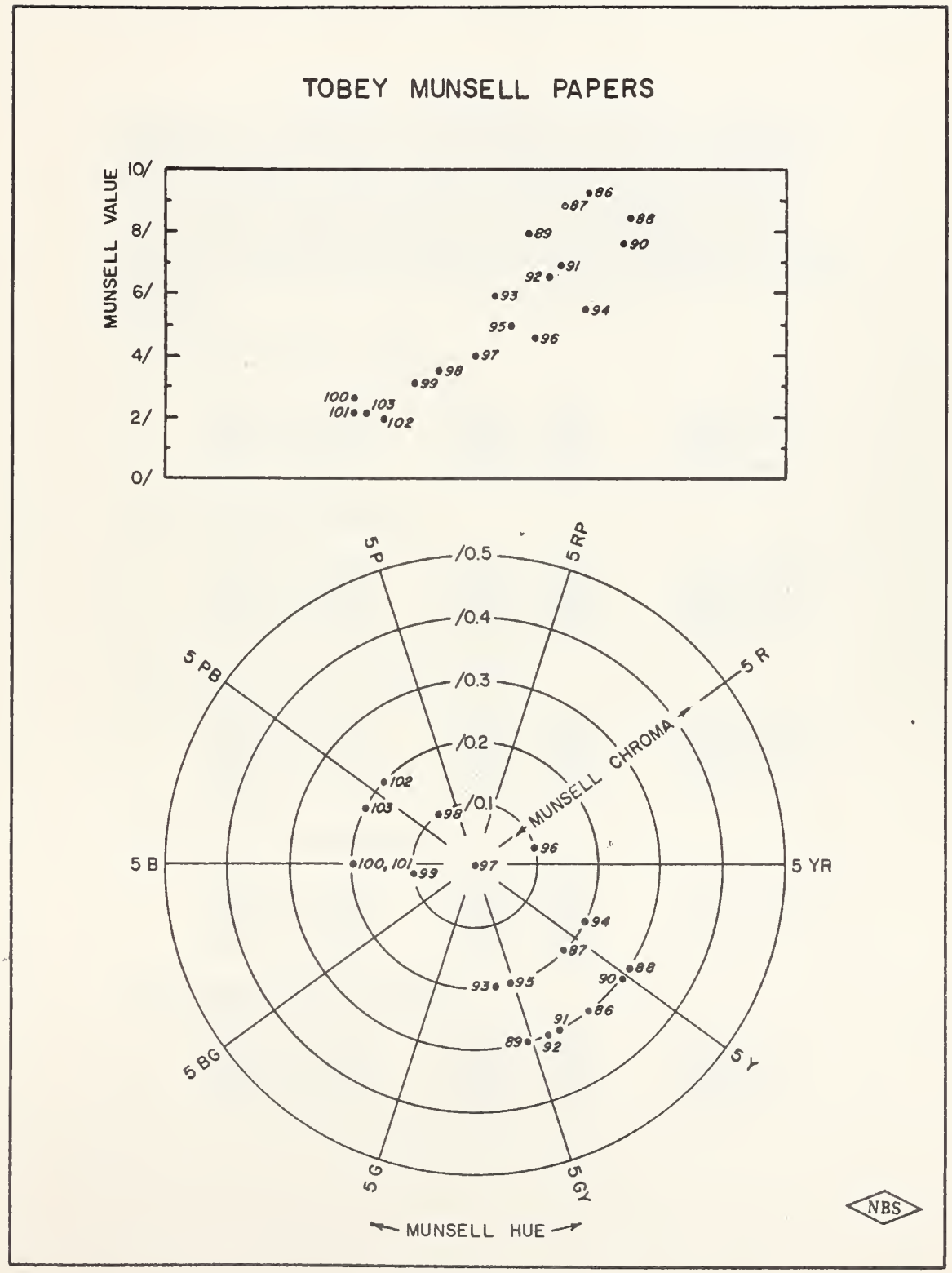
TOBEY MUNSELL PAPERS
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
103
102
5 P
5 RP
5 PB
5 R
5 B
5 YR
5 BG
5 Y
5 G
5 GY
/0.5
/0.4
/0.3
/0.2
/0.1
MUNSELL CHROMA
MUNSELL HUE
NBS

FIGURE 48

Figure 49. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of forty-five color transparencies of five dyed papers and cardboards on Ansco daylight color film for the indicated shutter speeds (seconds) at f/8 aperture.

a) Orange Mimeo Bond:

(104)	1/400	(107)	1/25	(110)	1/2
(105)	1/100	(108)	1/10	(111)	1
(106)	1/50	(109)	1/5	(112)	2

b) Blue Onion Skin:

(113)	1/800	(116)	1/50	(119)	1/5
(114)	1/200	(117)	1/25	(120)	1/2
(115)	1/100	(118)	1/10	(121)	1

c) Canary Yellow Onion Skin:

(122)	1/800	(125)	1/50	(128)	1/5
(123)	1/200	(126)	1/25	(129)	1/2
(124)	1/100	(127)	1/10	(130)	1

d) Pink Onion Skin:

(131)	1/800	(134)	1/50	(137)	1/5
(132)	1/200	(135)	1/25	(138)	1/2
(133)	1/100	(136)	1/10	(139)	1

e) Red Railroad Board:

(140)	1/400	(143)	1/25	(146)	1/2
(141)	1/100	(144)	1/10	(147)	1
(142)	1/50	(145)	1/5	(148)	2

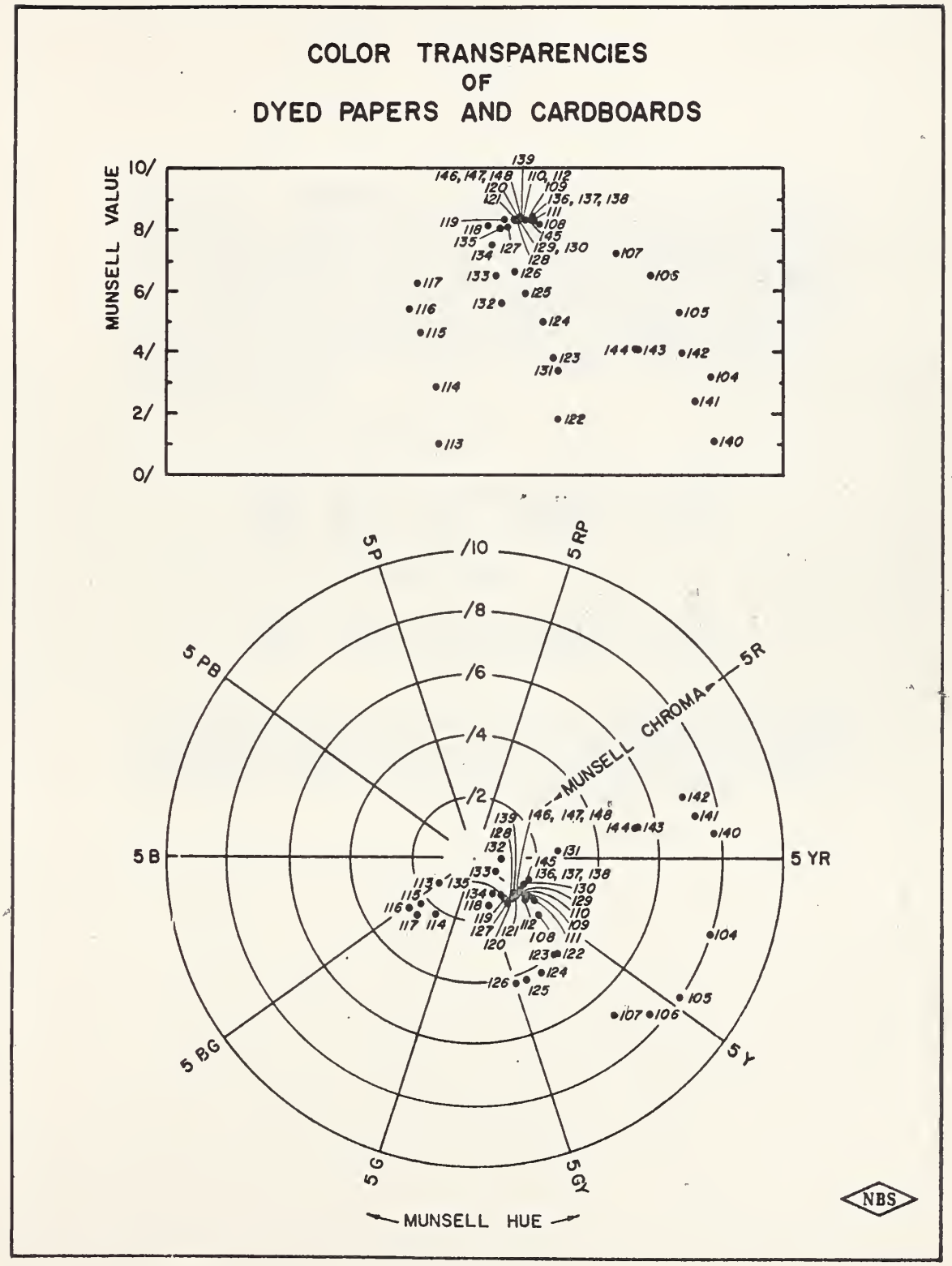
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
5P
5RP
5PB
5R
5B
5YR
5BG
5Y
5G
5GY
/10
/8
/6
/4
/2
MUNSELL CHROMA
MUNSELL HUE
NBS

FIGURE 49

Figure 50. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of four color transparencies of two dyed cardboards on special Ansco green and blue sensitive film at the indicated apertures for 1/200 seconds shutter speeds.

a) Blue Railroad Board

(149) W-132 Normal exposure. f/5.6
(150) W-133 Over exposure. f/4

b) Tuscan Railroad Board

(151) W-134 Normal exposure. f/16
(152) W-135 Over exposure. f/8

(The Munsell renotations of the original blue and buff, or tuscan, cardboards may be seen on Figures 65 and 67, pages 90 and 92, respectively, NBS Report 4438 [6]).

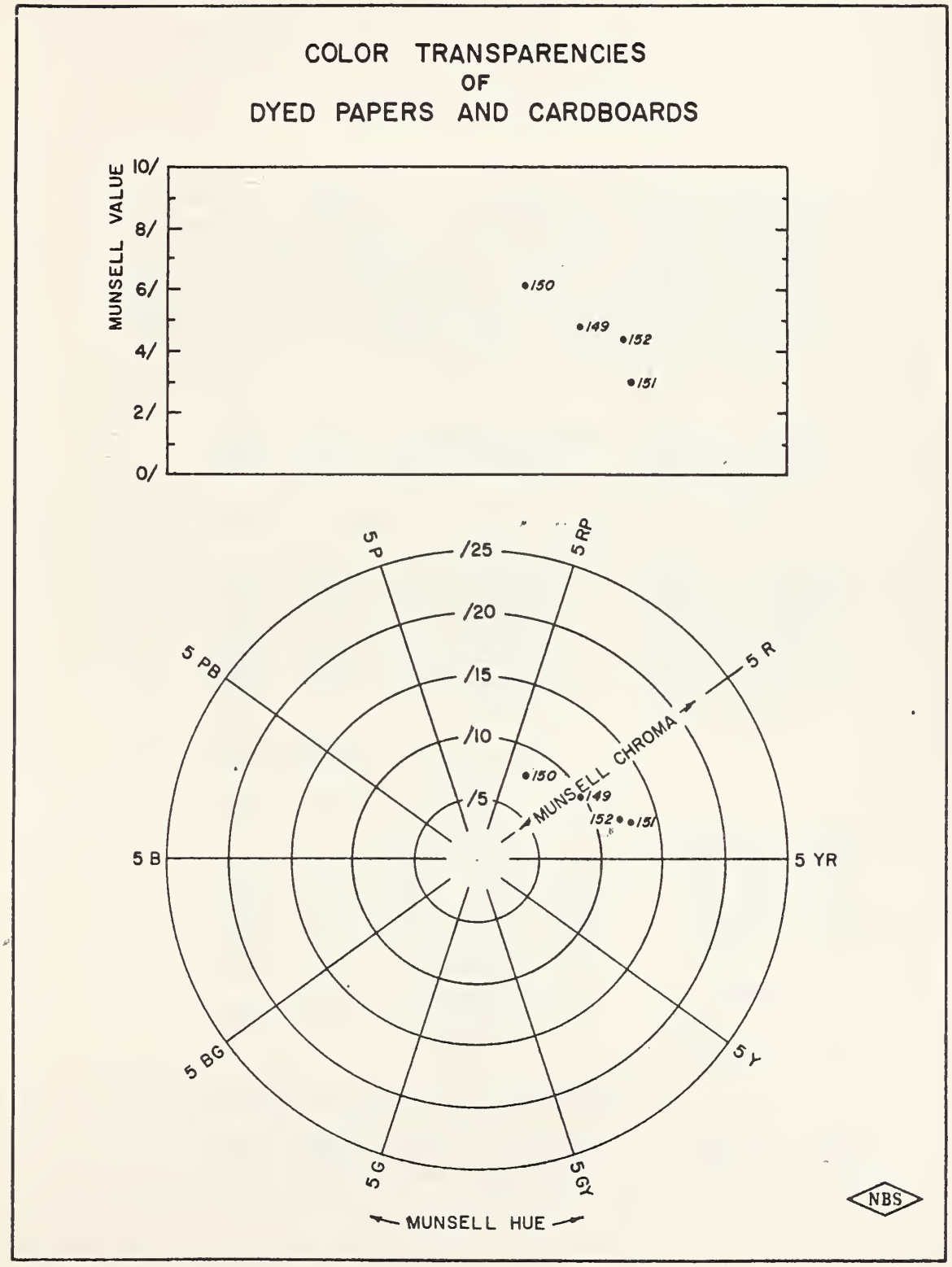
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
150
149
152
151
5 P
5 RP
5 R
5 PB
5 B
5 YR
5 BG
5 Y
5 G
5 GY
/25
/20
/15
/10
/5
MUNSELL CHROMA
MUNSELL HUE
NBS

FIGURE 50

Figure 51. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of seventeen color transparencies of a US Army Olive Drab Winter Shirt (Sample 55, Figure 13):

a) On Special Ansco Green and Blue Sensitive Film

(153)	W-141	Normal exposure.	1/50 sec., f/5.6
(154)	W-142	Over exposure.	1/50 sec., f/4

b) On Special Ansco Red and Green Sensitive Film

(155)	W-171	Normal exposure.	1/100 sec., f/11
(156)	W-172	Over exposure.	1/100 sec., f/5.6
(157)	W-173	Over exposure.	1/100 sec., f/4
(158)	W-198	Under exposure.	1/200 sec., f/11
(159)	W-199	Normal exposure.	1/200 sec., f/5.6
(160)	W-200	Over exposure.	1/200 sec., f/4

c) On Ansco Daylight Color Film

(161)	W-291	No filter, Normal exposure.	1/50 sec., f/11
(162)	W-292	With red filter.	1/50 sec., f/2.8
(163)	W-293	With yellow filter.	1/50 sec., f/8
(164)	W-294	With green filter.	1/100 sec., f/2.8
(165)	W-295	With blue filter.	1/50 sec., f/2.8
(166)	W-296	No filter, Over exposure.	1/50 sec., f/8
(167)	W-297	No filter, Over exposure.	1/50 sec., f/5.6

d) On Special Ansco Blue Sensitive Film

(168)	W-430	Normal exposure.	1/50 sec., f/11
(169)	W-431	Over exposure.	1/50 sec., f/5.6

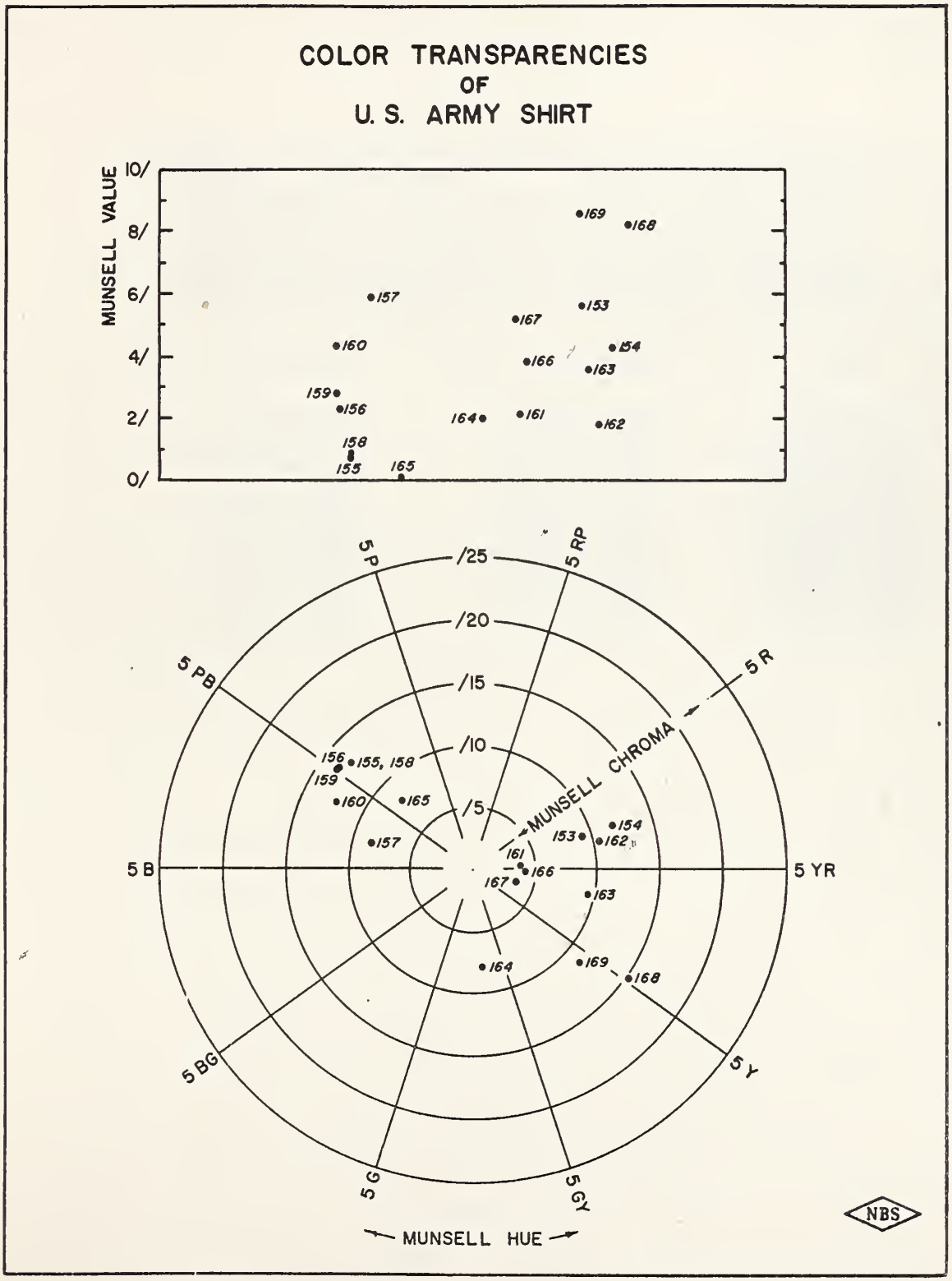
COLOR TRANSPARENCIES
OF
U. S. ARMY SHIRT
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
169
168
157
153
167
160
154
166
163
159
156
164
161
162
158
155
165
5 P
5 RP
5 R
5 PB
5 B
5 YR
5 BG
5 Y
5 G
5 GY
/25
/20
/15
/10
/5
MUNSELL CHROMA
MUNSELL HUE
NBS

FIGURE 51

Figure 52. Schematic illustration of the vertical and horizontal projections of the "ideal" Munsell system showing Munsell Value (upper diagram) plotted against the Munsell Hue and Chroma points projected from the lower diagram of twenty-seven color transparencies on Ansco daylight color film of fluorescent, incandescent, and neon lamp sources in the O'Neill-Nagel light table [3].

a) Fluorescent	b) Incandescent	c) Neon
(170) W-1862	(179) W-1869	(188) W-1878
(171) W-1861	(180) W-1867	(189) W-1876
(172) W-1858	(181) W-1868	(190) W-1877
(173) W-1859	(182) W-1870	(191) W-1881
(174) W-1860	(183) W-1871	(192) W-1879
(175) W-1865	(184) W-1872	(193) W-1880
(176) W-1863	(185) W-1873	(194) W-1884
(177) W-1864	(186) W-1874	(195) W-1882
(178) W-1866	(187) W-1875	(196) W-1883

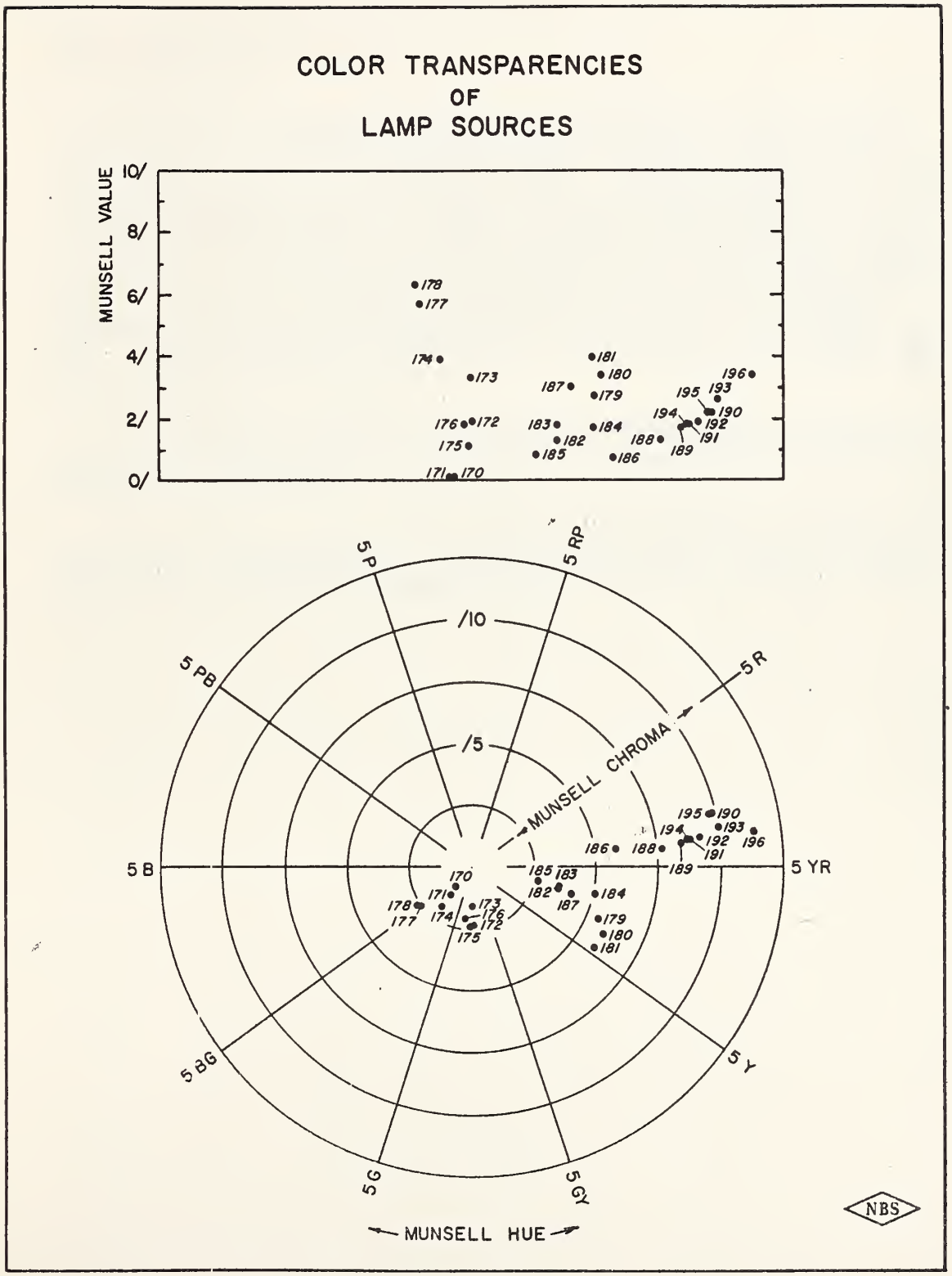
COLOR TRANSPARENCIES
OF
LAMP SOURCES
MUNSELL VALUE
10/
8/
6/
4/
2/
0/
178
177
174
173
181
180
187
179
196
193
195
190
194
192
191
176
172
183
184
188
189
175
182
185
186
171
170
5 P
5 RP
/10
5 PB
5 R
/5
MUNSELL CHROMA
5 B
5 YR
5 BG
5 Y
5 G
5 GY
MUNSELL HUE
NBS

FIGURE 52

VIII. Lovibond Notations

In order that a comparison may be made between the one hundred and thirty-six transmitting samples of this report and a standardized system of colored transparent media, conversions were made from the CIE chromaticity coordinates, x and z, of Part VI of this report to the Lovibond notations by means of large scale graphs printed on aluminum, for CIE Source C, of the "ideal" Lovibond system as derived by Scofield [21] and sold by the Tintometer Ltd., Salisbury, England [22] . A similar CIE graph, for Standard Source C, for the NBS standard set of the Lovibond glasses is also available in this country [23] . This and other information on the Lovibond Color System have been published by Judd [24] .

The Lovibond analyses and daylight transmittances of the forty-three transmitting objects are listed in Table IVA and illustrated in Figures 53 and 54.

The Lovibond analyses and daylight transmittances of the ninety-three color transparencies of man-made objects are listed in Table IVB, and are illustrated in Figures 55 to 58.

Table IV

Lovibond Analysis and Daylight Transmittance, for Source C, of the Indicated Samples.

IVA. Transmitting Man-Made Objects

Sample Number	Lovibond Analysis R	Y	B	Daylight Transmittance Y(%)
	Processed Unexposed Film			
(1)	21.	16.	0.0	0.3
(2)	Outside Gamut			0.5
(3)	32.5	20.	0.0	8.0
(4)	Outside Gamut			8.6
(5)	0.0	9.2	26.6	12.6
(6)	23.4	0.0	5.1	6.0
(7)	3.6	60.	0.0	57.0
	Dye on Film Base			
(8)	0.0	9.6	34.	9.1
(9)	58.8	0.0	11.2	4.4
(10)	4.5	100.	0.0	58.7
(11)	4.5	75.	0.0	58.3
	Color Compensating Filters			
(12)	0.0	0.2	0.0	89.9
(13)	0.2	0.6	0.0	89.2
(14)	0.1	0.9	0.0	91.1
(15)	0.3	1.9	0.0	88.2
(16)	0.5	4.5	0.0	86.5
(17)	0.9	0.0	0.2	84.0
(18)	1.5	0.0	0.2	76.3
(19)	2.7	0.0	0.4	67.2
(20)	0.0	0.1	0.6	87.1
(21)	0.0	0.5	1.2	84.0
(22)	0.0	1.3	2.8	78.7
(23)	0.0	0.2	0.0	91.5
(24)	0.2	0.3	0.0	91.3
(25)	0.3	0.7	0.0	90.6
(26)	0.3	1.4	0.0	90.5
(27)	0.2	1.9	0.0	90.0
(28)	0.2	2.3	0.0	89.4
(29)	0.3	2.9	0.0	88.8
(30)	0.1	0.2	0.0	87.4
(31)	0.7	0.0	0.1	86.6

Table IV (Continued)

Sample Number	Lovibond Analysis R	Y	B	Daylight Transmittance Y(%)
(32)	0.9	0.0	0.1	81.3
(33)	2.0	0.0	0.3	73.3
(34)	2.5	0.0	0.2	68.0
(35)	3.9	0.0	0.5	60.9
(36)	4.6	0.0	0.6	54.9
(37)	0.0	0.0	0.2	88.1
(38)	0.0	0.0	0.4	86.3
(39)	0.0	0.6	1.4	83.2
(40)	0.0	1.0	2.5	76.6
(41)	0.0	1.7	3.8	69.3
(42)	0.0	2.0	4.7	64.4
(43)	0.0	2.5	6.2	57.7

IVB. Color Transparencies of Man-Made Objects

Photographs of Dyed Papers and Cardboards

(104)	6.6	38.	0.0	7.5
(105)	3.8	14.5	0.0	23.0
(106)	1.6	10.5	0.0	35.7
(107)	1.1	7.0	0.0	46.5
(108)	0.8	2.0	0.0	61.8
(109)	0.8	1.4	0.0	64.1
(110)	0.6	1.4	0.0	64.5
(111)	0.8	1.7	0.0	64.1
(112)	0.8	1.4	0.0	64.3
(113)	0.0	2.2	4.6	1.3
(114)	0.0	2.7	3.5	11.3
(115)	0.0	2.2	3.5	16.2
(116)	0.0	2.0	3.4	24.1
(117)	0.0	2.0	3.1	32.7
(118)	0.0	0.9	0.0	61.0
(119)	0.4	1.1	0.0	64.0
(120)	0.6	1.2	0.0	65.0
(121)	0.6	1.2	0.0	64.4
(122)	1.2	18.5	0.0	2.6
(123)	1.1	6.1	0.0	10.7

Table IV (Continued)

Sample Number	Lovibond Analysis R	Y	B	Daylight Transmittance Y(%)
(124)	0.2	5.1	0.0	19.8
(125)	0.0	3.5	0.1	29.4
(126)	0.0	3.4	0.6	37.9
(127)	0.4	1.3	0.0	61.5
(128)	0.4	1.2	0.0	63.5
(129)	0.7	1.2	0.0	64.0
(130)	0.7	1.2	0.0	64.6
(131)	4.3	2.3	0.0	8.5
(132)	1.0	0.5	0.0	25.5
(133)	0.5	0.5	0.0	36.4
(134)	0.3	0.8	0.0	51.4
(135)	0.2	1.0	0.0	58.4
(136)	0.7	1.1	0.0	68.3
(137)	0.7	1.1	0.0	68.3
(138)	0.7	1.1	0.0	68.3
(139)	0.8	1.2	0.0	66.6
(140)	38.	16.	0.0	1.4
(141)	15.8	6.9	0.0	4.3
(142)	10.0	4.7	0.0	10.5
(143)	6.1	4.8	0.0	12.5
(144)	7.3	4.0	0.0	12.5
(145)	0.6	1.3	0.0	64.8
(146)	0.7	1.2	0.0	67.2
(147)	0.7	1.2	0.0	67.3
(148)	0.7	1.2	0.0	68.4
(149)	12.4	1.1	0.0	18.2
(150)	6.7	0.6	0.0	32.6
(151)	34.	20.	0.0	6.6
(152)	16.0	10.0	0.0	14.9
	Photographs of U.S. Army Shirt			
(153)	9.0	5.3	0.0	25.5
(154)	16.4	9.1	0.0	13.9
(155)	Outside Gamut			0.8
(156)	0.0	7.0	30.	4.0
(157)	0.0	2.7	8.9	28.7
(158)	0.0	9.	55.	1.1
(159)	0.0	5.3	24.0	5.9
(160)	0.0	3.5	15.4	14.2
(161)	8.2	3.9	0.0	3.3
(162)	52.	100.	0.0	2.5

Table IV (Continued)

Sample Number	Lovibond Analysis R	Y	B	Daylight Transmittance Y(%)
(163)	8.2	50.	0.0	9.3
(164)	Outside Gamut			3.0
(165)	0.0	1.5	46.	0.1
(166)	5.4	4.2	0.0	10.5
(167)	2.7	3.0	0.0	22.1
(168)	2.5	39.	0.0	62.6
(169)	1.2	18.0	0.0	69.3
	Photographs of Lamp Sources			
(170)	Outside Gamut			0.0_2
(171)	Outside Gamut			0.2
(172)	0.0	3.5	2.8	2.9
(173)	1.7	1.3	0.0	7.7
(174)	0.0	2.3	3.3	11.5
(175)	Outside Gamut			1.5
(176)	0.0	2.9	3.0	2.5
(177)	0.0	2.4	3.6	26.2
(178)	0.0	2.0	3.5	34.1
(179)	5.7	25.	0.0	5.4
(180)	3.8	20.	0.0	8.6
(181)	3.0	16.	0.0	11.7
(182)	6.8	16.	0.0	1.7
(183)	7.6	30.	0.0	2.6
(184)	8.2	32.	0.0	2.5
(185)	10.	30.	0.0	0.9
(186)	43.	100.	0.0	0.1
(187)	4.6	6.0	0.0	6.5
(188)	30.5	50.	0.0	1.7
(189)	27.2	40.	0.0	2.5
(190)	28.	20.	0.0	3.6
(191)	26.	40.	0.0	2.7
(192)	28.	50.	0.0	2.8
(193)	22.	40.	0.0	5.0
(194)	29.	40.	0.0	2.6
(195)	27.	30.	0.0	3.6
(196)	15.7	45.	0.0	8.5

Figure 53. Schematic illustration of the "ideal" Lovibond system showing daylight transmittance (upper diagram) plotted against the units of the Lovibond Color System, based on Red, Yellow, and Blue glass standards, projected from the lower diagram of seven processed unexposed film and four dye-on-film base of Ansco daylight color film.

a) Processed unexposed film:

(1) W-126 RGB (Ansco daylight color film)
(2) W-125 RG (special Ansco red and green sensitive film)
(3) W-130 GB (special Ansco green and blue sensitive film)
(4) W-124 BR (special Ansco blue and red sensitive film)
(5) W-129 R (special Ansco red sensitive film)
(6) W-128 G (special Ansco green sensitive film)
(7) W-127 B (special Ansco blue sensitive film)

b) Dye-on-Film Base:

(8) Cyan dye on film base
(9) Magenta dye on film base
(10 & (11) Yellow dye on film base (two determinations on same sample)

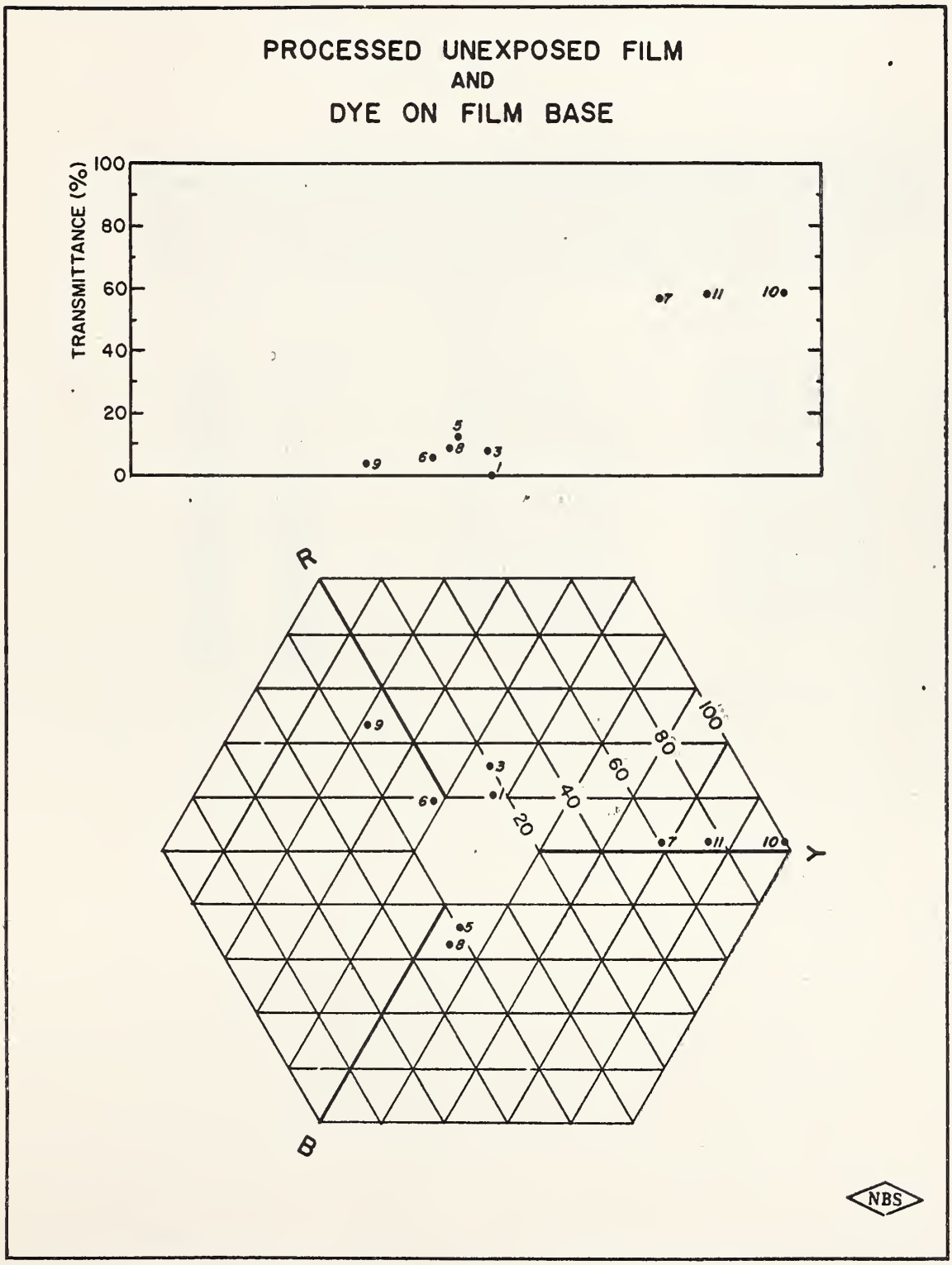
PROCESSED UNEXPOSED FILM
AND
DYE ON FILM BASE
TRANSMITTANCE (%)
100
80
60
40
20
0
9
6
8
5
3
1
7
11
10
R
B
Y
100
80
60
40
20
NBS

FIGURE 53

Figure 54. Schematic illustration of the "ideal" Lovibond system showing daylight transmittance (upper diagram) plotted against the units of the Lovibond Color System, based on Red, Yellow, and Blue glass standards, projected from the lower diagram of thirty-two Ansco color compensating filters:

a) Yellow	b) Magenta	c) Cyan
(12) UV-16P	(17) 33	(20) 43
(13) 23	(18) 34	(21) 44
(14) 24	(19) 35	(22) 45
(15) 25	(30) .025M	(37) .025C
(16) 26	(31) .05M	(38) .05C
(23) .025Y	(32) .10M	(39) .10C
(24) .05Y	(33) .20M	(40) .20C
(25) .10Y	(34) .30M	(41) .30C
(26) .20Y	(35) .40M	(42) .40C
(27) .30Y	(36) .50M	(43) .50C
(28) .40Y		
(29) .50Y		

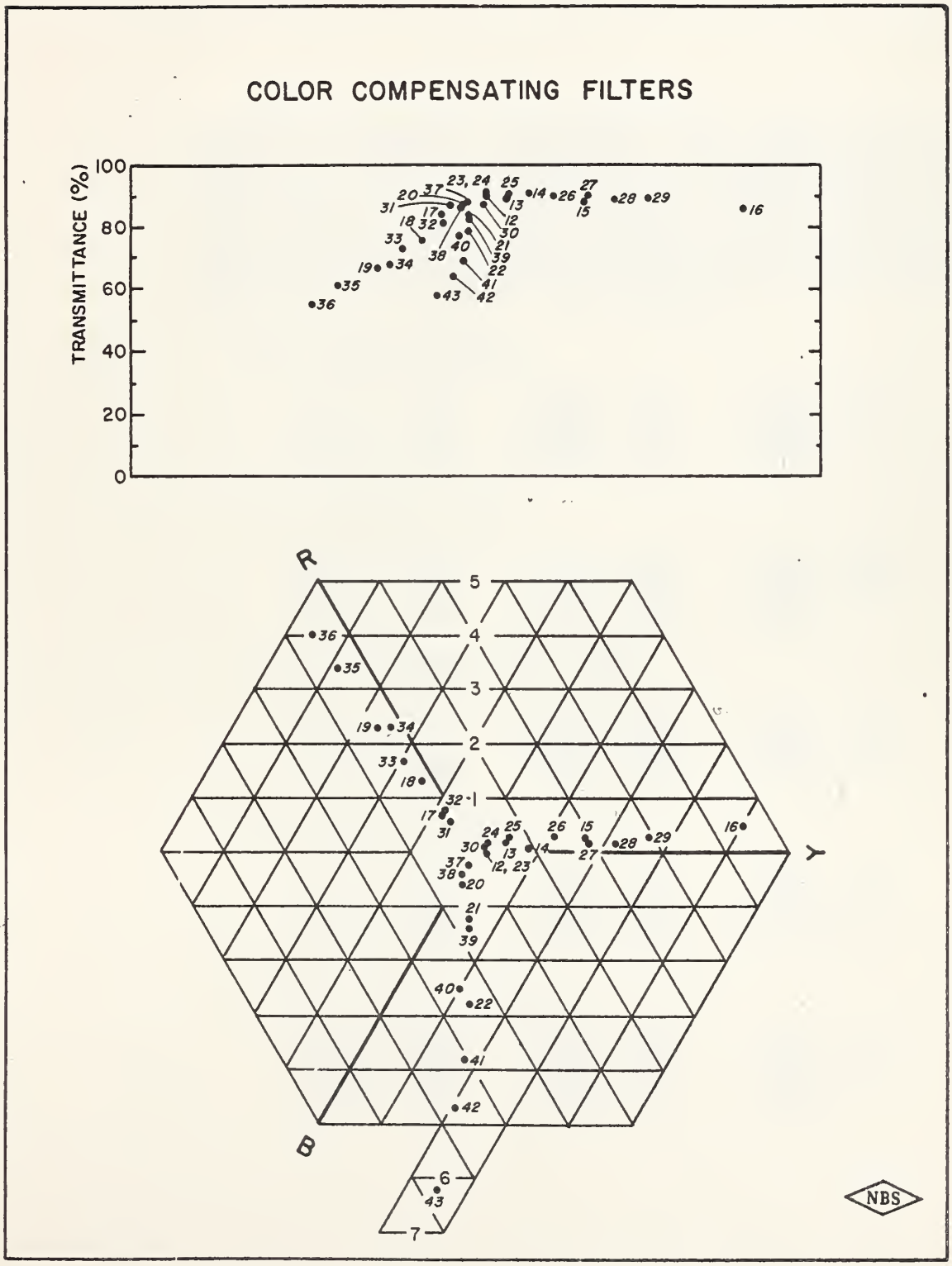
COLOR COMPENSATING FILTERS
TRANSMITTANCE (%)
100
80
60
40
20
0
R
B
Y
5
4
3
2
1
6
7
NBS

FIGURE 54

Figure 55. Schematic illustration of the "ideal" Lovibond system showing daylight transmittance (upper diagram) plotted against the units of the Lovibond Color System, based on Red, Yellow, and Blue glass standards, projected from the lower diagram of forty-five color transparencies of five dyed papers and cardboards on Ansco daylight color film for the indicated shutter speeds (seconds) at f/8 aperture.

a) Orange Mimeo Bond:

(104)	1/400	(107)	1/25	(110)	1/2
(105)	1/100	(108)	1/10	(111)	1
(106)	1/50	(109)	1/5	(112)	2

b) Blue Onion Skin:

(113)	1/800	(116)	1/50	(119)	1/5
(114)	1/200	(117)	1/25	(120)	1/2
(115)	1/100	(118)	1/10	(121)	1

c) Canary Yellow Onion Skin:

(122)	1/800	(125)	1/50	(128)	1/5
(123)	1/200	(126)	1/25	(129)	1/2
(124)	1/100	(127)	1/10	(130)	1

d) Pink Onion Skin:

(131)	1/800	(134)	1/50	(137)	1/5
(132)	1/200	(135)	1/25	(138)	1/2
(133)	1/100	(136)	1/10	(139)	1

e) Red Railroad Board:

(140)	1/400	(143)	1/25	(146)	1/2
(141)	1/100	(144)	1/10	(147)	1
(142)	1/50	(145)	1/5	(148)	2

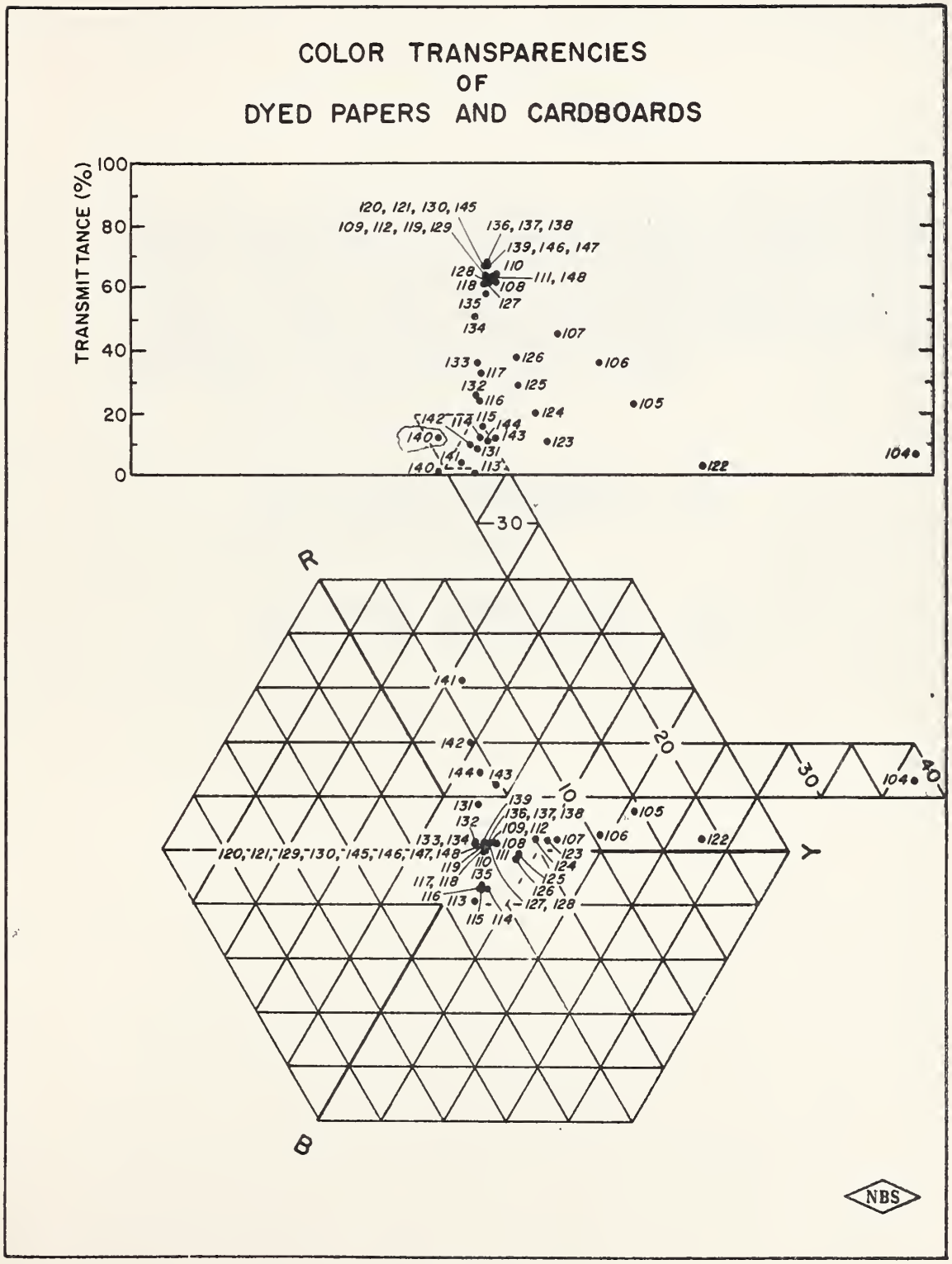
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
TRANSMITTANCE (%)
100
80
60
40
20
0
120, 121, 130, 145
109, 112, 119, 129
136, 137, 138
139, 146, 147
110
128
111, 148
118
108
135
127
134
107
133
126
106
117
132
125
116
105
142
114
115
124
144
140
143
123
131
141
104
140
113
122
30
R
141
142
20
30
40
104
144
143
10
139
131
136, 137, 138
105
132
109, 112
133, 134
108
107
106
122
120, 121, 129, 130, 145, 146, 147, 148
111
123
Y
110
124
119
135
125
117, 118
126
116
113
127, 128
115
114
B
NBS

FIGURE 55

Figure 56. Schematic illustration of the "ideal" Lovibond system showing daylight transmittance (upper diagram) plotted against the units of the Lovibond Color System, based on Red, Yellow, and Blue glass standards, projected from the lower diagram of four color transparencies of two dyed cardboards on special Ansco green and blue sensitive film at the indicated apertures for 1/200 second shutter speed:

a) Blue Railroad Board

(149) W-132 Normal exposure. f/5.6
(150) W-133 Over exposure. f/4

b) Tuscan Railroad Board

(151) W-134 Normal exposure. f/16
(152) W-135 Over exposure. f/8

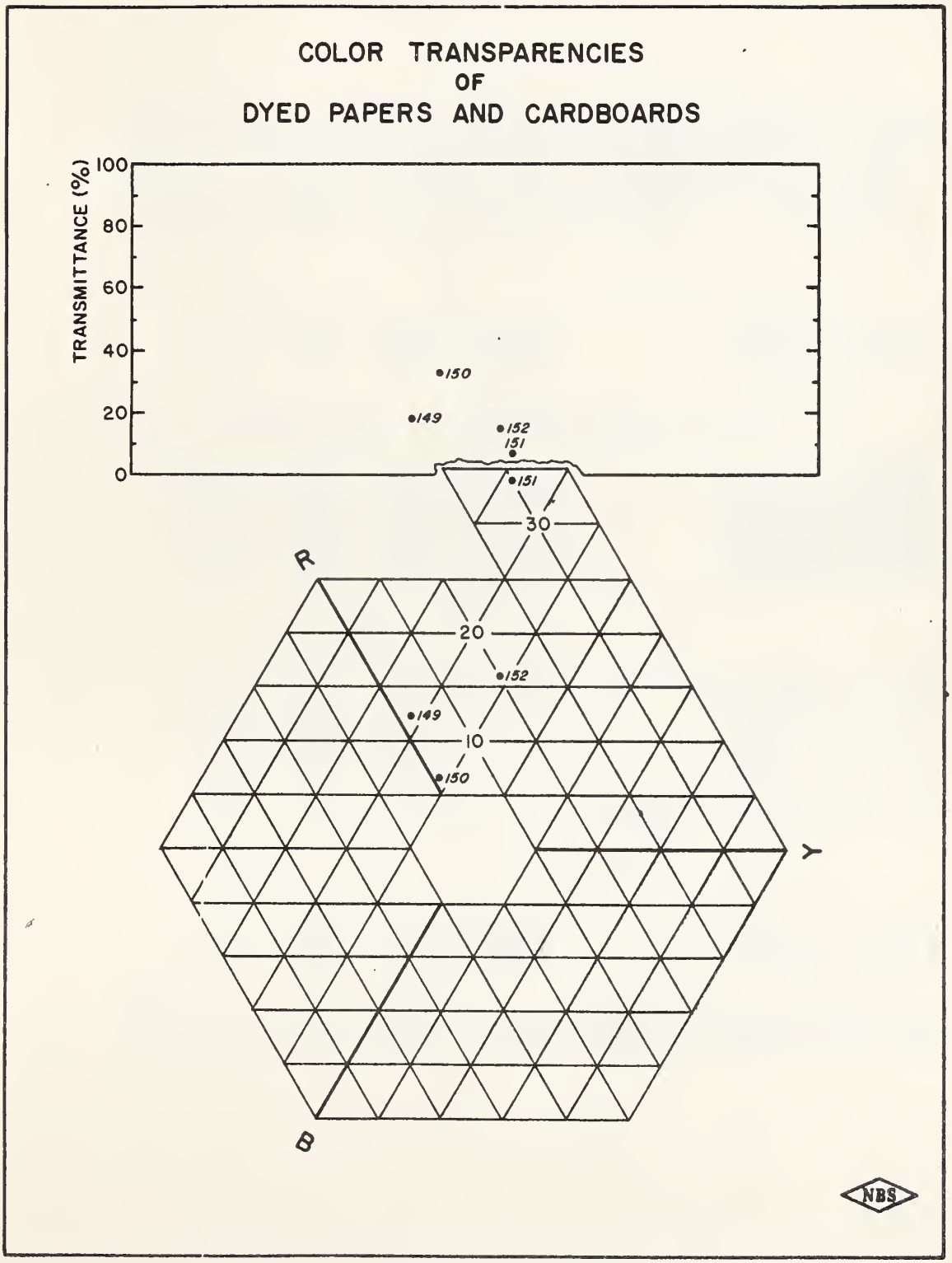
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
TRANSMITTANCE (%)
100
80
60
40
20
0
150
149
152
151
151
30
R
20
152
149
10
150
Y
B
NBS

FIGURE 56

Figure 57. Schematic illustration of the "ideal" Lovibond system showing daylight transmittance (upper diagram) plotted against the units of the Lovibond Color System, based on Red, Yellow, and Blue glass standards, projected from the lower diagram of fifteen color transparencies of a US Army Olive Drab Winter Shirt (Sample No. 55, Figure 13):

a) On Special Ansco Green and Blue Sensitive Film

(153)	W-141	Normal exposure.	1/50 sec., f/5.6
(154)	W-142	Over exposure.	1/50 sec., f/4

b) On Special Ansco Red and Green Sensitive Film

(156)	W-172	Over exposure.	1/100 sec., f/5.6
(157)	W-173	Over exposure.	1/100 sec., f/4
(158)	W-198	Under exposure.	1/200 sec., f/11
(159)	W-199	Normal exposure.	1/200 sec., f/5.6
(160)	W-200	Over exposure.	1/200 sec., f/4

c) On Ansco Daylight Color Film

(161)	W-291	No filter, Normal exposure.	1/50 sec., f/11
(162)	W-292	With red filter.	1/50 sec., f/2.8
(163)	W-293	With yellow filter.	1/50 sec., f/8
(165)	W-295	With blue filter.	1/50 sec., f/2.8
(166)	W-296	No filter, Over exposure.	1/50 sec., f/8
(167)	W-297	No filter, Over exposure.	1/50 sec., f/5.6

d) On Special Ansco Blue Sensitive Film

(168)	W-430	Normal exposure.	1/50 sec., f/11
(169)	W-431	Over exposure.	1/50 sec., f/5.6

Sample Nos. (155) and (164) are not shown on the diagram as these colors are outside the gamut of the Lovibond Color System.

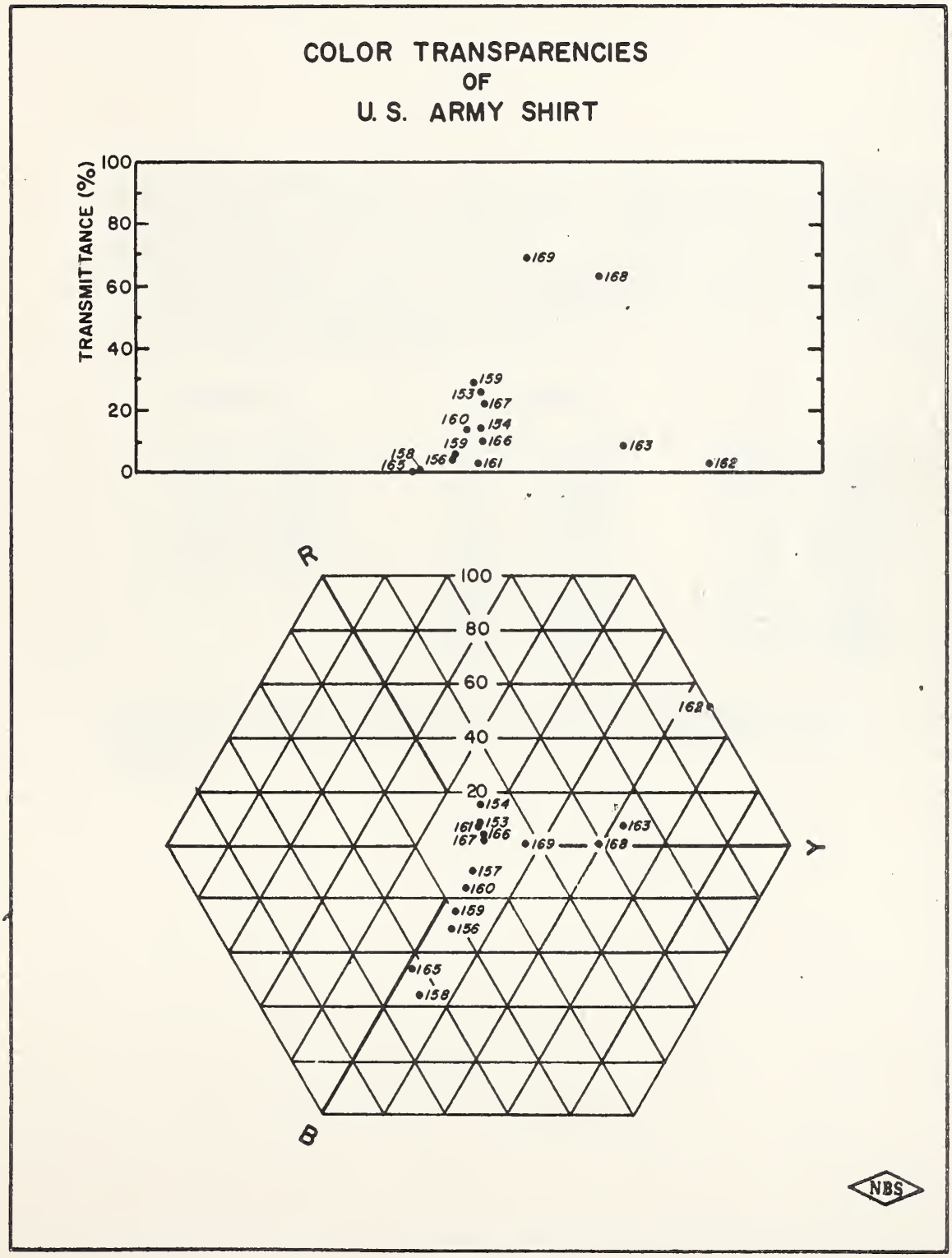
COLOR TRANSPARENCIES
OF
U. S. ARMY SHIRT
TRANSMITTANCE (%)
100
80
60
40
20
0
169
168
159
153
167
160
154
159
166
158
165
156
161
163
162
R
100
80
60
40
20
162
154
161
153
167
166
163
169
168
Y
157
160
159
156
165
158
B
NBS

FIGURE 57

Figure 58. Schematic illustration of the "ideal" Lovibond system showing daylight transmittance (upper diagram) plotted against the units of the Lovibond Color System, based on Red, Yellow, and Blue glass standards, projected from the lower diagram of twenty-four color transparencies on Ansco daylight color film of fluorescent, incandescent, and neon lamp sources in the O'Neill-Nagel light table [3] .

a) Fluorescent	b) Incandescent	c) Neon
(172) W-1858	(179) W-1869	(188) W-1878
(173) W-1859	(180) W-1867	(189) W-1876
(174) W-1860	(181) W-1868	(190) W-1877
(176) W-1863	(182) W-1870	(191) W-1881
(177) W-1864	(183) W-1871	(192) W-1879
(178) W-1866	(184) W-1872	(193) W-1880
	(185) W-1873	(194) W-1884
	(186) W-1974	(195) W-1882
	(187) W-1875	(196) W-1883

Sample Nos. (170), (171), and (175) are not shown on the diagram as they fall outside the gamut of the Lovibond Color System.

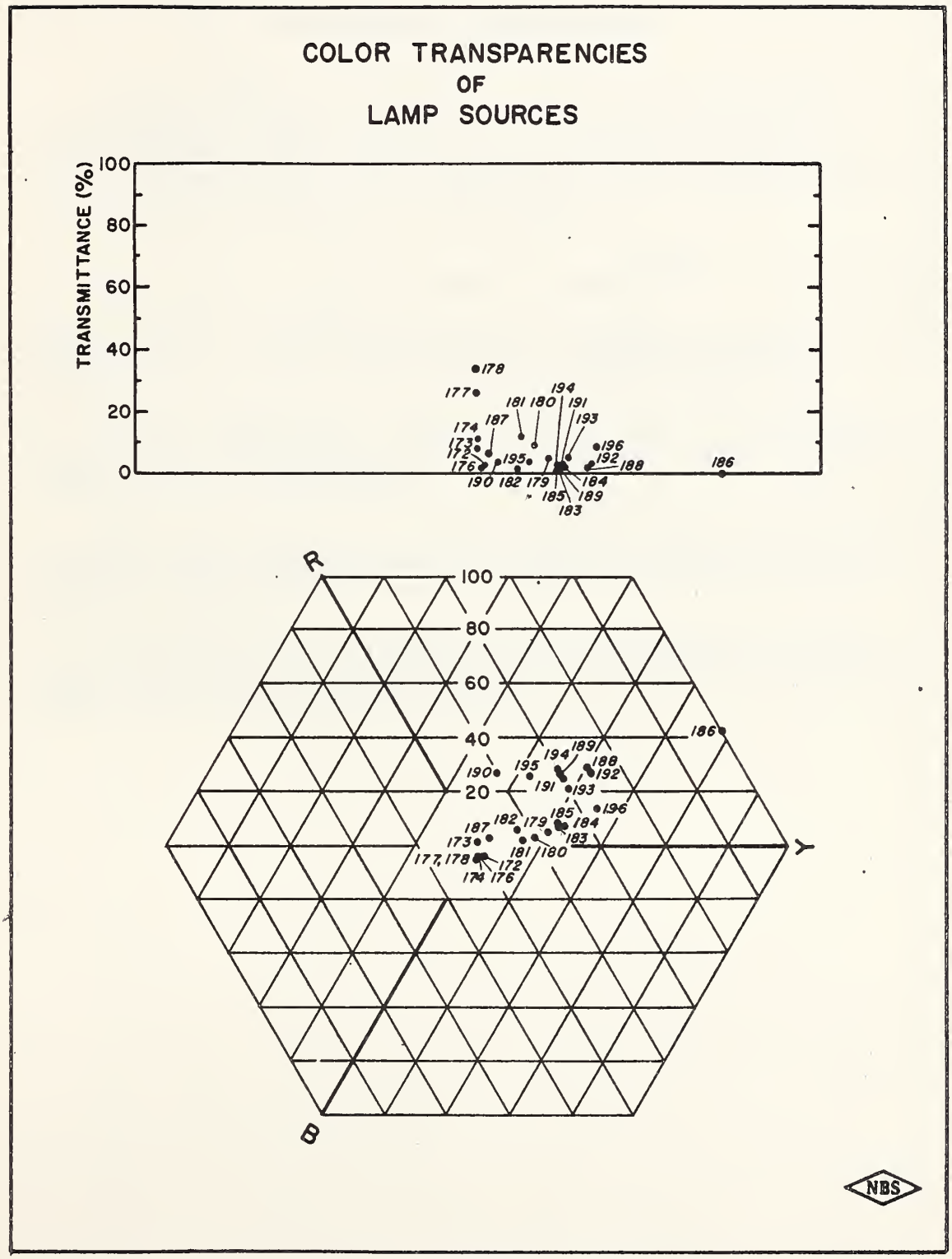
COLOR TRANSPARENCIES
OF
LAMP SOURCES
TRANSMITTANCE (%)
100
80
60
40
20
0
178
177
174
173
172
176
187
181
180
194
191
193
196
195
192
188
186
190
182
179
184
185
189
183
R
100
80
60
40
20
B
Y
186
189
194
188
190
195
192
191
193
196
185
182
179
184
187
183
173
181
180
177
178
172
174
176
NBS

FIGURE 58

IX. Color Difference Computations.

From the Munsell renotations of five of the dyed papers and cardboards (samples 44 to 48) and from forty-five color transparencies of these samples on various types of color films, color differences have been computed by means of the Godlove color difference formula [25] as follows:

$$\Delta E_{NBS} = 5\left[2\, C_1\, C_2\, \phi(H) + (\Delta C)^2 + (4\Delta V)^2\right]^{1/2}$$

where $\phi(H) = 1 - \cos 3.6\Delta H$, and ΔH, ΔV, and ΔC refer to differences in Munsell hue, value, and chroma, respectively.

Similar computations were made between the U. S. Army Shirt (sample 55) and seventeen color transparencies of this sample on various types of color film.

The color differences between the dyed papers and cardboards and their color transparencies are listed in Table VA, and illustrated in Figure 59.

The color differences between the U. S. Army shirt and its color transparencies on various types of color film are listed in Table VB, and illustrated in Figure 60.

Table V

Color Differences Computed using the Godlove Color-Difference Formula Between the Indicated Samples.

VA. Dyed Papers and Cardboards

Color Differences Between Samples Number Reference	Comparison	Color Difference ΔE
(44)	(104)	88.2
(44)	(105)	51.2
(44)	(106)	37.4
(44)	(107)	37.4
(44)	(108)	49.4
(44)	(109)	52.4
(44)	(110)	52.8
(44)	(111)	51.1
(44)	(112)	53.0
(45)	(113)	127.0
(45)	(114)	70.1
(45)	(115)	56.4
(45)	(116)	41.0
(45)	(117)	27.8
(45)	(118)	30.2
(45)	(119)	33.7
(45)	(120)	35.0
(45)	(121)	34.6
(46)	(122)	136.2
(46)	(123)	96.2
(46)	(124)	72.4
(46)	(125)	54.8
(46)	(126)	41.6
(46)	(127)	22.4
(46)	(128)	19.2
(46)	(129)	18.6
(46)	(130)	18.8
(47)	(131)	83.7
(47)	(132)	49.0
(47)	(133)	41.8
(47)	(134)	43.3
(47)	(135)	46.2
(47)	(136)	48.8
(47)	(137)	48.8
(47)	(138)	48.8
(47)	(139)	47.7

Table V (Continued)

Color Differences Between Samples Number		Color Difference
Reference	Comparison	ΔE
(48)	(140)	84.2
(48)	(141)	62.6
(48)	(142)	39.9
(48)	(143)	46.6
(48)	(144)	46.6
(48)	(145)	90.8
(48)	(146)	93.6
(48)	(147)	93.6
(48)	(148)	95.0
	VB. U.S. Army Shirt	
(55)	(153)	48.2
(55)	(154)	51.2
(55)	(155)	103.3
(55)	(156)	88.1
(55)	(157)	65.4
(55)	(158)	100.7
(55)	(159)	84.6
(55)	(160)	74.1
(55)	(161)	41.6
(55)	(162)	45.1
(55)	(163)	36.2
(55)	(164)	53.9
(55)	(165)	95.8
(55)	(166)	13.0
(55)	(167)	22.9
(55)	(168)	103.2
(55)	(169)	100.1

Figure 59. Color difference computed by means of the Godlove color-difference formula, converted into NBS units of color difference, and plotted against the indicated time in seconds of shutter speed for five selected dyed papers and cardboards relative to forty-five color transparencies of these dyed papers and cardboards on Ansco daylight color film.

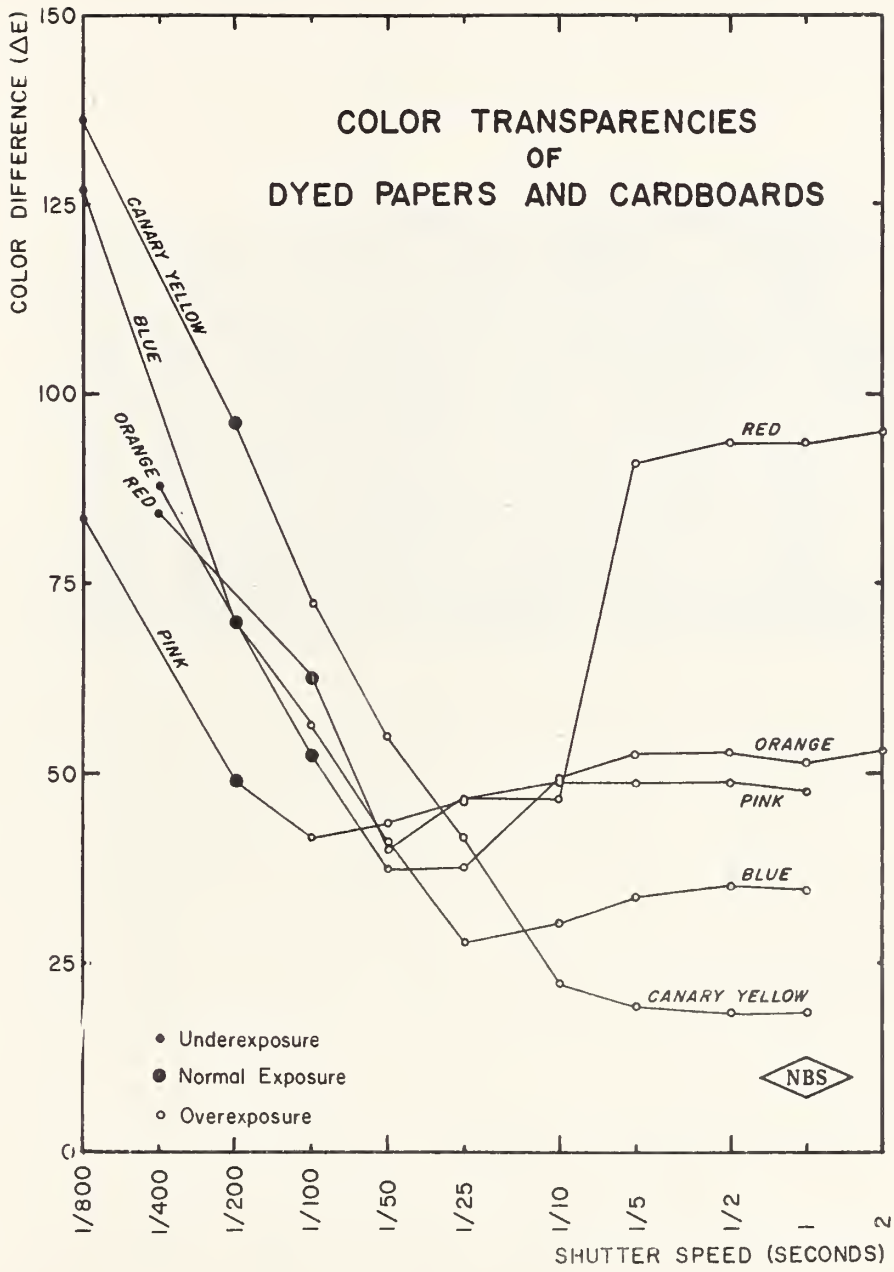
COLOR TRANSPARENCIES
OF
DYED PAPERS AND CARDBOARDS
COLOR DIFFERENCE (ΔE)
150
125
100
75
50
25
0
CANARY YELLOW
BLUE
ORANGE RED
PINK
RED
ORANGE
PINK
BLUE
CANARY YELLOW
• Underexposure
● Normal Exposure
○ Overexposure
NBS
1/800
1/400
1/200
1/100
1/50
1/25
1/10
1/5
1/2
1
2
SHUTTER SPEED (SECONDS)

FIGURE 59

Figure 60. Color differences computed by means of the Godlove color-difference formula, converted into NBS units for a US Army Drab Winter Shirt (Sample No. 55, Figure 13) and of its photographs on the indicated types of Ansco color films plotted against apertures. In descending order; Line (168) to (169), Blue sensitive film; Line (155) to (156) to (157), and Line (158) to (159) to (160), Red and Green sensitive film; Line (153) to (154), Green and Blue sensitive film; and Line (161) to (166) to (167), Ansco daylight color film. Points (162), (163), (164), and (165), Ansco daylight color film with red, yellow, green, and blue filters used respectively.

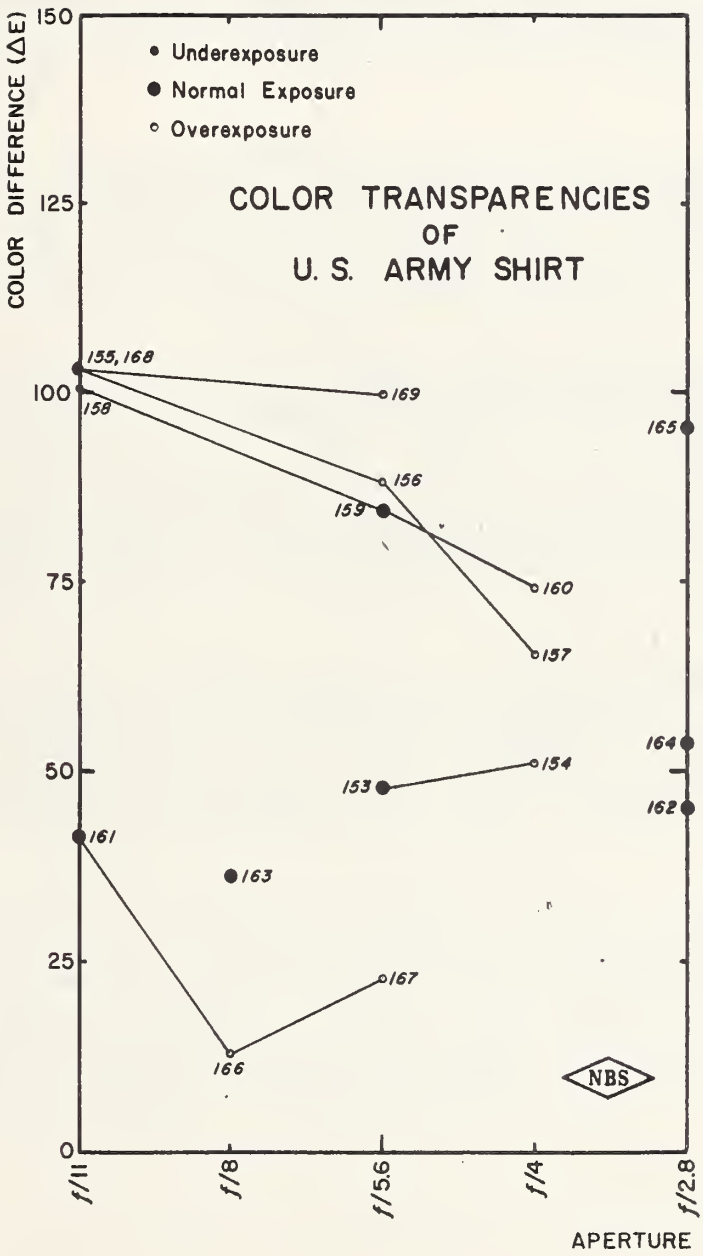
COLOR DIFFERENCE (ΔE)
150
125
100
75
50
25
0
• Underexposure
● Normal Exposure
○ Overexposure
COLOR TRANSPARENCIES
OF
U. S. ARMY SHIRT
155, 168
169
158
165
156
159
160
157
164
154
153
162
161
163
167
166
NBS
f/11
f/8
f/5.6
f/4
f/2.8
APERTURE

FIGURE 60

X. Summary.

The results of this report on man-made objects and color transparencies of man-made objects should be compared with those in the companion NBS Report 4794 on natural objects and color transparencies of natural objects [10].

The same types of Ansco color films were used for the photographs of the man-made and the natural objects, and the same wide gamut of color was obtained and detected by means of these color film components regardless of object origin.

Practically the same conclusions could be drawn for both natural and man-made objects photographed by the same films and the same components of these films. Huge color-differences and high color contrast were obtained for almost all of the natural and man-made objects by means of the separate layers or combinations of them used to make-up commercial color film.

In all cases studied, the commercial color film gave higher color fidelity when used to photograph natural and man-made objects than was obtained when the same objects were photographed by the single and double layers of the emulsion of these films. This is to be expected. However, in the case of the dyed papers and cardboards, color differences as high as 100 NBS units of color differences were measured from commercial color films using normal exposure. The optimum condition for color fidelity for the cases studied appears to be a shutter speed two to four times that for normal exposure.

As in the study of natural objects, the spectral reflectances of the man-made objects are far from identical with the spectral transmittances of the color transparencies of the objects regardless of the emulsions used. Thus, for man-made objects, as was found for natural objects, we find that the spectral reflectance of an object cannot be deduced from the spectral transmittance of the color transparency of the object.

This study was not primarily concerned with color fidelity. However, it can be deduced from the results of these color reconnaissance studies [4 to 10] that no new film need be manufactured for obtaining huge color contrast in aerial photography, and that within the color gamut of the dyes now used in the various layers of the three-layer color film, almost any color may be obtained for almost any object provided that the object has any reasonable spectral reflectance [26, 27, 28].

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Appendix A. Work Requests.

Copies of the nine work requests received from Dr. H. T. O'Neill authorizing studies on the man-made objects and the color transparencies of man-made objects herein reported are included in this appendix. It will be noted that two of the requests also authorized measurements of natural objects and color transparencies of natural objects. All of the samples pertaining to the natural objects were described in NBS Report 4794 [10] issued to WADC in March 1957.

- - - - - - - - - - - - -

The following are copies of the original work requests which resulted in the present report. Also included are some notes by Dr. O'Neill accompanying the work requests.

* * * * *

Serial Number 2.1 WADC-6/52 October 14, 1952

"Determine color fidelity as well as other characteristics of set of photographs numbered 1 to 45, showing the performance on a clear cloudless day with only very moderate haze, of Ansco tricolor film, magenta film, cyan film, and Ansco supreme with and without filters. Pictures were taken on October 13, 1952, processing to be done as soon as possible by Mr. Wm. Nagel of Ansco (probably done within a few days of date). This series is to be studied along with the two succeeding requests which should be consulted in this connection."

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Serial Number 2.1 WADC-28/53 (A) July 17, 1953

"Please make spectrophotometric curves for several hundred 2-1/4 x 2-1/4 inch color transparencies, showing color fidelity, of eight types of color (Ansco color reversal or color negative) as well as the spectrophotometric curves of such important military backgrounds as: sky, haze, water, vegetation, soil, airplanes, army uniforms, effect of water on the chromaticity of soil, etc."

"To enable us to compare the efficiency of the various types of color photography and of the individual layers, alone or collectively, with or without filters in the field of military reconnaissance and intelligence. Also to make use of these in conjunction with filters for increasing contrast with background when viewing such color transparencies on a light-table."

* * * * *

Serial Number 2.1 WADC-28/53 (B) July 23, 1953

"Spectrophotometric curves and Munsell notations are requested on samples of film (2-1/4 x 2-1/4 inches) whose purpose and function are more or less explained on the tabulation sheet herewith."

"Film numbers W-132 to W-236 are sent herewith with tabulation sheet. In a sense when these curves have been made, it will enable a series of comparisons to be made of many of the factors involved in this study on the principle of solving for a series of simultaneous equations."

"To test color fidelity over: 1. A range of underexposure and overexposure of seven types of color reversal film; 2. The possibility of making suitable filters by overexposure, i.e., securing in this convenient and inexpensive way, a filter sufficienty thin but really exactly representing on any particular film used, objects of military importance; 3. When such a filter exactly representing a military object is compared with a similarly prepared filter for any of the various backgrounds, the following can be deduced with fair accuracy: a) degree of contrast between object and background on the seven types of films studied, b) a filter can be plotted that will best serve to give maximum contrast between object and background when used in photographing such a pair on any kind of photographic film studied, and c) a similar filter or filtering system can be planned that will give the maximum contrast between the background and the military object showing on a color transparency when this filter is interposed between the eye of the observer and transparency or between the source of light and the transparency."

"Note: The Project Director would like to have these films for further study at some later date."

* * * * *

Serial Number 2.1 WADC-32/54 February 10, 1954

"Please determine spectrophotometric curves of Quartermaster uniforms, olive drab jacket, and khaki shirt. (Olive drab trousers and cap match jacket by eye. Can bring them in if you think necessary.) Please give Munsell Color Notations also unless this seems unnecessary. Please determine spectrophotometric curve, if necessary, and note if already duplicated by other objects, and/or the Munsell color reading of the following Marine clothing: Fatigue cap, trousers, and jacket. Khaki shirt and trousers (slightly different shades on each). Khaki tie and overseas cap. Olive drab cap, trousers, and jacket. These have not yet been photographed but it is proposed to use them very soon on dummies."

"To obtain the spectrophotometric curves for these uniforms, also later for any films, filters, sources of light, and how each of these records the color, etc. as shown on the spectrophotometer. The spectrophotometric curves for any of these are requested as soon as convenient so that they can be used on clear plastic for superposing over a source of light. This superposing

method should show to what extent this procedure will be practical for photographers to decide what film, filter, source of light, etc. is best for photographing and later studying such photographs, where it is proposed to detect these objects by photographic means."

* * * * *

Serial Number 2.1 WADC - 33/54 September 21, 1954

"Spectrophotometric study of five paints used for color targets in aerial photography, and the following Munsell samples prepared by the Tobey Press, Saint Louis, Missouri: 18 samples of the gray series; 7 samples of the Red scale; and 9 samples of the most saturated chromatic scale."

* * * * *

Serial Number 2.1 WADC - 34/55 (A) July 22, 1953

"Please determine spectrophotometric curves of the samples submitted herewith as follows: A series of seven 2" by 2" Ansco color films, W-124 to W-130, illustrating six types of film, all elements of the seventh type, the Ansco Color Daylight type.

W-124 Two layers, blue and red sensitive only.
W-125 Two layers, green and red sensitive only.
W-126 Three layers of the complete Ansco color.
W-127 Single layer, blue sensitive only.
W-128 Single layer, green sensitive only.
W-129 Single layer, red sensitive only.
W-130 Double layer, blue and green sensitive only.

Rate and kind of fading tests are requested. All these samples are color-reversal film, all of them unexposed."

"The curves shown by these films are requested to be transferred to clear plastic (Ozachrome) so that they can be used to determine the following: 1. The effect of light on the dye in the emulsion, when this curve of the unexposed but developed film is compared with the curve of the exposed and developed film. 2. The effect of the entire process of manufacturing and developing by reversal process on the absorption spectrum of each dye can be observed by comparison of this curve with the curve of the dye alone in aqueous suspension, with and without gelatin. Mr. Keegan has cited a Russian reference which states that notable differences in the absorption spectra of certain dyes occurs in the presence of at least some kinds of gelatin used in the industry. We wish to determine, in a preliminary way, the magnitude of this change and other changes. Further: Munsell Notation of each of these is requested. P.S. Samples are duplicates of the author's collection and may be kept at the Bureau for purposes of further studies."

* * * * *

Serial Number 2.1 WADC - 34/55 (B) July 29, 1953

"Determine the total amount of light transmitted by color transparencies which we have submitted to the Bureau of Standards or will submit in the near future, especially, Numbers W-124 to W-130, i.e. the series of unexposed developed color reversal film modifications, single layers only, double layers, etc. Also W-132 to W-299."

"For obtaining data on the use of normally exposed, overexposed, and even underexposed color-reversal transparencies as filters in a light table or illuminating table. Results can be expressed in absolute units or in the scale of filter factors in use in photography, that is, where a factor of 2 corresponds to 1 full stop in exposure or a reduction of one half of the total amount of light. While it is realized that this figure may be calculated or deduced from the graph of the spectrophotometric curve, it is believed that direct measurement would be much more rapid, more accurate (?), and furnish an excellent means of checking total transmittance and/or reflectance (?) at least sufficiently accurately for the purposes of this research. It is left to the judgment of Mr. Keegan to decide how best to do this."

* * * * *

Serial Number 2.1 WADC - 36/55 April 20, 1955

"Spectrophotometric curves of color transparencies of three types of light sources used in the O'Neill - Nagel light table. W-1858 to W-1884 inclusive. Total: 27."

* * * * *

Serial Number 2.1 WADC - 37/55 June 3, 1955

"Spectrophotometer samples of Ansco color correcting printing foils on GE. Samples consist of 7 yellows, 7 cyans, 7 magentas, and 10 samples from the old set of filters."

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Appendix B

Tables of Spectrophotometric Data

Tables of spectral transmittance (400 to 750 millimicrons) of 43 transmitting man-made objects, such as processed unexposed film, dye-on-film base, and color compensating filters.

Tables of spectral directional reflectance (400 to 750 millimicrons) of 39 reflecting man-made objects, such as dyed papers and cardboards and Munsell papers (Tobey Press); and tables of the visible and the near infrared spectral directional reflectance (400 to 1080 millimicrons) of 14 US military wearing apparel, and 7 painted pressboard samples.

Tables of spectral transmittance (400 to 750 millimicrons) of 93 color transparencies of man-made objects, such as dyed papers and cardboards, US Army olive drab shirt, and incandescent, fluorescent, and neon lamp sources.

Values of spectral transmittance or of spectral directional reflectance were read at 10 millimicron intervals from the original copies of the 39 recordings shown in Appendix D. For the overlapping segments of the region 730 to 750 millimicrons, on the reflectance measurements, an average of both determinations in each case is reported.

Transmitting Man-Made Objects

Spectral Transmittance of Processed Unexposed Films and Dye-on-Film Base for the Visible Spectrum 400 to 750 millimicrons. (See Table IA and Appendix D, GE Graph Sheet Numbers GE I-1386 and GE II-1555, -1556, and -1557.)

Wave length mμ	Sample Number (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
400	0.000	0.068	0.008	0.008	0.209	0.263	0.011	0.161	0.162	0.000	0.000
10	.000	.079	.004	.006	.294	.209	.006	.246	.128	.000	.000
20	.000	.082	.000	.004	.392	.159	.002	.342	.090	.000	.000
30	.000	.077	.000	.003	.478	.120	.000	.436	.059	.000	.000
40	.000	.072	.000	.002	.548	.095	.000	.506	.037	.000	.000
450	.000	.078	.000	.002	.583	.098	.000	.536	.029	.000	.000
60	.000	.087	.000	.006	.590	.110	.000	.534	.022	.000	.000
70	.000	.078	.000	.014	.573	.102	.006	.507	.014	.000	.000
80	.000	.054	.005	.032	.534	.075	.021	.460	.006	.004	.002
90	.002	.030	.009	.069	.470	.046	.058	.404	.000	.021	.020
500	.002	.014	.011	.117	.419	.024	.128	.336	.000	.070	.075
10	.001	.006	.011	.161	.344	.013	.238	.266	.000	.167	.174
20	.000	.000	.011	.185	.269	.008	.360	.191	.000	.301	.307
30	.000	.000	.012	.181	.194	.006	.470	.129	.000	.444	.446
40	.000	.000	.013	.156	.132	.006	.566	.076	.000	.563	.558
550	.000	.000	.017	.120	.080	.008	.622	.041	.000	.649	.642
60	.000	.000	.026	.085	.046	.012	.662	.018	.000	.710	.702
70	.002	.000	.044	.058	.024	.023	.698	.007	.008	.750	.740
80	.004	.000	.074	.037	.012	.041	.722	.000	.022	.778	.770
90	.006	.000	.117	.023	.004	.070	.742	.000	.048	.800	.790
600	.008	.000	.174	.014	.000	.116	.764	.000	.092	.816	.810
10	.009	.000	.238	.008	.000	.167	.780	.000	.148	.831	.824
20	.010	.000	.303	.006	.000	.226	.791	.000	.210	.844	.838
30	.010	.000	.371	.004	.000	.284	.799	.000	.280	.849	.842
40	.011	.000	.435	.002	.000	.346	.812	.000	.348	.858	.852
650	.012	.000	.499	.002	.000	.408	.815	.000	.415	.860	.856
60	.016	.000	.561	.004	.000	.471	.824	.000	.484	.867	.859
70	.020	.000	.616	.005	.000	.530	.832	.000	.546	.874	.870
80	.028	.000	.665	.008	.000	.586	.832	.000	.598	.873	.868
90	.040	.000	.707	.012	.000	.633	.841	.000	.644	.880	.873
700	.059	.000	.742	.021	.002	.678	.849	.000	.685	.884	.880
10	.088	.004	.771	.036	.008	.718	.849	.000	.715	.881	.878
20	.128	.012	.792	.060	.018	.748	.859	.004	.741	.888	.882
30	.176	.027	.808	.093	.036	.767	.866	.012	.760	.893	.888
40	.236	.051	.823	.138	.064	.785	.864	.028	.773	.889	.887
750	.299	.088	.830	.196	.101	.802	.869	.053	.782	.890	.887

Transmitting Man-Made Objects

Spectral Transmittance of Ansco Color Compensating Filters for the Visible Spectrum 400 to 750 millimicrons. (See Table IA and Appendix D, GE Graph Sheet Numbers GE II-1796, -1797, and -1798.)

Wave length mμ	Sample Number (12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
400	0.288	0.725	0.726	0.532	0.314	0.902	0.895	0.765	0.898	0.825	0.800
10	.500	.722	.695	.515	.287	.902	.895	.776	.902	.844	.826
20	.692	.721	.669	.504	.271	.902	.891	.784	.905	.856	.845
30	.798	.722	.657	.501	.266	.899	.884	.788	.906	.865	.856
40	.845	.728	.661	.507	.271	.894	.871	.789	.906	.872	.866
450	.865	.738	.687	.524	.289	.885	.854	.784	.907	.878	.872
60	.874	.758	.723	.562	.332	.875	.833	.770	.908	.883	.878
70	.881	.784	.769	.617	.407	.863	.808	.747	.908	.887	.883
80	.885	.811	.827	.680	.496	.848	.780	.717	.909	.889	.885
90	.888	.842	.873	.758	.616	.833	.747	.680	.909	.891	.887
500	.892	.868	.900	.826	.752	.820	.729	.644	.908	.892	.888
10	.894	.887	.911	.873	.845	.810	.710	.610	.907	.892	.886
20	.896	.893	.916	.892	.882	.796	.686	.580	.903	.891	.882
30	.897	.896	.917	.897	.894	.790	.674	.564	.898	.888	.876
40	.898	.898	.918	.900	.898	.799	.691	.564	.893	.884	.866
550	.900	.900	.919	.902	.900	.810	.710	.575	.886	.875	.842
60	.901	.900	.920	.902	.901	.814	.714	.592	.875	.860	.819
70	.903	.901	.920	.904	.903	.824	.730	.631	.864	.844	.785
80	.904	.902	.921	.904	.904	.852	.781	.699	.855	.824	.750
90	.904	.903	.921	.904	.904	.887	.844	.776	.848	.798	.704
600	.905	.903	.922	.905	.905	.910	.892	.839	.835	.754	.636
10	.905	.903	.922	.905	.905	.920	.912	.873	.815	.728	.593
20	.906	.904	.922	.906	.906	.924	.920	.890	.799	.724	.580
30	.906	.903	.922	.906	.906	.924	.923	.899	.798	.723	.578
40	.907	.904	.922	.907	.907	.925	.924	.903	.808	.724	.586
650	.907	.904	.922	.907	.907	.925	.924	.904	.810	.715	.584
60	.907	.905	.922	.907	.907	.926	.924	.905	.804	.643	.501
70	.908	.905	.922	.908	.908	.926	.924	.907	.783	.525	.384
80	.908	.906	.923	.908	.908	.927	.925	.908	.778	.533	.406
90	.908	.906	.923	.908	.908	.927	.925	.908	.817	.687	.584
700	.908	.906	.923	.908	.908	.927	.926	.909	.862	.815	.744
10	.909	.906	.923	.909	.909	.927	.926	.909	.891	.860	.812
20	.909	.906	.923	.909	.909	.927	.926	.909	.908	.880	.847
30	.909	.906	.923	.909	.909	.927	.926	.909	.916	.891	.868
40	.910	.907	.923	.910	.910	.927	.926	.910	.921	.898	.881
750	.910	.907	.923	.910	.910	.926	.926	.910	.922	.902	.890

Transmitting Man-Made Objects

Spectral Transmittance of Ansco Color Compensating Filters for the Visible Spectrum 400 to 750 millimicrons. (See Table 1A and Appendix D, GE Graph Sheet Number GE II-1799.)

Wave length mμ	Sample Number (23)	(24)	(25)	(26)	(27)	(28)	(29)
400	0.853	0.802	0.712	0.568	0.494	0.411	0.330
10	.853	.805	.711	.546	.466	.386	.305
20	.853	.809	.716	.536	.456	.380	.300
30	.854	.814	.724	.541	.463	.394	.316
40	.858	.823	.736	.566	.491	.427	.351
450	.865	.836	.751	.610	.538	.481	.408
60	.873	.848	.771	.660	.600	.545	.479
70	.883	.863	.797	.724	.675	.627	.567
80	.892	.878	.822	.798	.763	.731	.689
90	.900	.891	.847	.852	.837	.816	.792
500	.907	.899	.872	.885	.878	.865	.856
10	.910	.906	.892	.901	.896	.887	.882
20	.912	.910	.903	.907	.904	.898	.894
30	.914	.913	.908	.911	.909	.904	.900
40	.915	.915	.915	.914	.912	.908	.905
550	.916	.916	.916	.916	.914	.910	.907
60	.917	.917	.917	.917	.915	.911	.909
70	.918	.918	.918	.918	.915	.913	.911
80	.918	.918	.918	.918	.917	.914	.912
90	.919	.919	.919	.919	.918	.916	.913
600	.920	.920	.920	.920	.918	.916	.914
10	.921	.921	.921	.921	.919	.917	.916
20	.922	.922	.922	.922	.920	.918	.917
30	.923	.923	.923	.923	.921	.919	.917
40	.923	.923	.923	.923	.922	.920	.918
650	.923	.923	.923	.923	.922	.921	.918
60	.924	.924	.924	.924	.923	.921	.919
70	.924	.924	.924	.924	.923	.921	.920
80	.925	.925	.925	.925	.923	.921	.921
90	.925	.925	.925	.925	.923	.921	.921
700	.925	.926	.925	.925	.923	.922	.921
10	.925	.926	.925	.925	.923	.923	.921
20	.925	.927	.925	.925	.923	.923	.921
30	.926	.927	.926	.926	.924	.924	.921
40	.926	.927	.926	.925	.924	.924	.922
750	.927	.928	.927	.926	.925	.925	.922

Spectral Transmittance of Ansco Color Compensating Filters for the Visible Spectrum 400 to 750 millimicrons. (See Table 1A and Appendix D, GE Graph Sheet Number GE II-1800.)

Wave length mμ	Sample Number (30)	(31)	(32)	(33)	(34)	(35)	(36)
400	0.847	0.881	0.869	0.858	0.847	0.836	0.797
10	.854	.883	.873	.861	.851	.837	.802
20	.859	.886	.873	.859	.847	.830	.796
30	.862	.887	.872	.852	.837	.815	.779
40	.865	.886	.867	.840	.820	.790	.752
450	.866	.883	.859	.822	.796	.757	.712
60	.867	.878	.848	.799	.766	.717	.666
70	.866	.873	.834	.774	.733	.673	.617
80	.866	.866	.817	.744	.692	.622	.558
90	.863	.858	.798	.711	.651	.569	.502
500	.861	.852	.786	.688	.623	.533	.464
10	.860	.847	.774	.667	.596	.502	.431
20	.858	.840	.759	.641	.565	.466	.392
30	.858	.836	.752	.631	.552	.451	.376
40	.862	.842	.765	.650	.575	.479	.404
550	.866	.850	.778	.671	.600	.507	.435
60	.869	.852	.781	.676	.607	.515	.444
70	.873	.857	.794	.698	.633	.545	.476
80	.881	.875	.832	.761	.711	.643	.580
90	.890	.894	.873	.837	.809	.769	.721
600	.897	.909	.899	.884	.872	.854	.822
10	.900	.913	.910	.904	.899	.892	.868
20	.903	.916	.915	.913	.911	.908	.888
30	.904	.919	.919	.917	.916	.913	.896
40	.905	.920	.920	.919	.919	.917	.901
650	.906	.921	.921	.921	.921	.919	.905
60	.907	.921	.921	.921	.921	.920	.907
70	.908	.922	.922	.922	.922	.921	.908
80	.909	.922	.922	.922	.922	.922	.910
90	.909	.922	.922	.922	.922	.922	.912
700	.910	.922	.922	.922	.922	.922	.913
10	.910	.922	.922	.922	.922	.922	.913
20	.911	.923	.923	.923	.923	.923	.915
30	.911	.923	.923	.923	.923	.923	.915
40	.911	.923	.923	.923	.923	.923	.916
750	.912	.924	.924	.924	.924	.924	.917

Transmitting Man-Made Objects

Spectral Transmittance of Ansco Color Compensating Filters for the Visible Spectrum 400 to 750 millimicrons. (See Table 1A and Appendix D, GE Graph Sheet Number GE II-1801.)

Wave length mμ	Sample Number (37)	(38)	(39)	(40)	(41)	(42)	(43)
400	0.870	0.872	0.870	0.847	0.825	0.807	0.787
10	.874	.879	.877	.858	.838	.826	.808
20	.879	.883	.882	.865	.847	.835	.820
30	.882	.885	.883	.867	.849	.838	.821
40	.884	.887	.885	.867	.850	.838	.820
450	.887	.888	.887	.868	.850	.838	.819
60	.889	.890	.888	.870	.852	.839	.819
70	.892	.892	.889	.871	.852	.841	.821
80	.893	.893	.890	.872	.854	.842	.822
90	.893	.893	.890	.872	.853	.840	.818
500	.894	.892	.889	.869	.848	.835	.810
10	.894	.891	.886	.863	.838	.822	.792
20	.894	.889	.880	.855	.821	.801	.765
30	.892	.885	.873	.840	.799	.773	.727
40	.890	.880	.863	.822	.772	.739	.683
550	.888	.874	.852	.800	.739	.698	.632
60	.884	.865	.837	.775	.699	.649	.573
70	.879	.856	.820	.744	.655	.597	.514
80	.874	.846	.804	.717	.617	.550	.459
90	.870	.839	.791	.694	.585	.513	.416
600	.864	.829	.774	.662	.543	.466	.367
10	.859	.818	.755	.629	.500	.416	.320
20	.854	.808	.738	.598	.464	.375	.282
30	.848	.806	.734	.592	.455	.368	.274
40	.856	.812	.745	.608	.475	.388	.293
650	.858	.814	.747	.611	.479	.393	.297
60	.857	.813	.742	.598	.466	.378	.287
70	.857	.809	.735	.583	.449	.358	.274
80	.861	.813	.740	.584	.451	.359	.279
90	.877	.844	.788	.661	.544	.458	.378
700	.896	.879	.850	.766	.696	.618	.558
10	.908	.900	.886	.833	.786	.742	.708
20	.913	.911	.906	.874	.852	.822	.800
30	.915	.915	.914	.896	.880	.866	.854
40	.917	.917	.919	.906	.896	.888	.881
750	.918	.918	.921	.912	.904	.901	.897

Reflecting Man-Made Objects

Spectral Directional Reflectance of Five Dyed Papers and Cardboards for the Visible Spectrum, 400 to 750 millimicrons. (See Table IB and Appendix D, GE Graph Sheets Serial No. GE II-1225, -1226, -1227, -1228, and -1229.)

Wave length mμ	Sample Number (44)	(45)	(46)	(47)	(48)
400	0.066	0.534	0.275	0.464	0.074
10	.062	.557	.262	.480	.070
20	.060	.578	.250	.496	.068
30	.060	.596	.248	.515	.066
40	.063	.612	.258	.526	.064
450	.066	.625	.271	.514	.059
60	.072	.634	.303	.483	.055
70	.079	.636	.366	.448	.051
80	.092	.634	.442	.411	.050
90	.114	.626	.504	.380	.049
500	.156	.612	.558	.355	.050
10	.222	.590	.606	.336	.050
20	.298	.566	.646	.328	.050
30	.369	.539	.682	.326	.054
40	.419	.514	.710	.330	.059
550	.459	.491	.730	.342	.069
60	.506	.469	.741	.370	.086
70	.573	.448	.747	.426	.128
80	.654	.426	.750	.508	.209
90	.728	.406	.754	.610	.338
600	.784	.386	.756	.692	.474
10	.820	.366	.756	.733	.600
20	.840	.350	.756	.756	.690
30	.854	.338	.758	.760	.744
40	.864	.327	.760	.764	.774
650	.870	.319	.764	.766	.792
60	.874	.314	.768	.768	.804
70	.877	.311	.770	.770	.814
80	.880	.308	.772	.770	.821
90	.884	.306	.774	.771	.828
700	.886	.308	.774	.772	.833
10	.890	.310	.775	.773	.838
20	.891	.312	.775	.774	.841
30	.893	.316	.774	.774	.844
40	.894	.321	.774	.772	.846
750	.894	.325	.774	.772	.848

Reflecting Man-Made Objects

Spectral Directional Reflectance, R_λ, of Two Samples from U. S. Army Shade Book No. 5045 for the Visible and Near Infrared Spectrum, 400 to 1080 millimicrons. (See Appendix D, GE Graph Sheets Serial No. GE II-1384 and -1385.)

(49) Khaki #1 (cotton)			
Wave Length mμ	R_λ	Wave Length mμ	R_λ
400	0.165	750	0.575
10	.161	60	.588
20	.155	70	.600
30	.150	80	.610
40	.144	90	.622
450	.140	800	.634
60	.143	10	.646
70	.150	20	.660
80	.164	30	.674
90	.180	40	.686
500	.194	850	.698
10	.210	60	.708
20	.224	70	.718
30	.234	80	.727
40	.241	90	.735
550	.246	900	.744
60	.248	10	.750
70	.251	20	.756
80	.255	30	.764
90	.262	40	.770
600	.272	950	.775
10	.285	60	.780
20	.299	70	.784
30	.314	80	.788
40	.334	90	.791
650	.361	1000	.794
60	.392	10	.798
70	.422	20	.802
80	.450	30	.806
90	.471	40	.810
700	.490	1050	.812
10	.508	60	.816
20	.526	70	.820
30	.546	80	.824
40	.562		

(50) Olive Drab #52 (wool)			
Wave Length mμ	R_λ	Wave Length mμ	R_λ
400	0.052	750	0.467
10	.052	60	.494
20	.052	70	.519
30	.052	80	.540
40	.052	90	.559
450	.052	800	.576
60	.054	10	.591
70	.056	20	.605
80	.060	30	.618
90	.068	40	.630
500	.076	850	.640
10	.088	60	.650
20	.095	70	.662
30	.100	80	.673
40	.103	90	.684
550	.104	900	.696
60	.104	10	.709
70	.104	20	.721
80	.105	30	.735
90	.106	40	.746
600	.110	950	.758
10	.116	60	.768
20	.123	70	.777
30	.133	80	.785
40	.145	90	.793
650	.161	1000	.799
60	.182	10	.804
70	.205	20	.809
80	.234	30	.814
90	.266	40	.820
700	.300	1050	.829
10	.334	60	.835
20	.371	70	.842
30	.408	80	.848
40	.440		

Reflecting Man-Made Objects

Spectral Directional Reflectance, R_λ, of Three Samples of U. S. Marine Corps Wearing Apparel for the Visible and Near Infrared Spectrum, 400 to 1080 millimicrons. (See Appendix D, GE Graph Sheets Serial No. GE II-1486 and -1489.)

(51) US Marine Corps Necktie				(52) US Marine Corps Overseas Cap (Summer)				(53) US Marine Corps Pants (Summer)			
Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ
400	0.110	750	0.398	400	0.124	750	0.489	400	0.150	750	0.576
10	.115	60	.406	10	.121	60	.501	10	.148	60	.580
20	.118	70	.414	20	.116	70	.512	20	.142	70	.589
30	.119	80	.422	30	.110	80	.522	30	.136	80	.596
40	.120	90	.432	40	.104	90	.531	40	.130	90	.604
450	.122	800	.442	450	.100	800	.541	450	.126	800	.612
60	.124	10	.452	60	.101	10	.553	60	.126	10	.622
70	.126	20	.466	70	.106	20	.565	70	.132	20	.631
80	.128	30	.478	80	.116	30	.576	80	.142	30	.640
90	.134	40	.493	90	.127	40	.586	90	.155	40	.650
500	.140	850	.510	500	.140	850	.598	500	.168	850	.658
10	.149	60	.527	10	.152	60	.607	10	.182	60	.664
20	.161	70	.545	20	.165	70	.616	20	.194	70	.670
30	.176	80	.564	30	.176	80	.624	30	.203	80	.676
40	.192	90	.583	40	.183	90	.631	40	.210	90	.680
550	.204	900	.604	550	.189	900	.638	550	.216	900	.683
60	.212	10	.623	60	.193	10	.644	60	.218	10	.686
70	.216	20	.642	70	.196	20	.650	70	.220	20	.690
80	.218	30	.660	80	.200	30	.655	80	.222	30	.692
90	.220	40	.676	90	.206	40	.660	90	.227	40	.694
600	.222	950	.692	600	.214	950	.666	600	.236	950	.697
10	.230	60	.706	10	.227	60	.670	10	.249	60	.699
20	.239	70	.718	20	.237	70	.675	20	.262	70	.700
30	.257	80	.728	30	.250	80	.679	30	.276	80	.701
40	.276	90	.738	40	.266	90	.683	40	.295	90	.702
650	.298	1000	.746	650	.288	1000	.686	650	.326	1000	.703
60	.316	10	.753	60	.315	10	.690	60	.365	10	.704
70	.330	20	.758	70	.342	20	.694	70	.406	20	.706
80	.342	30	.766	80	.369	30	.698	80	.444	30	.706
90	.352	40	.770	90	.390	40	.701	90	.475	40	.708
700	.362	1050	.778	700	.408	1050	.706	700	.500	1050	.710
10	.370	60	.784	10	.426	60	.708	10	.518	60	.710
20	.376	70	.790	20	.444	70	.710	20	.536	70	.710
30	.385	80	.796	30	.460	80	.712	30	.548	80	.712
40	.392			40	.475			40	.564		

Reflecting Man-Made Objects

Spectral Directional Reflectance, R_λ, of Three Samples of U. S. Military Wearing Apparel for the Visible and Near Infrared Spectrum, 400 to 1080 millimicrons. (See Appendix D, GE Graph Sheets Serial No. GE II-1486 and -1489.)

(54) US Marine Corps Shirt (Summer)				(55) US Army Shirt (Winter)				(56) US Army Eisenhower Jacket (Winter)			
Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ
400	0.160	750	0.392	400	0.049	750	0.385	400	0.032	750	0.344
10	.156	60	.395	10	.051	60	.396	10	.032	60	.362
20	.150	70	.399	20	.054	70	.404	20	.034	70	.375
30	.141	80	.404	30	.057	80	.412	30	.036	80	.388
40	.133	90	.412	40	.060	90	.420	40	.036	90	.399
450	.128	800	.421	450	.065	800	.428	450	.038	800	.409
60	.128	10	.430	60	.070	10	.435	60	.040	10	.420
70	.132	20	.440	70	.078	20	.442	70	.043	20	.432
80	.142	30	.453	80	.086	30	.449	80	.046	30	.442
90	.154	40	.464	90	.096	40	.454	90	.050	40	.450
500	.166	850	.477	500	.103	850	.460	500	.054	850	.460
10	.182	60	.490	10	.110	60	.466	10	.059	60	.468
20	.202	70	.503	20	.115	70	.472	20	.062	70	.478
30	.222	80	.517	30	.119	80	.478	30	.065	80	.488
40	.236	90	.530	40	.123	90	.483	40	.066	90	.497
550	.244	900	.544	550	.126	900	.489	550	.066	900	.508
60	.246	10	.557	60	.130	10	.494	60	.066	10	.519
70	.246	20	.570	70	.131	20	.500	70	.066	20	.530
80	.246	30	.580	80	.134	30	.506	80	.067	30	.540
90	.249	40	.590	90	.140	40	.510	90	.069	40	.550
600	.254	950	.600	600	.146	950	.516	600	.072	950	.558
10	.261	60	.608	10	.151	60	.521	10	.076	60	.565
20	.268	70	.614	20	.156	70	.526	20	.080	70	.572
30	.276	80	.620	30	.161	80	.532	30	.086	80	.578
40	.290	90	.625	40	.170	90	.536	40	.094	90	.585
650	.308	1000	.628	650	.185	1000	.540	650	.104	1000	.590
60	.326	10	.632	60	.203	10	.545	60	.118	10	.596
70	.342	20	.635	70	.226	20	.550	70	.136	20	.600
80	.356	30	.637	80	.253	30	.554	80	.160	30	.606
90	.366	40	.640	90	.280	40	.560	90	.186	40	.610
700	.372	1050	.642	700	.305	1050	.564	700	.218	1050	.618
10	.378	60	.642	10	.327	60	.568	10	.248	60	.622
20	.381	70	.646	20	.346	70	.572	20	.278	70	.628
30	.385	80	.646	30	.362	80	.577	30	.306	80	.634
40	.388			40	.375			40	.326		

Reflecting Man-Made Objects

Spectral Directional Reflectance, R_λ, of Three Samples of U. S. Marine Corps Wearing Apparel for the Visible and Near Infrared Spectrum, 400 to 1080 millimicrons. (See Appendix D, GE Graph Sheets Serial No. GE II-1487 and -1490.)

(57) US Marine Corps Overseas Cap (Winter)				(58) US Marine Corps Blouse (Winter)				(59) US Marine Corps Pants (Winter)			
Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ
400	0.033	750	0.428	400	0.039	750	0.417	400	0.039	750	0.438
10	.034	60	.456	10	.040	60	.447	10	.040	60	.464
20	.037	70	.481	20	.040	70	.472	20	.042	70	.487
30	.038	80	.501	30	.040	80	.490	30	.044	80	.506
40	.040	90	.520	40	.040	90	.510	40	.045	90	.523
450	.042	800	.537	450	.040	800	.524	450	.046	800	.538
60	.043	10	.552	60	.042	10	.537	60	.049	10	.552
70	.046	20	.561	70	.042	20	.550	70	.051	20	.561
80	.050	30	.577	80	.045	30	.562	80	.054	30	.577
90	.053	40	.588	90	.048	40	.572	90	.058	40	.588
500	.056	850	.600	500	.050	850	.582	500	.060	850	.598
10	.057	60	.610	10	.054	60	.590	10	.062	60	.608
20	.058	70	.618	20	.056	70	.596	20	.064	70	.615
30	.057	80	.626	30	.057	80	.602	30	.064	80	.623
40	.056	90	.633	40	.056	90	.609	40	.062	90	.630
550	.055	900	.640	550	.055	900	.616	550	.061	900	.636
60	.052	10	.648	60	.052	10	.623	60	.059	10	.643
70	.051	20	.655	70	.051	20	.630	70	.057	20	.650
80	.050	30	.662	80	.050	30	.639	80	.056	30	.656
90	.050	40	.669	90	.049	40	.646	90	.056	40	.664
600	.051	950	.675	600	.050	950	.653	600	.057	950	.670
10	.052	60	.680	10	.050	60	.659	10	.059	60	.674
20	.054	70	.684	20	.051	70	.664	20	.060	70	.678
30	.056	80	.688	30	.052	80	.668	30	.062	80	.682
40	.060	90	.691	40	.054	90	.672	40	.066	90	.686
650	.068	1000	.694	650	.060	1000	.675	650	.076	1000	.688
60	.083	10	.698	60	.070	10	.678	60	.092	10	.691
70	.106	20	.700	70	.089	20	.680	70	.116	20	.694
80	.138	30	.704	80	.116	30	.683	80	.148	30	.698
90	.180	40	.708	90	.154	40	.686	90	.190	40	.700
700	.226	1050	.712	700	.200	1050	.690	700	.238	1050	.704
10	.274	60	.717	10	.249	60	.694	10	.286	60	.708
20	.319	70	.720	20	.299	70	.696	20	.329	70	.712
30	.361	80	.725	30	.343	80	.700	30	.373	80	.717
40	.396			40	.385			40	.408		

Reflecting Man-Made Objects

Spectral Directional Reflectance, R_λ, of Three Samples of U. S. Marine Corps Wearing Apparel for the Visible and Near Infrared Spectrum, 400 to 1080 millimicrons. (See Appendix D, GE Graph Sheets Serial No. GE II-1487 and -1490.)

(60) US Marine Corps Fatigue Cap				(61) US Marine Corps Fatigue Shirt				(62) US Marine Corps Fatigue Pants			
Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ
400	0.073	750	0.124	400	0.102	750	0.176	400	0.124	750	0.212
10	.077	60	.129	10	.106	60	.183	10	.128	60	.220
20	.080	70	.136	20	.106	70	.192	20	.132	70	.230
30	.084	80	.143	30	.104	80	.198	30	.136	80	.240
40	.086	90	.150	40	.102	90	.206	40	.140	90	.250
450	.090	800	.160	450	.101	800	.216	450	.144	800	.262
60	.092	10	.170	60	.104	10	.223	60	.150	10	.274
70	.096	20	.178	70	.109	20	.238	70	.153	20	.288
80	.096	30	.190	80	.115	30	.244	80	.156	30	.301
90	.097	40	.201	90	.120	40	.255	90	.160	40	.315
500	.100	850	.215	500	.124	850	.268	500	.161	850	.330
10	.102	60	.229	10	.128	60	.281	10	.165	60	.347
20	.107	70	.244	20	.136	70	.295	20	.173	70	.364
30	.115	80	.261	30	.142	80	.310	30	.182	80	.382
40	.124	90	.278	40	.148	90	.326	40	.187	90	.400
550	.130	900	.298	550	.152	900	.342	550	.190	900	.420
60	.132	10	.318	60	.154	10	.360	60	.188	10	.440
70	.132	20	.339	70	.154	20	.378	70	.184	20	.460
80	.130	30	.360	80	.154	30	.398	80	.180	30	.480
90	.125	40	.383	90	.154	40	.416	90	.176	40	.500
600	.120	950	.405	600	.152	950	.437	600	.170	950	.518
10	.114	60	.427	10	.152	60	.456	10	.166	60	.538
20	.110	70	.450	20	.150	70	.476	20	.163	70	.555
30	.105	80	.472	30	.150	80	.496	30	.160	80	.573
40	.102	90	.494	40	.148	90	.517	40	.158	90	.589
650	.100	1000	.514	650	.146	1000	.535	650	.158	1000	.604
60	.098	10	.532	60	.146	10	.553	60	.159	10	.618
70	.098	20	.550	70	.146	20	.571	70	.162	20	.630
80	.098	30	.566	80	.147	30	.589	80	.164	30	.642
90	.100	40	.580	90	.148	40	.606	90	.170	40	.650
700	.100	1050	.592	700	.150	1050	.622	700	.176	1050	.660
10	.104	60	.607	10	.152	60	.636	10	.182	60	.666
20	.108	70	.618	20	.155	70	.650	20	.188	70	.674
30	.113	80	.626	30	.161	80	.661	30	.196	80	.679
40	.118			40	.169			40	.204		

Reflecting Man-Made Objects

Spectral Directional Reflectance, R_λ, of Three Painted Pressboard Targets for the Visible and Near Infrared Spectrum, 400 to 1080 millimicrons. (See Appendix D, GE Graph Sheets Serial No. GE II-1470, -1471, -1735, and -1748.)

(63) Chinese Red #6335 Chi-namel Paint, Chi-namel Paint & Varnish Co.				(64) Colony Yellow #317 House Paint, Lowe Brothers				(65) Green #173 Tractor Paint, Lowe Brothers			
Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ
400	0.048	750	0.797	400	0.226	750	0.818	400	0.052	750	0.041
10	.048	60	.797	10	.252	60	.820	10	.053	60	.042
20	.048	70	.796	20	.262	70	.820	20	.053	70	.042
30	.048	80	.795	30	.277	80	.818	30	.054	80	.042
40	.048	90	.795	40	.298	90	.816	40	.056	90	.042
450	.048	800	.794	450	.322	800	.812	450	.059	800	.042
60	.048	10	.792	60	.347	10	.808	60	.065	10	.042
70	.049	20	.791	70	.376	20	.804	70	.075	20	.042
80	.049	30	.790	80	.408	30	.800	80	.088	30	.043
90	.050	40	.788	90	.442	40	.796	90	.100	40	.043
500	.050	850	.788	500	.476	850	.792	500	.105	850	.044
10	.050	60	.786	10	.516	60	.788	10	.103	60	.044
20	.050	70	.785	20	.563	70	.785	20	.096	70	.044
30	.050	80	.784	30	.617	80	.782	30	.084	80	.044
40	.052	90	.783	40	.669	90	.779	40	.076	90	.045
550	.058	900	.782	550	.716	900	.777	550	.068	900	.046
60	.068	10	.781	60	.749	10	.776	60	.062	10	.048
70	.087	20	.779	70	.768	20	.774	70	.057	20	.049
80	.127	30	.779	80	.778	30	.773	80	.054	30	.049
90	.212	40	.779	90	.782	40	.774	90	.051	40	.050
600	.352	950	.778	600	.784	950	.774	600	.049	950	.052
10	.497	60	.778	10	.784	60	.776	10	.048	60	.054
20	.625	70	.776	20	.783	70	.776	20	.045	70	.056
30	.711	80	.776	30	.782	80	.779	30	.045	80	.058
40	.758	90	.774	40	.782	90	.780	40	.044	90	.061
650	.783	1000	.774	650	.782	1000	.782	650	.043	1000	.064
60	.793	10	.774	60	.783	10	.784	60	.042	10	.067
70	.798	20	.773	70	.784	20	.786	70	.042	20	.070
80	.800	30	.773	80	.787	30	.788	80	.041	30	.074
90	.801	40	.775	90	.793	40	.793	90	.041	40	.078
700	.800	1050	.776	700	.797	1050	.797	700	.041	1050	.083
10	.800	60	.776	10	.803	60	.800	10	.040	60	.087
20	.800	70	.776	20	.808	70	.804	20	.040	70	.093
30	.800	80	.776	30	.814	80	.808	30	.041	80	.093
40	.798			40	.817			40	.041		

Reflecting Man-Made Objects

Spectral Directional Reflectance, R_λ, of Two Painted Pressboard Targets for the Visible and Near Infrared Spectrum, 400 to 1080 millimicrons. (See Appendix D, GE Graph Sheets Serial No. GE II-1470 and -1471.)

(66) Red #139 Tractor Paint, Lowe Brothers				(67) Royal Blue Permanent Trim Paint, John W. Masury & Son			
Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ
400	0.046	750	0.608	400	0.143	750	0.097
10	.046	60	.604	10	.168	60	.110
20	.046	70	.598	20	.178	70	.125
30	.046	80	.592	30	.187	80	.138
40	.046	90	.585	40	.197	90	.149
450	.046	800	.578	450	.207	800	.160
60	.046	10	.572	60	.210	10	.168
70	.047	20	.565	70	.207	20	.175
80	.047	30	.560	80	.200	30	.181
90	.047	40	.557	90	.188	40	.185
500	.048	850	.553	500	.175	850	.188
10	.048	60	.550	10	.160	60	.191
20	.048	70	.550	20	.145	70	.193
30	.048	80	.549	30	.125	80	.194
40	.049	90	.551	40	.106	90	.195
550	.051	900	.553	550	.090	900	.195
60	.057	10	.557	60	.077	10	.196
70	.066	20	.560	70	.070	20	.197
80	.081	30	.564	80	.066	30	.196
90	.104	40	.570	90	.065	40	.197
600	.152	950	.577	600	.064	950	.197
10	.244	60	.583	10	.062	60	.197
20	.365	70	.589	20	.062	70	.196
30	.466	80	.595	30	.064	80	.196
40	.525	90	.602	40	.066	90	.196
650	.555	1000	.606	650	.069	1000	.195
60	.569	10	.610	60	.071	10	.194
70	.579	20	.615	70	.071	20	.194
80	.585	30	.618	80	.069	30	.192
90	.592	40	.621	90	.067	40	.192
700	.598	1050	.624	700	.066	1050	.192
10	.604	60	.626	10	.068	60	.190
20	.609	70	.628	20	.072	70	.189
30	.611	80	.632	30	.079	80	.189
40	.611			40	.087		

Reflecting Man-Made Objects

Spectral Directional Reflectance, R_λ, of Two Painted Pressboard Targets for the Visible and Near Infrared Spectrum, 400 to 1080 millimicrons. (See Appendix D, GE Graph Sheets Serial No. GE II-1470, -1471, -1735, and -1748.)

(68) Seal Brown Supreme House Paint, John W. Masury & Son				(69) Verdi Green #6830 Super House Paint Chi-namel Paint & Varnish Co.			
Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ	Wave Length mμ	R_λ
400	0.054	750	0.149	400	0.117	750	0.170
10	.054	60	.151	10	.126	60	.183
20	.054	70	.151	20	.133	70	.190
30	.054	80	.151	30	.143	80	.193
40	.055	90	.151	40	.157	90	.203
450	.056	800	.150	450	.180	800	.220
60	.057	10	.150	60	.215	10	.254
70	.058	20	.149	70	.283	20	.286
80	.058	30	.149	80	.363	30	.328
90	.059	40	.148	90	.435	40	.370
500	.059	850	.148	500	.481	850	.414
10	.060	60	.148	10	.490	60	.454
20	.063	70	.149	20	.476	70	.491
30	.064	80	.150	30	.448	80	.526
40	.067	90	.151	40	.406	90	.559
550	.071	900	.152	550	.355	900	.593
60	.077	10	.155	60	.305	10	.624
70	.084	20	.158	70	.259	20	.650
80	.095	30	.161	80	.215	30	.670
90	.103	40	.165	90	.176	40	.688
600	.110	950	.168	600	.148	950	.702
10	.114	60	.172	10	.132	60	.714
20	.118	70	.177	20	.125	70	.725
30	.119	80	.182	30	.121	80	.733
40	.122	90	.185	40	.119	90	.738
650	.123	1000	.189	650	.118	1000	.742
60	.125	10	.193	60	.120	10	.744
70	.127	20	.196	70	.127	20	.745
80	.130	30	.198	80	.136	30	.744
90	.133	40	.201	90	.145	40	.745
700	.136	1050	.203	700	.151	1050	.745
10	.139	60	.205	10	.151	60	.747
20	.142	70	.207	20	.147	70	.748
30	.145	80	.209	30	.146	80	.748
40	.148			40	.155		

Reflecting Man-Made Objects

Spectral Directional Reflectance of Nine Munsell Saturated Hue Scale (Tobey Press) Samples for the Visible Spectrum, 400 to 750 millimicrons. (See Table IB and Appendix D, GE Graph Sheets Serial No. GE II-1515 and -1516.)

Wave length mμ	Sample Number (70)	(71)	(72)	(73)	(74)	(75)	(76)	(77)	(78)
400	0.048	0.046	0.052	0.081	0.080	0.112	0.101	0.256	0.155
10	.048	.048	.053	.086	.086	.130	.129	.311	.169
20	.048	.048	.055	.088	.090	.136	.147	.317	.172
30	.048	.050	.057	.093	.096	.155	.168	.304	.170
40	.048	.053	.060	.099	.105	.176	.203	.278	.164
450	.048	.057	.067	.110	.120	.206	.255	.248	.154
60	.049	.064	.079	.126	.139	.251	.282	.218	.137
70	.050	.074	.100	.152	.177	.298	.285	.188	.119
80	.052	.089	.129	.184	.205	.325	.267	.164	.103
90	.055	.118	.175	.220	.219	.317	.227	.142	.092
500	.062	.183	.250	.263	.219	.286	.187	.124	.082
10	.086	.304	.370	.307	.217	.246	.146	.112	.074
20	.131	.446	.483	.322	.204	.199	.111	.104	.069
30	.172	.554	.538	.299	.174	.157	.084	.096	.067
40	.194	.614	.535	.261	.139	.122	.064	.090	.064
550	.228	.645	.503	.217	.109	.096	.052	.091	.062
60	.283	.668	.463	.178	.088	.077	.045	.096	.062
70	.367	.683	.430	.146	.074	.067	.042	.096	.068
80	.459	.693	.404	.118	.065	.061	.040	.091	.089
90	.527	.699	.385	.097	.058	.057	.040	.091	.119
600	.566	.702	.365	.081	.054	.055	.040	.109	.161
10	.584	.706	.351	.072	.050	.053	.040	.151	.225
20	.594	.710	.345	.068	.050	.052	.041	.218	.318
30	.600	.712	.345	.065	.050	.053	.042	.291	.416
40	.603	.715	.350	.064	.050	.054	.043	.362	.503
650	.607	.720	.357	.064	.050	.055	.044	.420	.573
60	.609	.723	.363	.064	.050	.055	.045	.473	.622
70	.611	.727	.369	.066	.050	.055	.044	.520	.662
80	.612	.731	.372	.068	.051	.055	.043	.566	.692
90	.614	.735	.374	.071	.052	.055	.042	.610	.717
700	.616	.739	.378	.073	.053	.055	.043	.647	.739
10	.617	.743	.385	.073	.054	.056	.045	.680	.755
20	.618	.745	.395	.071	.054	.058	.047	.706	.768
30	.619	.747	.407	.070	.054	.060	.050	.722	.778
40	.620	.749	.432	.074	.056	.065	.055	.733	.785
750	.619	.749	.464	.079	.060	.071	.061	.738	.789

Reflecting Man-Made Objects

Spectral Directional Reflectance of Seven Munsell 5R Hue Scale (Tobey Press) Samples for the Visible Spectrum, 400 to 750 millimicrons. (See Table IB and Appendix D, GE Graph Sheets Serial No. GE II-1520 and -1522.)

Wave length mμ	Sample Number (79)	(80)	(81)	(82)	(83)	(84)	(85)
400	0.060	0.062	0.065	0.072	0.083	0.096	0.102
10	.061	.063	.066	.072	.084	.099	.105
20	.060	.062	.065	.072	.083	.098	.105
30	.060	.062	.064	.072	.082	.098	.105
40	.059	.062	.065	.071	.081	.097	.105
450	.059	.062	.064	.069	.080	.096	.104
60	.058	.061	.064	.069	.078	.095	.104
70	.058	.060	.063	.068	.077	.093	.103
80	.057	.060	.062	.066	.076	.091	.101
90	.057	.061	.062	.066	.074	.089	.099
500	.056	.061	.062	.066	.074	.088	.098
10	.057	.062	.063	.066	.073	.088	.098
20	.057	.062	.063	.066	.072	.086	.099
30	.057	.062	.062	.066	.072	.086	.099
40	.057	.063	.062	.066	.073	.087	.099
550	.059	.065	.063	.068	.075	.090	.101
60	.062	.069	.068	.073	.081	.095	.105
70	.068	.075	.074	.080	.088	.103	.111
80	.082	.086	.088	.093	.106	.119	.125
90	.121	.126	.139	.134	.150	.154	.140
600	.215	.218	.199	.212	.213	.193	.159
10	.322	.342	.301	.287	.257	.209	.160
20	.541	.485	.413	.332	.274	.216	.157
30	.654	.580	.483	.347	.281	.212	.155
40	.701	.635	.525	.351	.288	.216	.154
650	.726	.661	.548	.350	.293	.220	.155
60	.738	.673	.561	.347	.298	.224	.156
70	.748	.681	.566	.344	.302	.226	.158
80	.754	.686	.569	.342	.301	.225	.160
90	.763	.692	.571	.339	.300	.224	.160
700	.769	.697	.573	.336	.301	.224	.163
10	.775	.703	.576	.334	.307	.229	.164
20	.782	.709	.579	.332	.314	.236	.165
30	.787	.714	.581	.330	.325	.244	.169
40	.791	.718	.583	.327	.347	.262	.176
750	.793	.720	.584	.325	.375	.285	.189

Reflecting Man-Made Objects

Spectral Directional Reflectance of Nine Munsell Value Scale (Tobey Press) Samples for the Visible Spectrum, 400 to 750 millimicrons. (See Table IB and Appendix D, GE Graph Sheets Serial No. GE II-1523, -1528, and -1529.)

Wave length mμ	Sample Number (86)	(87)	(88)	(89)	(90)	(91)	(92)	(93)	(94)
400	0.593	0.412	0.414	0.381	0.368	0.320	0.276	0.246	0.214
10	.727	.623	.580	.518	.464	.389	.328	.283	.242
20	.760	.697	.628	.550	.490	.400	.342	.286	.244
30	.771	.713	.637	.553	.494	.400	.342	.283	.244
40	.778	.718	.640	.553	.495	.398	.342	.280	.243
450	.784	.721	.643	.552	.495	.398	.342	.278	.241
60	.790	.725	.646	.553	.497	.397	.342	.276	.242
70	.796	.728	.649	.551	.497	.397	.341	.275	.241
80	.800	.728	.651	.550	.496	.395	.340	.273	.239
90	.804	.729	.655	.551	.496	.395	.337	.272	.238
500	.807	.731	.660	.554	.498	.397	.338	.272	.239
10	.809	.734	.664	.564	.504	.406	.344	.277	.242
20	.812	.736	.667	.571	.512	.415	.353	.281	.246
30	.814	.737	.668	.574	.514	.418	.356	.282	.247
40	.816	.738	.669	.576	.516	.420	.358	.283	.248
550	.818	.741	.671	.578	.517	.421	.359	.285	.249
60	.821	.744	.674	.581	.519	.425	.361	.288	.252
70	.823	.748	.677	.583	.520	.427	.362	.291	.255
80	.824	.749	.679	.583	.521	.426	.361	.290	.255
90	.826	.749	.679	.582	.520	.422	.360	.288	.254
600	.826	.747	.678	.579	.520	.418	.357	.285	.253
10	.827	.745	.678	.576	.518	.412	.355	.282	.252
20	.827	.744	.678	.572	.517	.411	.353	.279	.250
30	.828	.742	.677	.569	.515	.406	.352	.275	.248
40	.828	.742	.678	.566	.514	.404	.350	.272	.247
650	.830	.742	.678	.564	.513	.401	.348	.269	.245
60	.832	.742	.679	.560	.512	.398	.347	.266	.243
70	.835	.742	.680	.558	.512	.396	.345	.263	.242
80	.837	.742	.681	.555	.510	.395	.342	.260	.240
90	.840	.743	.682	.554	.510	.392	.338	.258	.238
700	.843	.744	.684	.551	.509	.390	.338	.255	.237
10	.846	.745	.685	.549	.509	.388	.340	.252	.236
20	.847	.745	.686	.546	.508	.385	.342	.250	.234
30	.848	.745	.686	.545	.507	.383	.345	.247	.233
40	.848	.744	.686	.542	.506	.381	.346	.245	.232
750	.849	.745	.686	.540	.506	.378	.346	.243	.230

Reflecting Man-Made Objects

Spectral Directional Reflectance of Nine Munsell Value Scale (Tobey Press) Samples for the Visible Spectrum, 400 to 750 millimicrons. (See Table IB and Appendix D, GE Graph Sheets Serial No. GE II-1523, -1528, and -1529.)

Wave length mμ	Sample Number (95)	(96)	(97)	(98)	(99)	(100)	(101)	(102)	(103)
400	0.189	0.144	0.119	0.091	0.073	0.052	0.036	0.032	0.036
10	.194	.157	.123	.096	.074	.052	.036	.032	.036
20	.193	.158	.121	.095	.072	.052	.036	.032	.036
30	.191	.156	.120	.094	.072	.052	.036	.031	.036
40	.188	.155	.118	.093	.071	.051	.035	.031	.036
450	.187	.154	.116	.093	.069	.051	.035	.031	.035
60	.184	.154	.115	.092	.068	.050	.035	.030	.035
70	.183	.153	.114	.091	.068	.050	.034	.031	.035
80	.181	.151	.112	.091	.067	.049	.034	.031	.035
90	.180	.151	.111	.090	.067	.049	.034	.030	.035
500	.181	.151	.112	.089	.067	.049	.034	.030	.035
10	.185	.152	.114	.089	.068	.049	.034	.030	.034
20	.188	.154	.117	.089	.068	.049	.034	.030	.034
30	.189	.155	.117	.089	.068	.049	.035	.030	.034
40	.189	.155	.118	.089	.068	.049	.034	.030	.035
550	.191	.157	.118	.090	.069	.049	.034	.030	.034
60	.194	.160	.120	.091	.069	.050	.034	.030	.034
70	.195	.163	.122	.093	.070	.050	.034	.030	.034
80	.195	.164	.122	.093	.070	.050	.034	.030	.034
90	.193	.163	.120	.092	.070	.050	.034	.030	.034
600	.190	.162	.119	.091	.068	.049	.033	.030	.034
10	.188	.160	.117	.090	.068	.049	.033	.030	.034
20	.185	.158	.115	.089	.066	.048	.033	.029	.034
30	.183	.156	.114	.088	.065	.048	.033	.029	.034
40	.179	.154	.111	.087	.064	.047	.033	.029	.034
650	.178	.153	.110	.086	.064	.046	.033	.029	.034
60	.175	.151	.108	.085	.063	.045	.033	.029	.033
70	.173	.149	.106	.084	.062	.045	.032	.029	.033
80	.171	.147	.105	.083	.061	.044	.032	.029	.033
90	.168	.144	.103	.083	.060	.044	.032	.029	.032
700	.166	.142	.102	.082	.060	.044	.032	.029	.032
10	.164	.143	.101	.081	.059	.044	.032	.029	.032
20	.163	.144	.099	.080	.059	.044	.032	.029	.032
30	.160	.144	.099	.079	.058	.044	.032	.029	.032
40	.158	.144	.098	.079	.058	.044	.032	.029	.032
750	.157	.144	.096	.078	.058	.044	.031	.029	.032

Color Transparencies of Man-Made Objects

Spectral Transmittance of Nine Color Transparencies of Orange Mimeo Bond Paper on Ansco Daylight Color Film. (See Table IC and Appendix D, GE Graph Sheet Serial No. GE II-1227.)

Wave length mμ	Sample Number (104)	(105)	(106)	(107)	(108)	(109)	(110)	(111)	(112)
400	0.000	0.028	0.051	0.088	0.205	0.236	0.236	0.236	0.236
10	.000	.024	.051	.094	.251	.294	.296	.294	.294
20	.000	.020	.046	.094	.288	.342	.343	.342	.342
30	.000	.016	.042	.090	.317	.380	.388	.380	.379
40	.000	.014	.041	.091	.342	.416	.426	.417	.416
450	.000	.016	.046	.102	.384	.458	.467	.456	.457
60	.000	.022	.063	.128	.429	.500	.510	.499	.502
70	.002	.038	.094	.172	.476	.540	.550	.538	.544
80	.009	.069	.145	.235	.520	.547	.582	.574	.580
90	.020	.110	.205	.306	.557	.600	.607	.600	.607
500	.032	.148	.258	.364	.577	.612	.617	.612	.618
10	.042	.175	.292	.400	.579	.606	.610	.606	.610
20	.048	.190	.317	.430	.585	.608	.612	.609	.612
30	.050	.202	.336	.456	.600	.621	.626	.624	.624
40	.052	.206	.345	.466	.604	.624	.628	.625	.626
550	.057	.216	.357	.480	.614	.632	.636	.632	.633
60	.066	.232	.374	.494	.625	.645	.648	.645	.645
70	.079	.250	.390	.504	.634	.651	.655	.651	.651
80	.094	.271	.404	.511	.640	.658	.662	.658	.658
90	.110	.289	.416	.515	.646	.664	.668	.664	.664
600	.124	.300	.422	.515	.650	.670	.672	.669	.669
10	.132	.306	.424	.514	.659	.676	.680	.676	.678
20	.138	.310	.429	.518	.676	.697	.699	.697	.698
30	.142	.317	.438	.529	.702	.722	.727	.726	.726
40	.147	.322	.444	.537	.722	.745	.750	.746	.750
650	.151	.328	.450	.544	.738	.760	.766	.762	.766
60	.160	.336	.460	.552	.749	.771	.778	.774	.778
70	.174	.353	.474	.566	.760	.782	.789	.784	.789
80	.194	.375	.495	.584	.772	.792	.800	.795	.800
90	.222	.400	.520	.606	.782	.802	.808	.804	.809
700	.260	.445	.554	.632	.794	.814	.819	.814	.818
10	.306	.488	.592	.664	.806	.824	.829	.824	.828
20	.362	.536	.630	.695	.820	.834	.839	.834	.839
30	.424	.588	.669	.725	.830	.844	.848	.844	.847
40	.484	.634	.704	.752	.839	.850	.855	.850	.854
750	.542	.676	.735	.776	.846	.854	.860	.855	.858

Color Transparencies of Man-Made Objects

Spectral Transmittance of Nine Color Transparencies of Blue Onion Skin Paper on Ansco Daylight Color Film. (See Table IC and Appendix D, GE Graph Sheet Serial No. GE II-1229.)

Wave length mμ	Sample Number (113)	(114)	(115)	(116)	(117)	(118)	(119)	(120)	(121)
400	0.014	0.062	0.088	0.126	0.151	0.220	0.220	0.220	0.222
10	.014	.074	.108	.156	.193	.286	.292	.290	.290
20	.012	.076	.119	.180	.226	.346	.352	.350	.352
30	.010	.076	.124	.194	.252	.396	.404	.398	.404
40	.008	.078	.129	.206	.274	.440	.448	.443	.449
450	.010	.088	.146	.231	.304	.483	.492	.493	.491
60	.014	.110	.175	.266	.344	.524	.534	.534	.534
70	.020	.138	.208	.302	.383	.564	.574	.574	.574
80	.028	.165	.238	.334	.415	.592	.604	.604	.604
90	.031	.179	.250	.348	.432	.614	.624	.624	.624
500	.028	.175	.242	.340	.428	.620	.632	.632	.632
10	.022	.156	.219	.314	.404	.610	.621	.624	.623
20	.016	.136	.194	.288	.381	.608	.620	.622	.621
30	.012	.121	.175	.266	.363	.616	.632	.635	.632
40	.010	.109	.159	.246	.342	.612	.632	.636	.632
550	.009	.102	.150	.234	.329	.614	.636	.644	.636
60	.010	.102	.149	.230	.322	.619	.646	.656	.646
70	.010	.103	.148	.225	.314	.617	.648	.661	.650
80	.010	.105	.148	.220	.303	.613	.650	.664	.654
90	.012	.105	.146	.213	.291	.607	.650	.666	.656
600	.012	.101	.141	.202	.275	.600	.648	.668	.658
10	.010	.096	.132	.187	.258	.594	.650	.672	.664
20	.010	.088	.124	.176	.244	.598	.663	.686	.680
30	.009	.082	.117	.167	.235	.612	.685	.709	.706
40	.008	.080	.113	.162	.229	.623	.704	.728	.728
650	.008	.078	.112	.159	.226	.629	.715	.742	.742
60	.008	.080	.112	.161	.229	.636	.725	.754	.754
70	.010	.088	.120	.170	.238	.647	.737	.766	.766
80	.015	.101	.135	.188	.256	.662	.749	.776	.776
90	.020	.121	.157	.212	.284	.679	.761	.786	.786
700	.034	.150	.191	.248	.320	.700	.775	.800	.800
10	.054	.189	.234	.293	.364	.722	.790	.812	.812
20	.083	.241	.286	.347	.420	.744	.806	.825	.825
30	.124	.300	.348	.407	.478	.771	.820	.836	.836
40	.176	.364	.413	.472	.534	.790	.832	.846	.846
750	.236	.430	.478	.533	.588	.808	.842	.854	.854

Color Transparencies of Man-Made Objects

Spectral Transmittance of Nine Color Transparencies of Canary Yellow Onion Skin Paper on Ansco Daylight Color Film. (See Table IC and Appendix D, GE Graph Sheet Serial No. GE II-1228.)

Wave length mμ	Sample Number (122)	(123)	(124)	(125)	(126)	(127)	(128)	(129)	(130)
400	0.004	0.024	0.050	0.077	0.100	0.198	0.209	0.212	0.212
10	.002	.024	.054	.090	.122	.260	.276	.281	.282
20	.000	.022	.052	.094	.134	.316	.336	.344	.342
30	.000	.020	.050	.096	.140	.362	.385	.392	.396
40	.000	.018	.048	.098	.147	.406	.432	.436	.440
450	.000	.020	.053	.110	.166	.452	.478	.481	.486
60	.000	.028	.069	.136	.196	.497	.522	.526	.530
70	.004	.045	.097	.176	.244	.539	.564	.566	.571
80	.010	.069	.136	.226	.299	.575	.596	.598	.600
90	.019	.095	.176	.274	.350	.602	.619	.620	.622
500	.026	.111	.201	.304	.385	.612	.626	.628	.630
10	.028	.114	.208	.312	.396	.604	.616	.618	.620
20	.026	.110	.206	.312	.400	.603	.614	.618	.620
30	.024	.104	.201	.310	.403	.612	.624	.628	.632
40	.022	.100	.194	.301	.396	.608	.623	.626	.631
550	.022	.097	.192	.297	.392	.612	.627	.631	.636
60	.024	.102	.196	.300	.393	.619	.636	.641	.647
70	.026	.108	.204	.302	.391	.620	.639	.645	.652
80	.030	.116	.211	.304	.387	.620	.642	.650	.656
90	.032	.123	.216	.300	.381	.621	.646	.652	.662
600	.034	.126	.214	.295	.371	.622	.648	.656	.666
10	.034	.125	.210	.286	.360	.624	.656	.664	.674
20	.032	.122	.204	.280	.354	.638	.674	.684	.693
30	.031	.120	.201	.276	.352	.663	.704	.714	.722
40	.030	.120	.199	.274	.352	.683	.725	.736	.746
650	.030	.120	.200	.274	.351	.692	.742	.754	.762
60	.031	.125	.204	.279	.356	.709	.755	.767	.775
70	.036	.135	.217	.290	.369	.721	.768	.780	.786
80	.044	.152	.236	.310	.388	.734	.779	.790	.797
90	.058	.176	.264	.338	.415	.748	.790	.800	.806
700	.079	.210	.302	.376	.456	.764	.802	.812	.817
10	.108	.253	.346	.422	.494	.780	.814	.824	.828
20	.148	.308	.400	.474	.539	.796	.826	.834	.839
30	.200	.368	.460	.527	.587	.812	.836	.842	.848
40	.260	.432	.517	.580	.634	.825	.845	.850	.854
750	.326	.490	.574	.628	.674	.836	.850	.855	.860

Color Transparencies of Man-Made Objects

Spectral Transmittance of Nine Color Transparencies of Pink Onion Skin Paper on Ansco Daylight Color Film. (See Table IC and Appendix D, GE Graph Sheet Serial No. GE II-1226.)

Wave length mμ	Sample Number (131)	(132)	(133)	(134)	(135)	(136)	(137)	(138)	(139)
400	0.050	0.140	0.176	0.213	0.232	0.258	0.258	0.258	0.258
10	.050	.166	.218	.266	.295	.330	.330	.330	.326
20	.046	.180	.252	.314	.346	.394	.394	.394	.382
30	.040	.186	.264	.345	.384	.444	.444	.444	.429
40	.036	.191	.279	.374	.420	.485	.485	.485	.470
450	.039	.209	.304	.408	.456	.528	.528	.528	.512
60	.051	.240	.340	.447	.496	.567	.567	.567	.548
70	.069	.274	.376	.486	.532	.600	.600	.600	.582
80	.088	.300	.404	.515	.563	.626	.626	.626	.608
90	.099	.310	.416	.534	.584	.642	.642	.642	.626
500	.096	.300	.408	.536	.589	.650	.650	.650	.632
10	.084	.272	.382	.520	.576	.640	.640	.640	.625
20	.070	.246	.360	.508	.570	.640	.640	.640	.626
30	.062	.230	.345	.506	.576	.658	.658	.658	.640
40	.056	.218	.333	.500	.574	.664	.664	.664	.646
550	.056	.216	.332	.500	.579	.676	.676	.676	.659
60	.064	.226	.342	.510	.590	.692	.692	.692	.676
70	.074	.242	.356	.518	.596	.701	.701	.701	.686
80	.090	.260	.370	.524	.598	.708	.708	.708	.692
90	.108	.279	.382	.526	.598	.711	.711	.711	.695
600	.124	.290	.388	.525	.592	.712	.712	.712	.695
10	.134	.296	.388	.521	.588	.715	.715	.715	.697
20	.140	.299	.389	.520	.590	.728	.728	.728	.710
30	.146	.302	.392	.526	.598	.757	.757	.757	.732
40	.152	.305	.396	.533	.606	.771	.771	.771	.750
650	.156	.308	.399	.536	.612	.782	.782	.782	.761
60	.165	.316	.405	.542	.617	.791	.791	.791	.769
70	.179	.330	.418	.554	.626	.800	.800	.800	.776
80	.199	.352	.439	.571	.640	.807	.807	.807	.785
90	.226	.380	.466	.594	.659	.816	.816	.816	.792
700	.264	.419	.500	.622	.682	.825	.825	.825	.801
10	.310	.464	.540	.652	.707	.836	.836	.836	.810
20	.365	.514	.585	.685	.734	.844	.844	.844	.820
30	.427	.566	.630	.718	.760	.852	.852	.852	.829
40	.488	.618	.674	.748	.782	.860	.860	.860	.835
750	.544	.662	.710	.774	.800	.865	.865	.865	.839

Color Transparencies of Man-Made Objects

Spectral Transmittance of Nine Color Transparencies of Red Railroad Board on Ansco Daylight Color Film. (See Table IC and Appendix D, GE Graph Sheet Serial No. GE II-1225.)

Wave length mμ	Sample Number (140)	(141)	(142)	(143)	(144)	(145)	(146)	(147)	(148)
400	0.004	0.016	0.040	0.055	0.055	0.262	0.275	0.275	0.275
10	.000	.012	.039	.054	.054	.328	.342	.342	.349
20	.000	.008	.032	.048	.048	.380	.394	.394	.400
30	.000	.005	.026	.041	.041	.420	.436	.436	.446
40	.000	.004	.024	.038	.038	.456	.472	.472	.483
450	.000	.004	.026	.042	.042	.493	.508	.508	.521
60	.000	.007	.036	.055	.055	.530	.545	.545	.559
70	.000	.012	.051	.075	.075	.565	.579	.579	.591
80	.000	.019	.071	.095	.095	.594	.606	.606	.616
90	.002	.024	.086	.108	.105	.614	.625	.625	.635
500	.002	.024	.089	.106	.104	.622	.632	.632	.641
10	.001	.020	.081	.094	.091	.615	.625	.625	.634
20	.000	.016	.074	.082	.082	.620	.630	.630	.640
30	.000	.014	.069	.075	.075	.635	.648	.648	.657
40	.000	.014	.066	.074	.074	.640	.654	.654	.664
550	.000	.016	.070	.078	.078	.654	.668	.668	.680
60	.002	.020	.084	.089	.089	.670	.686	.686	.698
70	.006	.030	.102	.110	.110	.680	.694	.694	.706
80	.012	.044	.129	.138	.138	.685	.700	.700	.712
90	.021	.062	.160	.171	.171	.688	.701	.704	.714
600	.034	.086	.190	.202	.202	.687	.700	.704	.714
10	.048	.109	.216	.229	.229	.688	.702	.705	.716
20	.060	.128	.235	.250	.250	.699	.714	.716	.729
30	.072	.146	.254	.270	.270	.718	.734	.738	.752
40	.084	.162	.270	.286	.286	.732	.749	.753	.768
650	.092	.178	.284	.300	.300	.742	.758	.762	.778
60	.107	.195	.300	.318	.318	.750	.764	.770	.785
70	.125	.217	.324	.340	.340	.758	.772	.778	.792
80	.148	.244	.350	.366	.366	.768	.781	.786	.800
90	.179	.276	.384	.400	.400	.778	.790	.795	.809
700	.218	.320	.426	.441	.441	.790	.800	.806	.819
10	.266	.370	.474	.488	.488	.804	.814	.816	.828
20	.324	.428	.525	.536	.536	.818	.825	.829	.839
30	.384	.486	.576	.588	.588	.830	.836	.839	.848
40	.445	.540	.625	.633	.633	.840	.848	.848	.855
750	.505	.594	.662	.676	.676	.848	.855	.855	.861

Color Transparenices of Man-Made Objects

Spectral Transmittance of Nine Color Transparencies of Two Railroad Boards, and one US Army Shirt on Special Ansco Green and Blue Sensitive Film, and of the Army Shirt on Special Ansco Red and Green Sensitive Film. (See Table IC and Appendix D, GE Graph Sheets Serial No. GE II-1579, -1580, and -1581.)

Wave length mμ	Sample Number (149)	(150)	(151)	(152)	(153)	(154)	(155)	(156)	(157)	(158)	(159)
400	0.206	0.340	0.009	0.057	0.140	0.053	0.078	0.133	0.308	0.091	0.163
10	.184	.331	.004	.041	.120	.038	.095	.175	.371	.111	.214
20	.153	.309	.000	.027	.096	.026	.102	.211	.433	.123	.257
30	.127	.285	.000	.018	.078	.016	.101	.237	.480	.125	.290
40	.111	.272	.000	.013	.068	.013	.099	.254	.520	.124	.312
450	.117	.285	.000	.012	.072	.014	.110	.278	.556	.137	.340
60	.135	.311	.000	.016	.088	.019	.121	.298	.582	.149	.359
70	.154	.331	.000	.025	.113	.029	.112	.289	.588	.138	.346
80	.159	.331	.004	.039	.141	.043	.084	.250	.574	.105	.316
90	.142	.310	.007	.051	.160	.053	.053	.196	.544	.069	.250
500	.122	.276	.008	.056	.160	.055	.028	.141	.500	.040	.192
10	.097	.236	.008	.055	.150	.051	.014	.095	.448	.021	.136
20	.081	.211	.007	.051	.140	.046	.006	.064	.402	.011	.097
30	.072	.196	.006	.050	.130	.044	.002	.044	.362	.006	.070
40	.072	.194	.008	.052	.137	.045	.000	.028	.322	.002	.051
550	.081	.209	.011	.061	.151	.053	.000	.020	.291	.000	.036
60	.100	.237	.018	.079	.181	.070	.000	.014	.262	.000	.026
70	.136	.295	.030	.110	.226	.098	.000	.009	.235	.000	.018
80	.190	.356	.054	.160	.291	.147	.000	.006	.206	.000	.012
90	.259	.429	.091	.219	.366	.209	.000	.002	.179	.000	.008
600	.335	.500	.143	.298	.446	.284	.000	.000	.153	.000	.004
10	.412	.567	.205	.377	.513	.360	.000	.000	.131	.000	.000
20	.482	.623	.270	.450	.577	.434	.000	.000	.114	.000	.000
30	.546	.670	.340	.516	.631	.500	.000	.000	.100	.000	.000
40	.601	.710	.407	.576	.676	.561	.000	.000	.092	.000	.000
650	.651	.742	.472	.630	.717	.616	.000	.000	.088	.000	.000
60	.694	.772	.531	.676	.751	.665	.000	.000	.088	.000	.000
70	.730	.796	.588	.716	.778	.706	.000	.000	.090	.000	.000
80	.761	.816	.638	.750	.800	.742	.000	.000	.103	.000	.000
90	.786	.832	.684	.778	.821	.771	.000	.000	.122	.000	.002
700	.807	.844	.724	.801	.836	.796	.000	.005	.150	.000	.007
10	.824	.854	.756	.821	.849	.816	.007	.011	.191	.006	.015
20	.836	.863	.782	.836	.857	.832	.017	.024	.242	.014	.028
30	.846	.868	.803	.846	.864	.844	.036	.046	.306	.031	.053
40	.854	.872	.818	.854	.870	.851	.064	.078	.376	.056	.086
750	.858	.876	.829	.858	.874	.858	.104	.126	.442	.092	.132

Color Transparencies of Man-Made Objects

Spectral Transmittance of Ten Color Transparencies of One US Army Shirt on Special Ansco Red and Green Sensitive Film, Ansco Daylight Color Film (With and Without Filters) and Special Ansco Blue Sensitive Film. (See Table IC and Appendix D, GE Graph Sheets Serial No. GE II-1580 and -1581.)

Wave length mμ	Sample Number (160)	(161)	(162)	(163)	(164)	(165)	(166)	(167)	(168)	(169)
400	0.258	0.022	0.000	0.000	0.000	0.038	0.052	0.116	0.022	0.094
10	.318	.019	.000	.000	.000	.036	.050	.115	.015	.082
20	.370	.014	.000	.000	.000	.029	.042	.105	.009	.067
30	.413	.010	.000	.000	.000	.022	.035	.094	.006	.056
40	.446	.008	.000	.000	.000	.017	.031	.089	.004	.052
450	.478	.010	.000	.000	.000	.019	.035	.097	.005	.055
60	.500	.014	.000	.000	.000	.024	.044	.117	.009	.071
70	.496	.020	.000	.000	.000	.023	.061	.148	.020	.109
80	.463	.027	.000	.006	.006	.015	.081	.181	.049	.178
90	.402	.032	.000	.016	.019	.007	.093	.204	.109	.280
500	.352	.030	.000	.029	.035	.000	.095	.208	.206	.394
10	.285	.025	.000	.041	.047	.000	.085	.197	.331	.506
20	.232	.021	.000	.050	.054	.000	.076	.186	.458	.598
30	.189	.017	.000	.056	.054	.000	.071	.179	.561	.666
40	.152	.016	.000	.061	.049	.000	.068	.176	.636	.713
550	.124	.017	.000	.068	.041	.000	.072	.182	.686	.745
60	.101	.021	.004	.081	.034	.000	.081	.198	.721	.764
70	.081	.027	.008	.099	.028	.000	.099	.223	.743	.779
80	.064	.038	.016	.121	.021	.000	.121	.248	.764	.792
90	.049	.049	.032	.143	.016	.000	.143	.271	.779	.803
600	.036	.057	.056	.162	.012	.000	.162	.288	.793	.815
10	.026	.064	.084	.175	.008	.000	.175	.298	.805	.820
20	.020	.069	.117	.184	.006	.000	.183	.304	.815	.833
30	.016	.072	.150	.192	.004	.000	.189	.310	.825	.837
40	.014	.076	.182	.199	.003	.000	.195	.316	.831	.842
650	.014	.081	.217	.207	.003	.000	.203	.322	.839	.851
60	.014	.088	.251	.220	.004	.002	.215	.334	.845	.851
70	.016	.100	.291	.236	.004	.004	.234	.354	.848	.857
80	.020	.117	.333	.260	.007	.007	.258	.376	.855	.864
90	.028	.142	.371	.292	.012	.012	.292	.411	.859	.863
700	.040	.176	.433	.334	.021	.021	.334	.452	.862	.870
10	.060	.221	.487	.383	.036	.036	.383	.499	.869	.876
20	.090	.277	.540	.441	.060	.061	.441	.549	.871	.874
30	.136	.338	.592	.500	.096	.098	.500	.602	.872	.878
40	.186	.402	.636	.555	.143	.146	.555	.646	.876	.884
750	.250	.469	.675	.606	.200	.204	.606	.686	.878	.882

Color Transparencies of Man-Made Objects

Spectral Transmittance of Nine Color Transparencies of Fluorescent Lamps in the O'Neill-Nagel Light Table on Ansco Daylight Color Film. (See Table IC and Appendix D, GE Graph Sheets Serial No. GE II-1601, -1602, -1603, and -1604.)

Wave length mμ	Sample Number (170)	(171)	(172)	(173)	(174)	(175)	(176)	(177)	(178)
400	0.002	0.004	0.020	0.051	0.077	0.011	0.019	0.150	0.178
10	.001	.002	.019	.053	.086	.010	.018	.180	.222
20	.000	.000	.016	.050	.086	.006	.015	.200	.254
30	.000	.000	.013	.046	.084	.004	.012	.213	.280
40	.000	.000	.012	.044	.084	.004	.011	.226	.304
450	.000	.000	.013	.051	.096	.004	.013	.252	.340
60	.000	.000	.018	.066	.119	.008	.019	.289	.379
70	.000	.003	.029	.086	.147	.014	.030	.326	.419
80	.000	.007	.042	.108	.173	.022	.041	.357	.447
90	.002	.009	.050	.120	.182	.028	.048	.369	.456
500	.002	.008	.050	.116	.175	.028	.046	.358	.446
10	.001	.006	.042	.100	.154	.024	.038	.332	.418
20	.000	.005	.035	.087	.134	.019	.030	.308	.397
30	.000	.002	.029	.076	.120	.015	.025	.289	.379
40	.000	.001	.026	.070	.109	.014	.022	.270	.359
550	.000	.000	.024	.066	.104	.012	.020	.260	.346
60	.000	.000	.025	.069	.104	.012	.021	.254	.336
70	.000	.000	.026	.072	.108	.013	.022	.250	.326
80	.000	.000	.028	.076	.108	.014	.024	.242	.313
90	.000	.000	.028	.078	.108	.014	.025	.232	.298
600	.000	.000	.028	.076	.103	.012	.024	.219	.279
10	.000	.000	.026	.072	.096	.011	.022	.204	.262
20	.000	.000	.024	.068	.090	.010	.020	.191	.249
30	.000	.000	.022	.065	.084	.008	.019	.182	.240
40	.000	.000	.022	.064	.081	.008	.018	.177	.234
650	.000	.000	.022	.065	.081	.008	.018	.176	.234
60	.000	.000	.024	.070	.086	.010	.020	.181	.240
70	.000	.000	.028	.078	.095	.012	.025	.192	.253
80	.000	.001	.036	.093	.110	.016	.032	.212	.274
90	.001	.006	.048	.116	.133	.024	.045	.240	.306
700	.006	.011	.068	.149	.166	.036	.064	.279	.346
10	.014	.020	.097	.191	.210	.056	.093	.329	.396
20	.028	.038	.138	.246	.264	.089	.133	.387	.452
30	.053	.068	.196	.309	.331	.134	.187	.453	.513
40	.088	.107	.258	.376	.399	.188	.250	.514	.570
750	.138	.161	.329	.444	.469	.254	.319	.576	.621

Color Transparencies of Man-Made Objects

Spectral Transmittance of Nine Color Transparencies of Lumiline Lamps in the O'Neill-Nagel Light Table on Ansco Daylight Color Film. (See Table IC and Appendix D, GE Graph Sheets Serial GE II-1601, -1602, -1603, and -1604.)

Wave length mμ	Sample Number (179)	(180)	(181)	(182)	(183)	(184)	(185)	(186)	(187)
400	0.002	0.007	0.013	0.004	0.000	0.000	0.000	0.000	0.019
10	.001	.006	.011	.002	.000	.000	.000	.000	.018
20	.000	.002	.008	.000	.000	.000	.000	.000	.015
30	.000	.000	.006	.000	.000	.000	.000	.000	.012
40	.000	.000	.004	.000	.000	.000	.000	.000	.011
450	.000	.001	.006	.000	.000	.000	.000	.000	.013
60	.000	.004	.010	.000	.000	.000	.000	.000	.019
70	.003	.011	.019	.004	.000	.000	.000	.000	.030
80	.010	.022	.037	.008	.004	.004	.000	.000	.046
90	.021	.040	.061	.012	.010	.008	.002	.000	.058
500	.031	.055	.082	.014	.014	.012	.004	.000	.061
10	.036	.064	.092	.012	.016	.014	.005	.000	.056
20	.037	.066	.096	.011	.015	.014	.005	.000	.050
30	.038	.066	.096	.009	.014	.014	.005	.000	.046
40	.038	.068	.097	.008	.014	.014	.006	.000	.044
550	.041	.072	.103	.010	.016	.016	.006	.000	.046
60	.048	.080	.114	.012	.020	.018	.006	.000	.052
70	.056	.094	.126	.016	.026	.024	.008	.000	.062
80	.068	.108	.142	.020	.032	.031	.011	.000	.075
90	.078	.120	.154	.026	.040	.039	.015	.002	.086
600	.086	.126	.161	.030	.046	.045	.018	.003	.098
10	.090	.129	.164	.032	.050	.049	.020	.004	.102
20	.092	.131	.165	.033	.051	.051	.020	.004	.106
30	.093	.133	.166	.035	.053	.053	.021	.004	.109
40	.095	.136	.169	.036	.056	.056	.022	.004	.113
650	.100	.141	.173	.039	.059	.059	.024	.004	.119
60	.107	.150	.181	.044	.066	.066	.028	.006	.128
70	.120	.166	.198	.052	.077	.075	.034	.008	.144
80	.138	.188	.219	.065	.093	.091	.043	.012	.166
90	.166	.220	.250	.084	.116	.113	.058	.018	.196
700	.201	.260	.293	.111	.149	.145	.080	.028	.235
10	.248	.310	.344	.149	.191	.186	.112	.042	.285
20	.306	.370	.403	.199	.246	.240	.156	.074	.341
30	.374	.433	.468	.263	.309	.304	.212	.116	.408
40	.438	.495	.527	.327	.376	.371	.275	.167	.472
750	.499	.555	.584	.397	.444	.440	.344	.231	.533

Color Transparencies of Man-Made Objects

Spectral Transmittance of Nine Color Transparencies of Neon Lamps in the O'Neill-Nagel Light Table on Ansco Daylight Color Film. (See Table IC and Appendix D, GE Graph Sheets Serial No. GE II-1601, -1602, -1603, and -1604.)

Wave length mμ	Sample Number (188)	(189)	(190)	(191)	(192)	(193)	(194)	(195)	(196)
400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	.000	.000	.000	.000	.000	.000	.000	.000	.000
20	.000	.000	.000	.000	.000	.000	.000	.000	.000
30	.000	.000	.000	.000	.000	.000	.000	.000	.000
40	.000	.000	.000	.000	.000	.000	.000	.000	.000
450	.000	.000	.000	.000	.000	.000	.000	.000	.000
60	.000	.000	.000	.000	.000	.000	.000	.000	.000
70	.000	.000	.000	.000	.000	.000	.000	.000	.000
80	.000	.000	.000	.000	.000	.000	.000	.000	.006
90	.001	.002	.002	.002	.002	.006	.002	.003	.013
500	.001	.004	.004	.004	.004	.009	.004	.004	.019
10	.001	.004	.005	.005	.004	.010	.004	.005	.024
20	.001	.004	.005	.005	.004	.010	.004	.006	.026
30	.001	.004	.006	.005	.004	.011	.004	.006	.028
40	.002	.004	.006	.006	.004	.012	.004	.007	.031
550	.004	.006	.009	.006	.006	.016	.006	.010	.038
60	.006	.009	.013	.010	.010	.022	.009	.014	.050
70	.010	.015	.022	.016	.016	.034	.015	.022	.070
80	.018	.024	.036	.026	.026	.052	.024	.036	.101
90	.028	.039	.056	.042	.043	.079	.039	.057	.136
600	.040	.056	.082	.060	.064	.109	.058	.080	.176
10	.051	.072	.108	.080	.083	.138	.076	.106	.211
20	.063	.088	.132	.099	.104	.170	.094	.131	.245
30	.074	.106	.158	.118	.125	.200	.113	.156	.280
40	.086	.122	.181	.135	.144	.227	.131	.180	.311
650	.099	.139	.205	.154	.166	.255	.150	.203	.340
60	.114	.159	.231	.175	.191	.284	.171	.231	.371
70	.134	.181	.263	.200	.218	.316	.197	.261	.404
80	.159	.211	.298	.232	.251	.350	.227	.297	.441
90	.193	.250	.338	.271	.294	.394	.264	.338	.480
700	.235	.291	.388	.318	.341	.442	.311	.387	.524
10	.286	.343	.443	.369	.394	.491	.365	.441	.570
20	.347	.402	.498	.428	.451	.544	.420	.496	.615
30	.412	.467	.556	.490	.510	.596	.484	.551	.657
40	.473	.527	.606	.544	.565	.639	.537	.601	.695
750	.531	.584	.652	.596	.614	.680	.588	.645	.728

Appendix C

Table of orientation and film holder scale values for 136 samples of transparent films of man-made objects, such as 11 samples of dye-on-film of Ansco Daylight Color, 32 samples of Ansco color compensating filters, 49 color transparencies of dyed papers and cardboards, 17 color transparencies of a US Army olive drab shirt, and 27 color transparencies of incandescent, fluorescent, and neon lamp sources. Included is Figure 61, used to indicate the actual area of the color transparency measured.

Figure 61. Grid to indicate the actual area of the color transparency which was measured. To use the diagram and data: (1) Place the color transparency on the coordinate grid, (2) Check that the correct side of the film is towards the observer, (3) Check that the positioning of the number is correct, (4) Move lower right corner of film to indicated H and V values, and (5) The position of the measured area of the color transparency is indicated by the open area within the cross-hatched square above and to the left of the grid.

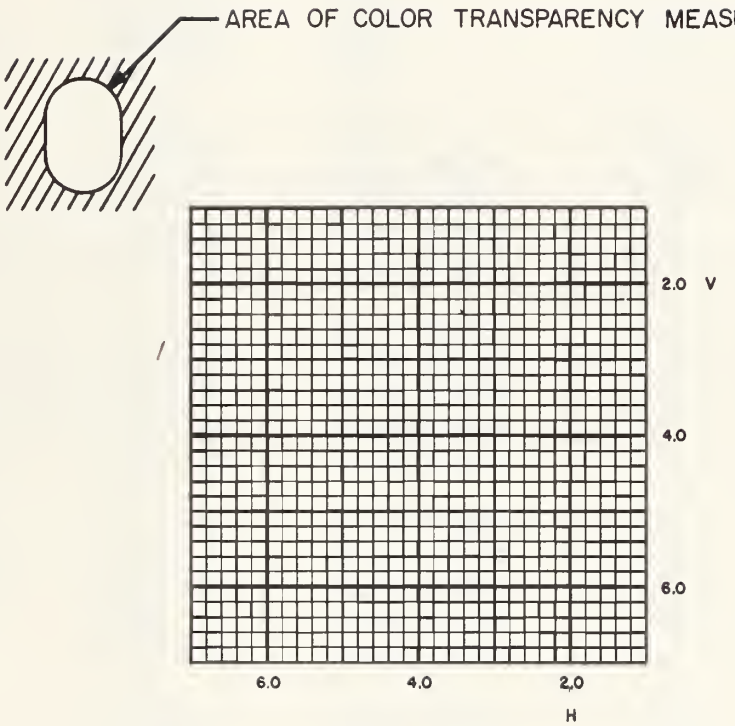

FIGURE 61

Color Transparency Orientation and Film Holder Scale Values for the Indicated Color Transparencies.

Sample Number	Code or Exposure Number	Side of Film Toward Source	Position of Inked Exposure No.	Film Holder Scale Value H	V	S
(1)	W-126	Emulsion	Bottom	5.5	3.0	4.2
(2)	W-125	Emulsion	Bottom	5.5	3.0	4.2
(3)	W-130	Emulsion	Bottom	5.5	3.0	4.2
(4)	W-124	Emulsion	Bottom	5.5	3.0	4.2
(5)	W-129	Emulsion	Bottom	5.5	3.0	4.2
(6)	W-128	Emulsion	Bottom	5.5	3.0	4.2
(7)	W-127	Emulsion	Bottom	5.5	3.0	4.2
(8)	Cyan	Emulsion	(***)	5.5	3.0	4.2
(9)	Magenta	Emulsion	(***)	5.5	3.0	4.2
(10)	(**)Yellow	Emulsion	(***)	5.5	3.0	4.2
(11)	(*)Yellow	Emulsion	(***)	5.5	3.0	4.2
(12)	UV-16P	Emulsion	Lower Right	5.5	3.0	4.2
(13)	Yellow 23	Emulsion	Lower Right	5.5	3.0	4.2
(14)	Yellow 24	Emulsion	Lower Right	5.5	3.0	4.2
(15)	Yellow 25	Emulsion	Lower Right	5.5	3.0	4.2
(16)	Yellow 26	Emulsion	Lower Right	5.5	3.0	4.2
(17)	Magenta 33	Emulsion	Lower Right	5.5	3.0	4.2
(18)	Magenta 34	Emulsion	Lower Right	5.5	3.0	4.2
(19)	Magenta 35	Emulsion	Lower Right	5.5	3.0	4.2
(20)	Cyan 43	Emulsion	Lower Right	5.5	3.0	4.2
(21)	Cyan 44	Emulsion	Lower Right	5.5	3.0	4.2
(22)	Cyan 45	Emulsion	Lower Right	5.5	3.0	4.2
(23)	.025Y	Emulsion	Lower Right	5.5	3.0	4.2
(24)	.05Y	Emulsion	Lower Right	5.5	3.0	4.2
(25)	.10Y	Emulsion	Lower Right	5.5	3.0	4.2
(26)	.20Y	Emulsion	Lower Right	5.5	3.0	4.2
(27)	.30Y	Emulsion	Lower Right	5.5	3.0	4.2
(28)	.40Y	Emulsion	Lower Right	5.5	3.0	4.2
(29)	.50Y	Emulsion	Lower Right	5.5	3.0	4.2
(30)	.025M	Emulsion	Lower Right	5.5	3.0	4.2
(31)	.05M	Emulsion	Lower Right	5.5	3.0	4.2
(32)	.10M	Emulsion	Lower Right	5.5	3.0	4.2
(33)	.20M	Emulsion	Lower Right	5.5	3.0	4.2
(34)	.30M	Emulsion	Lower Right	5.5	3.0	4.2
(35)	.40M	Emulsion	Lower Right	5.5	3.0	4.2

(*) Measured on GE I.
(**) Measured on GE II.
(***) No inked number.

Sample Number	Code or Exposure Number	Side of Film Toward Source	Position of Inked Exposure No.	Film Holder Scale Value H	V	S
(36)	.50M	Emulsion	Lower Right	5.5	3.0	4.2
(37)	.025C	Emulsion	Lower Right	5.5	3.0	4.2
(38)	.05C	Emulsion	Lower Right	5.5	3.0	4.2
(39)	.10C	Emulsion	Lower Right	5.5	3.0	4.2
(40)	.20C	Emulsion	Lower Right	5.5	3.0	4.2
(41)	.30C	Emulsion	Lower Right	5.5	3.0	4.2
(42)	.40C	Emulsion	Lower Right	5.5	3.0	4.2
(43)	.50C	Emulsion	Lower Right	5.5	3.0	4.2
(104)	Exp. 26	Base	Top	5.5	3.0	4.2
(105)	Exp. 19	Base	Top	5.5	3.0	4.2
(106)	Exp. 20	Base	Top	5.5	3.0	4.2
(107)	Exp. 21	Base	Top	5.5	3.0	4.2
(108)	Exp. 22	Base	Top	5.5	3.0	4.2
(109)	Exp. 23	Base	Top	5.5	3.0	4.2
(110)	Exp. 24	Base	Top	5.5	3.0	4.2
(111)	Exp. 25	Base	Top	5.5	3.0	4.2
(112)	Exp. 27	Base	Top	5.5	3.0	4.2
(113)	Exp. 44	Base	Top	5.5	3.0	4.2
(114)	Exp. 37	Base	Top	5.5	3.0	4.2
(115)	Exp. 38	Base	Top	5.5	3.0	4.2
(116)	Exp. 39	Base	Top	5.5	3.0	4.2
(117)	Exp. 40	Base	Top	5.5	3.0	4.2
(118)	Exp. 41	Base	Top	5.5	3.0	4.2
(119)	Exp. 42	Base	Top	5.5	3.0	4.2
(120)	Exp. 43	Base	Top	5.5	3.0	4.2
(121)	Exp. 45	Base	Top	5.5	3.0	4.2
(122)	Exp. 35	Base	(****)	5.5	3.0	4.2
(123)	Exp. 28	Base	Top	5.5	3.0	4.2
(124)	Exp. 29	Base	Top	5.5	3.0	4.2
(125)	Exp. 30	Base	Top	5.5	3.0	4.2
(126)	Exp. 31	Base	Top	5.5	3.0	4.2
(127)	Exp. 32	Base	Top	5.5	3.0	4.2
(128)	Exp. 33	Base	Top	5.5	3.0	4.2
(129)	Exp. 34	Base	Top	5.5	3.0	4.2
(130)	Exp. 36	Base	Top	5.5	3.0	4.2
(131)	Exp. 17	Base	Top	5.5	3.0	4.2
(132)	Exp. 10	Base	Top	5.5	3.0	4.2
(133)	Exp. 11	Base	Top	5.5	3.0	4.2
(134)	Exp. 12	Base	Top	5.5	3.0	4.2
(135)	Exp. 13	Base	Top	5.5	3.0	4.2

(****) No inked number on film. Number on photograph sample positioned to right.

Sample Number	Exposure Number	Side of Film Toward Source	Position of Inked Exposure No.	Film Holder Scale Value H	V	S
(136)	Exp. 14	Base	Top	5.5	3.0	4.2
(137)	Exp. 15	Base	Top	5.5	3.0	4.2
(138)	Exp. 16	Base	Top	5.5	3.0	4.2
(139)	Exp. 18	Base	Top	5.5	3.0	4.2
(140)	Exp. 8	Base	(****)	5.5	3.0	4.2
(141)	Exp. 1	Base	Top	5.5	3.0	4.2
(142)	Exp. 2	Base	Top	5.5	3.0	4.2
(143)	Exp. 3	Base	Top	5.5	3.0	4.2
(144)	Exp. 4	Base	Top	5.5	3.0	4.2
(145)	Exp. 5	Base	Top	5.5	3.0	4.2
(146)	Exp. 6	Base	Top	5.5	3.0	4.2
(147)	Exp. 7	Base	Top	5.5	3.0	4.2
(148)	Exp. 9	Base	Top	5.5	3.0	4.2
(149)	W-132	Emulsion	Right	4.6	4.0	4.3
(150)	W-133	Emulsion	Right	4.6	4.0	4.3
(151)	W-134	Emulsion	Right	4.6	4.0	4.3
(152)	W-135	Emulsion	Right	4.6	4.0	4.3
(153)	W-141	Emulsion	Upper Right	4.4	4.2	4.3
(154)	W-142	Emulsion	Upper Right	4.4	4.2	4.3
(155)	W-171	Emulsion	Upper Right	4.6	4.5	4.3
(156)	W-172	Emulsion	Upper Right	4.6	4.5	4.3
(157)	W-173	Emulsion	Upper Right	4.6	4.5	4.3
(158)	W-198	Emulsion	Right	4.6	4.2	4.3
(159)	W-199	Emulsion	Right	4.6	4.2	4.3
(160)	W-200	Emulsion	Right	4.6	4.2	4.3
(161)	W-291	Emulsion	Right	4.6	4.2	4.3
(162)	W-292	Emulsion	Right	4.6	4.2	4.3
(163)	W-293	Emulsion	Right	4.6	4.2	4.3
(164)	W-294	Emulsion	Right	4.6	4.5	4.3
(165)	W-295	Emulsion	Right	4.6	4.5	4.3
(166)	W-296	Emulsion	Right	4.6	4.2	4.3
(167)	W-297	Emulsion	Right	4.6	4.2	4.3
(168)	W-430	Emulsion	Right	5.3	4.5	4.3
(169)	W-431	Emulsion	Right	5.3	4.5	4.3
(170)	W-1862	Emulsion	Upper Right	5.5	3.0	4.2
(171)	W-1861	Emulsion	Upper Right	5.5	3.0	4.2
(172)	W-1858	Emulsion	Upper Right	5.5	3.0	4.2
(173)	W-1859	Emulsion	Upper Right	5.5	3.0	4.2
(174)	W-1860	Emulsion	Upper Right	5.5	3.0	4.2
(175)	W-1865	Emulsion	Top	5.5	3.0	4.2

(****) No inked number on film. Number on photograph sample positioned to right.

Sample Number	Exposure Number	Side of Film Toward Source	Position of Inked Exposure No.	Film Holder Scale Value H	V	S
(176)	W-1863	Emulsion	Top	5.5	3.0	4.2
(177)	W-1864	Emulsion	Top	5.0	3.0	4.2
(178)	W-1866	Emulsion	Upper Right	5.5	3.0	4.2
(179)	W-1869	Emulsion	Upper Right	5.5	3.0	4.2
(180)	W-1867	Emulsion	Upper Right	5.5	3.0	4.2
(181)	W-1868	Emulsion	Upper Right	5.5	3.0	4.2
(182)	W-1870	Emulsion	Upper Right	5.5	3.0	4.2
(183)	W-1871	Emulsion	Upper Right	5.5	3.0	4.2
(184)	W-1872	Emulsion	Upper Right	5.5	3.0	4.2
(185)	W-1873	Emulsion	Top	5.5	3.0	4.2
(186)	W-1874	Emulsion	Top	5.5	3.0	4.2
(187)	W-1875	Emulsion	Upper Right	4.7	4.2	4.3
(188)	W-1878	Emulsion	Upper Right	5.5	3.0	4.2
(189)	W-1876	Emulsion	Upper Right	5.5	3.0	4.2
(190)	W-1877	Emulsion	Upper Right	5.5	3.0	4.2
(191)	W-1881	Emulsion	Top	5.5	3.0	4.2
(192)	W-1879	Emulsion	Top	5.5	3.0	4.2
(193)	W-1880	Emulsion	Top	5.5	3.0	4.2
(194)	W-1884	Emulsion	Upper Left	5.5	3.0	4.2
(195)	W-1882	Emulsion	Upper Left	5.5	3.0	4.2
(196)	W-1883	Emulsion	Upper Left	5.5	3.0	4.2

Appendix D

Ozalid Prints of Original Spectrophotometric Graph Sheets

Set of the Ozalid prints of the thirty-nine original recordings made on the General Electric recording spectrophotometer for the 196 man-made objects studied in this report. An index to the spectrophotometric curves of this set is given in three parts in the following table: Part I lists 43 transmitting man-made objects. Part II lists 60 reflecting man-made objects: 39 for the visible spectrum and 21 for the visible and near infrared spectrum. Part III lists 93 color photographs of man-made objects.

The type of film is indicated in parenthesis following the description of the object; also listed is the date of the spectrophotometric measurement. Exposure numbers W-122, W-123, and W-131 shown on GE graph sheet Serial No. GE II-1579 are of natural objects and were explained in NBS Report 4794.

Index to Appendix D

Part I. Transmitting Man-made Objects

Sample Number	Exposure Number	Description	GE Graph Sheet Serial No. and Curve No. Visible Spectrum	Curve Number	Date Measured
(1)	W-126	Processed Unexposed Film (RGB)	GE II-1555	4	1-28-55
			-1556	4	1-31-55
(2)	W-125	Processed Unexposed Film (RG)	-1555	5	1-28-55
(3)	W-130	Processed Unexposed Film (GB)	-1555	7	1-28-55
(4)	W-124	Processed Unexposed Film (BR)	-1555	6	1-28-55
(5)	W-129	Processed Unexposed Film (R)	-1556	5	1-31-55
(6)	W-128	Processed Unexposed Film (G)	-1556	6	1-31-55
(7)	W-127	Processed Unexposed Film (B)	-1556	7	1-31-55
(8)	---	Cyan Dye on Film Base (R)	-1557	4	1-31-55
(9)	---	Magenta Dye on Film Base (G)	-1557	5	1-31-55
(10)	---	Yellow Dye on Film Base (B)	-1557	6	1-31-55
(11)	---	Yellow Dye on Film Base (B)	GE I -1386	2	1-31-55
(12)	---	Ansco Color Compensating Filter, UV-16P, Yellow	GE II-1796	4	2-21-57
(13)	---	Ansco Color Compensating Filter, 23, Yellow	-1796	5	2-21-57
(14)	---	Ansco Color Compensating Filter, 24, Yellow	-1796	6	2-21-57
(15)	---	Ansco Color Compensating Filter, 25, Yellow	-1796	7	2-21-57
(16)	---	Ansco Color Compensating Filter, 26, Yellow	-1796	8	2-21-57
(17)	---	Ansco Color Compensating Filter, 33, Magenta	-1797	4	2-25-57
(18)	---	Ansco Color Compensating Filter, 34, Magenta	-1797	5	2-25-57
(19)	---	Ansco Color Compensating Filter, 35, Magenta	-1797	6	2-25-57
(20)	---	Ansco Color Compensating Filter, 43, Cyan	-1798	4	2-25-57
(21)	---	Ansco Color Compensating Filter, 44, Cyan	-1798	5	2-25-57
(22)	---	Ansco Color Compensating Filter, 45, Cyan	-1798	6	2-25-57
(23)	---	Ansco Color Compensating Filter, .025Y, Yellow	-1799	4	2-25-57
(24)	---	Ansco Color Compensating Filter, .05Y, Yellow	-1799	5	2-25-57
(25)	---	Ansco Color Compensating Filter, .10Y, Yellow	-1799	6	2-25-57
(26)	---	Ansco Color Compensating Filter, .20Y, Yellow	-1799	7	2-25-57

Index to Appendix D (continued)

Sample Number	Exposure Number	Description	GE Graph Sheet Serial No. and Curve No. Visible Spectrum	Curve Number	Date Measured
(27)	---	Ansco Color Compensating Filter, .30Y, Yellow	GE II-1799	8	2-25-57
(28)	---	Ansco Color Compensating Filter, .40Y, Yellow	-1799	9	2-25-57
(29)	---	Ansco Color Compensating Filter, .50Y, Yellow	-1799	10	2-25-57
(30)	---	Ansco Color Compensating Filter, .025M, Magenta	-1800	4	2-25-57
(31)	---	Ansco Color Compensating Filter, .05M, Magenta	-1800	5	2-25-57
(32)	---	Ansco Color Compensating Filter, .10M, Magenta	-1800	6	2-25-57
(33)	---	Ansco Color Compensating Filter, .20M, Magenta	-1800	7	2-25-57
(34)	---	Ansco Color Compensating Filter, .30M, Magenta	-1800	8	2-25-57
(35)	---	Ansco Color Compensating Filter, .40M, Magenta	-1800	9	2-25-57
(36)	---	Ansco Color Compensating Filter, .50M, Magenta	-1800	10	2-25-57
(37)	---	Ansco Color Compensating Filter, .025C, Cyan	-1801	4	2-25-57
(38)	---	Ansco Color Compensating Filter, .05C, Cyan	-1801	5	2-25-57
(39)	---	Ansco Color Compensating Filter, .10C, Cyan	-1801	6	2-25-57
(40)	---	Ansco Color Compensating Filter, .20C, Cyan	-1801	7	2-25-57
(41)	---	Ansco Color Compensating Filter, .30C, Cyan	-1801	8	2-25-57
(42)	---	Ansco Color Compensating Filter, .40C, Cyan	-1801	9	2-25-57
(43)	---	Ansco Color Compensating Filter, .50C, Cyan	-1801	10	2-25-57

Index to Appendix D (continued)

Part II. Reflecting Man-made Objects:

Sample Number	Description	GE Graph Sheet Serial No. and Date Measured: Visible Spectrum	Near Infrared Spectrum	Curve Number
(44)	Mimeo Bond Paper, Orange	GE II-1227 6- 1-53	---	1
(45)	Onion Skin Paper, Blue	-1229 6- 1-53	---	1
(46)	Onion Skin Paper, Canary Yellow	-1228 6- 1-53	---	1
(47)	Onion Skin Paper, Pink	-1226 6- 1-53	---	1
(48)	Railroad Board, Red	-1225 6- 1-53	---	1
(49)	Khaki #1 (cotton) from Army Shade Book Serial No. 5045 at NBS	-1384 2- 5-54	GE II-1385	1
(50)	Olive Drab #52 (wool) from Army Shade Book Serial No. 5045 at NBS	-1384 2- 5-54	-1385	2
(51)	US Marine Corps Necktie	-1486 10- 6-54; 10- 7-54	-1489	1
(52)	US Marine Corps Overseas Cap (summer)	-1486 10- 6-54; 10- 7-54	-1489	2
(53)	US Marine Corps Pants (summer)	-1486 10- 6-54; 10- 7-54	-1489	3
(54)	US Marine Corps Shirt (summer)	-1486 10- 6-54; 10- 7-54	-1489	4
(55)	US Army Shirt (winter)	-1486 10- 6-54; 10- 7-54	-1489	5
(56)	US Army Eisenhower Jacket (winter)	-1486 10- 6-54; 10- 7-54	-1489	6
(57)	US Marine Corps Overseas Cap (winter)	-1487 10- 6-54; 10- 7-54	-1490	1
(58)	US Marine Corps Blouse (winter)	-1487 10- 6-54; 10- 7-54	-1490	2
(59)	US Marine Corps Pants (winter)	-1487 10- 6-54; 10- 7-54	-1490	3
(60)	US Marine Corps Fatigue Cap	-1487 10- 6-54; 10- 7-54	-1490	4
(61)	US Marine Corps Fatigue Shirt	-1487 10- 6-54; 10- 7-54	-1490	5
(62)	US Marine Corps Fatigue Pants	-1487 10- 6-54; 10- 7-54	-1490	6
(63)	Chinese Red #6335 Chi-namel Paint, Chi-namel Paint and Varnish Co.	-1735 8- 3-56;	-1748 8-21-56	4,7
(64)	Colony Yellow #317 House Paint, Lowe Brothers	-1470 9-27-54	-1471	6,11

Index to Appendix D (continued)

Sample Number	Description	GE Graph Sheet Serial No. and Date Measured: Visible Spectrum	Near Infrared Spectrum	Curve Number
(65)	Green #173 Tractor Paint, Lowe Brothers	GE II-1470	GE II-1471 9-27-54	5,12
(66)	Red #139 Tractor Paint, Lowe Brothers	-1470	-1471 9-27-54	7,10
(67)	Royal Blue Permanent Trim Paint, John W. Masury & Son	-1470	-1471 9-27-54	4,13
(68)	Seal Brown Supreme House Paint, John W. Masury & Son	-1470	-1471 9-27-54	8,9
(69)	Verdi Green #6830 Super House Paint, Chi-namel Paint and Varnish Co.	-1735 8- 3-56;	-1748 8-21-56	5,6
(70)	Munsell 5YR 6/12 (Tobey Press)	-1516	--- 11-26-54	6,9
(71)	Munsell 5Y 8/12 (Tobey Press)	-1515	--- 11-26-54	4,13
(72)	Munsell 5GY 7/10 (Tobey Press)	-1515	--- 11-26-54	6,11
(73)	Munsell 5G 5/8 (Tobey Press)	-1515	--- 11-26-54	7,10
(74)	Munsell 5BG 4/6 (Tobey Press)	-1516	--- 11-26-54	4,11
(75)	Munsell 5B 4/8 (Tobey Press)	-1515	--- 11-26-54	8,9
(76)	Munsell 5PB 3/12 (Tobey Press)	-1516	--- 11-26-54	5,10
(77)	Munsell 5P 4/12 (Tobey Press)	-1515	--- 11-26-54	5,12
(78)	Munsell 5RP 4/12 (Tobey Press)	-1516	--- 11-26-54	7,8
(79)	Munsell 5R 4/14 (Tobey Press)	-1520	--- 12- 2-54	7,8
(80)	Munsell 5R 4/12 (Tobey Press)	-1522	--- 12- 6-54	6,7
(81)	Munsell 5R 4/10 (Tobey Press)	-1520	--- 12- 2-54	6,9
(82)	Munsell 5R 4/8 (Tobey Press)	-1522	--- 12- 6-54	5,8
(83)	Munsell 5R 4/6 (Tobey Press)	-1520	--- 12- 2-54	5,10
(84)	Munsell 5R 4/4 (Tobey Press)	-1522	--- 12- 6-54	4,9
(85)	Munsell 5R 4/2 (Tobey Press)	-1520	--- 12- 2-54	4,11
(86)	Munsell N 9.5/ (Tobey Press)	-1523	--- 12- 7-54	4,15

Index to Appendix D (continued)

Sample Number	Description	GE Graph Sheet Serial No. and Date Measured: Visible Spectrum	GE Graph Sheet Serial No. and Date Measured: Near Infrared Spectrum	Curve Number
(87)	Munsell N 9/ (Tobey Press)	GE II-1528 12-16-54	---	4,15
(88)	Munsell N 8.5/ (Tobey Press)	-1529 12-16-54	---	4,15
(89)	Munsell N 8/ (Tobey Press)	-1523 12- 7-54	---	5,14
(90)	Munsell N 7.5/ (Tobey Press)	-1528 12-16-54	---	5,14
(91)	Munsell N 7/ (Tobey Press)	-1529 12-16-54	---	5,14
(92)	Munsell N 6.5/ (Tobey Press)	-1523 12- 7-54	---	6,13
(93)	Munsell N 6/ (Tobey Press)	-1528 12-16-54	---	6,13
(94)	Munsell N 5.5/ (Tobey Press)	-1529 12-16-54	---	6,13
(95)	Munsell N 5/ (Tobey Press)	-1523 12- 7-54	---	7,12
(96)	Munsell N 4.5/ (Tobey Press)	-1528 12-16-54	---	7,12
(97)	Munsell N 4/ (Tobey Press)	-1529 12-16-54	---	7,12
(98)	Munsell N 3.5/ (Tobey Press)	-1523 12- 7-54	---	8,11
(99)	Munsell N 3/ (Tobey Press)	-1528 12-16-54	---	8,11
(100)	Munsell N 2.5/ (Tobey Press)	-1529 12-16-54	---	8,11
(101)	Munsell N 2/ (Tobey Press)	-1523 12- 7-54	---	9,10
(102)	Munsell N 1.5/ (Tobey Press)	-1528 12-16-54	---	9,10
(103)	Munsell N 1/ (Tobey Press)	-1529 12-16-54	---	9,10

Index to Appendix D (continued)

Part III. Color Transparencies of Man-made Objects:

Sample Number	Exposure Number	Description	GE Graph Sheet Serial No. and Curve No. Visible Spectrum	Curve Number	Date Measured
(104)	26	Mimeo Bond Paper, Orange Under Exposure (RGB)	GE II-1227	9	6- 1-53
(105)	19	Mimeo Bond Paper, Orange Normal Exposure (RGB)	-1227	2	6- 1-53
(106)	20	Mimeo Bond Paper, Orange Over Exposure (RGB)	-1227	3	6- 1-53
(107)	21	Mimeo Bond Paper, Orange Over Exposure (RGB)	-1227	4	6- 1-53
(108)	22	Mimeo Bond Paper, Orange Over Exposure (RGB)	-1227	5	6- 1-53
(109)	23	Mimeo Bond Paper, Orange Over Exposure (RGB)	-1227	6	6- 1-53
(110)	24	Mimeo Bond Paper, Orange Over Exposure (RGB)	-1227	7	6- 1-53
(111)	25	Mimeo Bond Paper, Orange Over Exposure (RGB)	-1227	8	6- 1-53
(112)	27	Mimeo Bond Paper, Orange Over Exposure (RGB)	-1227	10	6- 1-53
(113)	44	Onion Skin Paper, Blue Under Exposure (RGB)	-1229	9	6- 1-53
(114)	37	Onion Skin Paper, Blue Normal Exposure (RGB)	-1229	2	6- 1-53
(115)	38	Onion Skin Paper, Blue Over Exposure (RGB)	-1229	3	6- 1-53
(116)	39	Onion Skin Paper, Blue Over Exposure (RGB)	-1229	4	6- 1-53
(117)	40	Onion Skin Paper, Blue Over Exposure (RGB)	-1229	5	6- 1-53
(118)	41	Onion Skin Paper, Blue Over Exposure (RGB)	-1229	6	6- 1-53
(119)	42	Onion Skin Paper, Blue Over Exposure (RGB)	-1229	7	6- 1-53
(120)	43	Onion Skin Paper, Blue Over Exposure (RGB)	-1229	8	6- 1-53
(121)	45	Onion Skin Paper, Blue Over Exposure (RGB)	-1229	10	6- 1-53
(122)	35	Onion Skin Paper, Canary Yellow, Under Exposure (RGB)	-1228	9	6- 1-53
(123)	28	Onion Skin Paper, Canary Yellow, Normal Exposure (RGB)	-1228	2	6- 1-53
(124)	29	Onion Skin Paper, Canary Yellow, Over Exposure (RGB)	-1228	3	6- 1-53
(125)	30	Onion Skin Paper, Canary Yellow, Over Exposure (RGB)	-1228	4	6- 1-53

Index to Appendix D (continued)

Sample Number	Exposure Number	Description	GE Graph Sheet Serial No. and Curve No. Visible Spectrum	Curve Number	Date Measured
(126)	31	Onion Skin Paper, Canary Yellow, Over Exposure (RGB)	GE II-1228	5	6- 1-53
(127)	32	Onion Skin Paper, Canary Yellow, Over Exposure (RGB)	-1228	6	6- 1-53
(128)	33	Onion Skin Paper, Canary Yellow, Over Exposure (RGB)	-1228	7	6- 1-53
(129)	34	Onion Skin Paper, Canary Yellow, Over Exposure (RGB)	-1228	8	6- 1-53
(130)	36	Onion Skin Paper, Canary Yellow, Over Exposure (RGB)	-1228	10	6- 1-53
(131)	17	Onion Skin Paper, Pink Under Exposure (RGB)	-1226	9	6- 1-53
(132)	10	Onion Skin Paper, Pink Normal Exposure (RGB)	-1226	2	6- 1-53
(133)	11	Onion Skin Paper, Pink Over Exposure (RGB)	-1226	3	6- 1-53
(134)	12	Onion Skin Paper, Pink Over Exposure (RGB)	-1226	4	6- 1-53
(135)	13	Onion Skin Paper, Pink Over Exposure (RGB)	-1226	5	6- 1-53
(136)	14	Onion Skin Paper, Pink Over Exposure (RGB)	-1226	6	6- 1-53
(137)	15	Onion Skin Paper, Pink Over Exposure (RGB)	-1226	7	6- 1-53
(138)	16	Onion Skin Paper, Pink Over Exposure (RGB)	-1226	8	6- 1-53
(139)	18	Onion Skin Paper, Pink Over Exposure (RGB)	-1226	10	6- 1-53
(140)	8	Railroad Board, Red Under Exposure (RGB)	-1225	9	6- 1-53
(141)	1	Railroad Board, Red Normal Exposure (RGB)	-1225	2	6- 1-53
(142)	2	Railroad Board, Red Over Exposure (RGB)	-1225	3	6- 1-53
(143)	3	Railroad Board, Red Over Exposure (RGB)	-1225	4	6- 1-53
(144)	4	Railroad Board, Red Over Exposure (RGB)	-1225	5	6- 1-53
(145)	5	Railroad Board, Red Over Exposure (RGB)	-1225	6	6- 1-53
(146)	6	Railroad Board, Red Over Exposure (RGB)	-1225	7	6- 1-53
(147)	7	Railroad Board, Red Over Exposure (RGB)	-1225	8	6- 1-53

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Sample Number	Exposure Number	Description	GE Graph Sheet Serial No. and Curve No. Visible Spectrum	Curve Number	Date Measured
(148)	9	Railroad Board, Red Over Exposure (RGB)	GE II-1225	10	6- 1-53
(149)	W-132	Railroad Board, Blue Normal Exposure (GB)	-1579	7	3-15-55
(150)	W-133	Railroad Board, Blue Over Exposure (GB)	-1579	8	3-15-55
(151)	W-134	Railroad Board, Tuscan Normal Exposure (GB)	-1579	9	3-15-55
(152)	W-135	Railroad Board, Tuscan Over Exposure (GB)	-1579	10	3-15-55
(153)	W-141	Olive Drab Army Shirt Normal Exposure (GB)	-1580	5	3-16-55
(154)	W-142	Olive Drab Army Shirt Over Exposure (GB)	-1580	4	3-16-55
(155)	W-171	Olive Drab Army Shirt Normal Exposure (RG)	-1580	8	3-16-55
(156)	W-172	Olive Drab Army Shirt Over Exposure (RG)	-1580	7	3-16-55
(157)	W-173	Olive Drab Army Shirt Over Exposure (RG)	-1580	6	3-16-55
(158)	W-198	Olive Drab Army Shirt Over Exposure (RG)	-1581	6	3-16-55
(159)	W-199	Olive Drab Army Shirt Normal Exposure (RG)	-1581	5	3-16-55
(160)	W-200	Olive Drab Army Shirt Over Exposure (RG)	-1581	4	3-16-55
(161)	W-291	Olive Drab Army Shirt, No Filter Normal Exposure (RGB)	-1581	9	3-16-55
(162)	W-292	Olive Drab Army Shirt Red Filter (RGB)	-1581	11	3-16-55
(163)	W-293	Olive Drab Army Shirt Yellow Filter (RGB)	-1581	10	3-16-55
(164)	W-294	Olive Drab Army Shirt Green Filter (RGB)	-1580	10	3-16-55
(165)	W-295	Olive Drab Army Shirt Blue Filter (RGB)	-1580	9	3-16-55
(166)	W-296	Olive Drab Army Shirt, No Filter Over Exposure (RGB)	-1581	8	3-16-55
(167)	W-297	Olive Drab Army Shirt, No Filter Over Exposure (RGB)	-1581	7	3-16-55
(168)	W-430	Olive Drab Army Shirt Normal Exposure (B)	-1580	12	3-16-55
(169)	W-431	Olive Drab Army Shirt Over Exposure (B)	-1580	11	3-16-55

Index to Appendix D (continued)

Sample Number	Exposure Number	Description	GE Graph Sheet Serial No. and Curve No. Visible Spectrum	Curve Number	Date Measured
(170)	W-1862	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Under Exposure (RGB)	GE II-1601	5	4-13-55
(171)	W-1861	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Under Exposure (RGB)	-1604	4	4-18-55
(172)	W-1858	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Normal Exposure (RGB)	-1601	4	4-13-55
(173)	W-1859	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Over Exposure (RGB)	-1602	4	4-13-55
(174)	W-1860	Light Table, 19 Fluorescent Lamps, 15 Inch Working Distance, No Extension Tube, Over Exposure (RGB)	-1603	4	4-15-55
(175)	W-1865	Light Table, 19 Fluorescent Lamps, 6-1/2 Inch Working Distance, 40mm Extension Tube, Under Exposure (RGB)	-1604	5	4-18-55
(176)	W-1863	Light Table, 19 Fluorescent Lamps, 6-1/2 Inch Working Distance, 40mm Extension Tube, Normal Exposure (RGB)	-1602	5	4-13-55
(177)	W-1864	Light Table, 19 Fluorescent Lamps, 6-1/2 Inch Working Distance, 40mm Extension Tube, Over Exposure (RGB)	-1603	5	4-15-55
(178)	W-1866	Light Table, 19 Fluorescent Lamps, 4-1/2 Inch Working Distance, 80mm Extension Tube, Normal Exposure (RGB)	-1601	6	4-13-55
(179)	W-1869	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats Out, Under Exposure (RGB)	-1604	6	4-18-55
(180)	W-1867	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats Out, Normal Exposure (RGB)	-1602	6	4-13-55

Index to Appendix D (continued)

Sample Number	Exposure Number	Description	GE Graph Sheet Serial No. and Curve No. Visible Spectrum	Curve Number	Date Measured
(181)	W-1868	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats Out, Over Exposure (RGB)	GE II-1603	6	4-15-55
(182)	W-1870	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats 3/4 In, Normal Exposure (RGB)	-1601	7	4-13-55
(183)	W-1871	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats 1/2 In, Normal Exposure (RGB)	-1602	7	4-13-55
(184)	W-1872	Light Table, 12 Lumiline Lamps, 15 Inch Working Distance, No Extension Tube, All Rheostats 1/4 In, Normal Exposure (RGB)	-1603	7	4-15-55
(185)	W-1873	Light Table, 12 Lumiline Lamps, 6-1/2 Inch Working Distance, 40mm Extension Tube, All Rheostats Out, Under Exposure (RGB)	-1604	7	4-18-55
(186)	W-1874	Light Table, 12 Lumiline Lamps, 6-1/2 Inch Working Distance, 40mm Extension Tube, All Rheostats 3/4 In, Under Exposure (RGB)	-1601	8	4-13-55
(187)	W-1875	Light Table, 12 Lumiline Lamps, 6-1/2 Inch Working Distance, 40mm Extension Tube, All Rheostats 3/4 In, Normal Exposure (RGB)	-1602	8	4-13-55
(188)	W-1878	Light Table, Neon Lamp, 15 Inch Working Distance, No Extension Tube, Under Exposure (RGB)	-1601	9	4-13-55
(189)	W-1876	Light Table, Neon Lamp, 15 Inch Working Distance, No Extension Tube, Normal Exposure (RGB)	-1603	8	4-15-55
(190)	W-1877	Light Table, Neon Lamp, 15 Inch Working Distance, No Extension Tube, Over Exposure (RGB)	-1604	8	4-18-55
(191)	W-1881	Light Table, Neon Lamp, 6-1/2 Inch Working Distance, 40mm Extension Tube, Under Exposure (RGB)	-1604	9	4-18-55

Index to Appendix D (continued)

Sample Number	Exposure Number	Description	GE Graph Sheet Serial No. and Curve No. Visible Spectrum	Curve Number	Date Measured
(192)	W-1879	Light Table, Neon Lamp, 6-1/2 Inch Working Distance, 40mm Extension Tube, Normal Exposure (RGB)	GE II-1602	9	4-13-55
(193)	W-1880	Light Table, Neon Lamp, 6-1/2 Inch Working Distance, 40mm Extension Tube, Over Exposure (RGB)	-1603	9	4-15-55
(194)	W-1884	Light Table, Neon Lamp, 4-1/2 Inch Working Distance, 80mm Extension Tube, Under Exposure (RGB)	-1603	10	4-15-55
(195)	W-1882	Light Table, Neon Lamp, 4-1/2 Inch Working Distance, 80mm Extension Tube, Normal Exposure (RGB)	-1601	10	4-13-55
(196)	W-1883	Light Table, Neon Lamp, 4-1/2 Inch Working Distance, 80mm Extension Tube, Over Exposure (RGB)	-1602	10	4-13-55

U. S. DEPARTMENT OF COMMERCE
Sinclair Weeks, *Secretary*

NATIONAL BUREAU OF STANDARDS
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