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PIGMENT COLOR RESEARCH REPORT

Final Report

Review of Dark Red and Maroon Pigments

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NEWARK PLANT

PIGMENT COLOR RESEARCH REPORT

Final Report

TITLE: Review of Dark Red and Maroon Pigments

PERIOD COVERED: March 1, 1944 to April 25, 1944.

SUBMITTED BY: J.B. Callaway

DATE SUBMITTED: April 25, 1944

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INTRODUCTION:

Since 1941, the study on red and maroon ^{pigments} for automotive finishes has been greatly curtailed. For several years prior to that date, however, a laboratory program devoted to improving and evaluating standard pigments and exploring for new products was continuously carried on. During the period 1941 to the present a large number of test panels have remained on outdoor exposure and as a result a considerable body of durability information is now available, on both our own and competitive products.

It is now possible to carry out an overall survey and to summarize the status on red and maroon pigments, both standard and experimental. It is also proposed in this report to review the standard line with respect to the following factors:

1. Color range and durability
2. Utility
3. Customer reactions
4. Comparisons with competition
5. Weaknesses.

Data on experimental products of interest because of exceptional color, durability or lower cost also will be examined.

In general, the report covers only information gained by high spot examination of exposure panels. Other pigments of interest may be revealed when more detailed analysis of the various exposure series is made.

Commercial automotive finishes available in 1941 have been analyzed and evaluated. These systems have been compared for durability with matches using standard pigments. The results of this work are now available and will be reported.

SUMMARY & CONCLUSIONS:

1. Standard Dark Reds and Maroons

A- In general, the color range required for the automotive field appears to be fairly well covered by the organic products discussed below except in the light red range where a durable non-bleeding pigment is still lacking and except for a standardized thioindigo maroon of acceptable properties. The standard line covers the spectrum from the depth of a para red to the dark maroon shade exemplified in the Lake Bordeaux B pigments.

RT-525-D. (Manganese "Lithosol" Red 2B) is in the color range of medium cadmium red. It is non-bleeding, possesses acceptable durability in alkyd and nitrocellulose systems for both single

pigment and metallic formulations. It has satisfactory resistance to baking, an important consideration in synthetic formulations. Even though it is stronger and more opaque than the medium cadmium red, it encounters strong competition with the latter because of its higher cost.

The F&F Department has confirmed the acceptable durability of this standard in both Duco and Dulux. Rinshed Mason have indicated that the pigment is one of the more light-fast of the non-bleeding reds. It is of interest to that company also because of excellent gloss, baking stability and superior opacity versus cadmium red. The Arco Company were considering including the standard in the "new machine line" of refinishing formulations. The F&F Department, Philadelphia, state, however, that at the present time they can see only minor use for the pigment unless it is priced at the level of the cadmium reds. Nevertheless, the superior properties of strength, opacity and gloss definitely maintain interest in RT-525-D.

(Manganese "Lithosol" Rubine 3G)

RT-499-D is the darker companion color to RT-525-D. It is in the color range of cadmium maroon and is more durable than the latter. Like the latter it is non-bleeding when over-stripped with white. It darkens considerably on exposure in lacquers and therefore its use would be limited in this vehicle. In synthetics, however, its durability is satisfactory both in full shades and in blends with metallics and other pigments of similar durability. An outstanding defect is its poor resistance to baking. Modifications of the formula (e.g. K-1309) to improve baking resistance have been made and the results are promising.

The F&F Department, Philadelphia, considers RT-499-D as one of the key pigments in their line. Cook Paint & Varnish Company are considering formulations of it with a Lake Bordeaux B pigment as a replacement for the thioindigo-cadmium red combinations, which were used in most of the synthetic automotive finishes of 1941.

Blends of RT-499-D with RT-347-D, with or without a small amount of iron oxide, appeared to have sales promotional possibilities in the formulation of trim paints but the high cost per gallon probably would limit its extensive use.

No competitive counterpart has been seen on the market. The patent position on RT-525-D and RT-499-D appears to be excellent. These products are covered in U.S.P.-2,225,665, assigned to the Du Pont Company.

RT-500-B (Para-chlor-ortho-nitro-aniline → Naphthanil ASD) is slightly lighter than RT-499-B. Being a pigment dyestuff it bleeds into white overstrips. However, it is durable in single pigment and blend formulations in both nitrocellulose and alkyd finishes. It is similar to an earlier product, RT-492-D (meta-nitro-para-toluidine → Naphthanil AS-D) but unlike the latter, has shown no reactivity in alkyd formulations. Like RT-492-D it enhances in some cases the durability of pigments blended with it.

A darker modification, RT-501-D, is also of interest due to its acceptable durability in both alkyd and lacquer. It is reactive in synthetics and therefore of limited application. Means have been found to reduce this reactivity but color value has been harmed by their application. At the present time the deficiencies of RT-501-D appear to rule it out of a standard line.

RT-347-D (Manganese Lake Bordeaux B) is the well known light color member of this class. Its principal competitor on the market is Harmon Color Company's Victoria Maroon of the same chemical composition. Although satisfactory in single pigment formulations in both lacquer and alkyd, its durability in metallics is questionable. It is durable in certain specific combinations with other pigments and can be used successfully in formulating certain automotive maroons in the synthetic field.

It has also shown some promise in blends with RT-499-D in Burgundy shades of trim paints but the high cost per gallon would limit its use.

RT-521-D (Manganese Lake Bordeaux B, dark type) is similar chemically to RT-347-D but is synthesized to give the darker and more desirable shade of the earlier calcium iron derivative, RT-354-D. RT-521-D is superior to RT-354-D in durability. Its competitive counterpart is Harmon's Infrex Maroon (calcium iron Lake Bordeaux B type) but it is superior to the competitive product in polish back and in lightfastness. It is durable in solid shades in both nitrocellulose and alkyd types but of questionable durability in metallics.

RT-521-D has aroused considerable interest among customers outside the DuPont Company. Cook Paint & Varnish Company are reported as being interested in blends of it with RT-499-D as replacement for the more expensive thioindigo-cadmium red combinations. In 1941 Acme White Lead & Color Company estimated its use at 1,000 lbs. per month for 1942. The Arco Company in 1941 were considering adding it to their "new machine line" for refinishes. On basis of its superiority to the Harmon Infrex Maroon the Dibble Color Company stated that RT-521-D would be used if it could be reformulated to compensate for color differences. Ditzler Color Company and Rinsed Mason also reported it of interest.

RT-521-D in one exposure series was found to be a very good color and durability match for Mayfair Maroon M-29, reported to be the Ford body color for 1941.

RT-436-D (Meta-nitro-para-toluidine →
Naphthanil BS). The pulp counterpart, RT-135-P, is used in the General Motors popular Parma Wine shade. Although RT-436-D and its competitive counterpart, Harmon's Toluidine Maroon MT-1, are durable in nitrocellulose metallic systems, they have not returned sufficient durability to warrant their use in synthetics. Recent exposure results have indicated that a higher pigment to binder ratio than normally used would overcome this deficiency to some extent. However, due to the higher cost involved this is not a practical solution. A durable pigment of the yellow undertone shade and brightness of RT-436-D, and durable in alkyd, is needed.

Helio Fast Rubine Lakes. At the present time RP-294-D is the representative of this class in F&P Philadelphia's standard line. Although not possessing acceptable durability in single pigment and metallic formulations, nevertheless, it can be used as a shading color for other maroons. Its desirability for shading purposes is appreciated when it is considered that of the eight automotive synthetic enamels examined in 1941 at Newark, seven contained Helio Fast Rubine lakes as shading agents.

Philadelphia has compared blends of Harmon's Alizarine Purple MV-2 with RT-347-D and RT-354-D versus similar blends with RP-293-D and RP-294-D. Although there is a slight superiority in the Harmon product, it was not deemed sufficient to replace RP-294-D in Philadelphia's standard line. An exceptionally dark bright pigment with the durability properties characterizing the thioindigos is needed.

B- Thioindigoid Maroons are valuable shading pigments since they do not fade when blended in small amounts with other pigments. This type of maroon checks badly in full shade formulations but can be used in 15 to 20% amounts. They have been used successfully as toning agents for grays, blues, reds and maroons in both lacquer and synthetic formulations. Their popularity for this purpose is well demonstrated by consideration of the fact that of twelve commercial automotive finishes examined, six were toned with a thioindigoid maroon.

After what was evidently large scale experimentation with products of varying depth and hue, the Harmon Color Company eventually set up at least three codes listed in order of increasing darkness: Inde Maroons MV-8, MV-1 and MV-4. RT-503-D, chemically similar to MV-8 and MV-1, was set up from "Sulfanthrene" Red 3B dye obtained from the Orchem Department. RT-503-D proved to be too light and dull and

in some instances inferior in durability to seriously compete with Harmon's offerings. As a result of color deficiency of RT-503-D, the Orchem Department carried on some experimental work on the "Sulfanthrene" Red 3B and eventually obtained a product which is intermediate in depth between MV-8 and MV-1. The improved product has been compared in one exposure series with the Harmon standards and it is believed to be at least equal in durability to competitive and is probably within a satisfactory shade range for general use. Recent contacts with the F&F Department reveal that the Indo Maroon MV-8 is the more desirable of the Harmon products. Therefore, the improved "Sulfanthrene" Red 3B probably would be satisfactory from a color standpoint.

The possibility remains, however, that the darker shades, the MV-1 and the MV-4, may be desirable for some formulations. The MV-1 has proved to be somewhat reactive in certain alkyd formulations and more transparent than the MV-8. The MV-4 is suspected of being a mixture of a thioindigoid plus a blue pigment, the latter not as yet definitely identified.

II. Experimental Products

Exploratory work has been promoted with several ends in view aside from improving the existing line: 1) to obtain new, novel and cheaper products of satisfactory durability and color; 2) to obtain a pigment which could produce the exceptional shade and highly desirable durability in alkyd metallics which is possible with the NBS maroon in lacquer finishes; 3) to synthesize precipitated pigments which would have the desirable durability and non-bleeding characteristics of the manganese-BON products but in a wider range of color. Exposure results on a large number of experimental products made up to 1941 have now become available. It is possible to draw from these exposure series a few of the more promising pigments and to evaluate them in the light of requirements in the red and maroon range.

A- Precipitated Pigments

K-8480 (Manganese Scarlet 2YL) has the desirable durability of RT-525-D and is non-bleeding. It is slightly lighter, slightly yellower and duller than RT-525-D. Because of its good durability and lighter shade it should not be forgotten but until the position of RT-525-D is established it does not seem feasible to recommend further laboratory work in development of this product at the present time.

K-8484 (Chromium "Lithosol" Red 2B) is similar in durability and color characteristics to RT-525-D. Its proximity to RT-525-D in color does not appear to warrant extensive development at the present time.

K-1898 (Manganese toner of metanilic acid → beta-oxy-naphthoic acid) is of interest because of its potentially lower cost compared with RT-525-D. Tintorially it is intermediate in depth between RT-525-D and RT-499-D. Exposure results have not advanced far enough to prove its durability.

K-1468 (Manganese toner of para-toluidine-metasulfonic acid → Naphthanil MX) is an experimental product designed to combine the desirable non-bleeding and durability characteristics of a precipitated pigment with the brightness of the pigment dyestuff class. It is inherently cheaper than the Naphthanil pigments, preliminary cost calculations indicating it to be in the neighborhood of RT-499-D. It is very slightly lighter and, very slightly yellower than RT-499-D but unlike the latter, shows a slight bleed associated with Naphthanils. Although it is equal in lightfastness on outdoor exposure to RT-499-D, at the end of ten months in Florida it is showing some checking. This is the only one of a series of products of this chemical nature that has not darkened severely on exposure.

B- Pigment Dyestuffs (Naphthanils). With growing emphasis on the use of synthetic enamels in automotive formulations, the interest in pigments of this class decreases because of their tendency to bleed when overstripped with white. This bleed is generally increased to a prohibitive extent when the enamels are baked, a technique which appears to be growing in popularity since it increases speed with which the finishes can be applied. The popularity of the NBS maroon for lacquer, however, has kept these experimental products in the picture and in the period 1939 - 1941, many combinations were synthesized with intermediates available on the market and exposure results were obtained. The following appear to be the more outstanding with respect to durability and are reported for future reference.

K-8895 (meta-nitro-para-toluidine → Naphthanil MX) is durable in both lacquer and alkyd and appears to have some promise in metallics in these systems. It is about the depth of RT-436-D but bluer in hue. The Naphthanil MX intermediate is the cheapest member of its class. It shows considerable bleed however, and the work to date to decrease this undesirable characteristic has not been successful. Nevertheless, the F&F Department, Philadelphia, has expressed interest in it because of its excellent lightfastness and film integrity in Dulux and has requested a sample for their own evaluation.

K-8898 (Meta-nitro-para-toluidine → Naphthanil BG) is yellow and dull compared to RT-525-D. It is satisfactory in durability in both alkyd and lacquer in masstone formulations. It fades badly in metallics.

K-9942 (5-nitro-2-amino-anisol → Naphthanil ASD) is of interest in Dulux since it approaches the depth and yellow hue of RT-436-D but is superior in durability both in masstone and metallics. Philadelphia considers this product an interesting one and a possible substitute for the non-durable RT-436-D and has requested a sample for evaluation.

K-9953 (5-nitro-2-amino-toluene → Naphthanil ASD) is intermediate in depth between RT-499-D and RT-347-D. The pigment is durable in both lacquer and alkyd, masstone and metallic formulations. Depth of color can be varied by simple formula changes.

K-9972 (Para-nitro-ortho-toluidine → Naphthanil ASD) is an exceptionally light yellowish red in the range of RT-427-D. It is durable in both lacquer and alkyd, masstone and metallic formulations.

K-9994 (Ortho-chlor-para-nitro-aniline → Naphthanil ASD) is primarily of interest because it produces a very light golden hued metallic in alkyd which enamel shows excellent durability. This might be of interest as a specialty in Dulux.

K-1010 (Para-chlor-ortho-nitro-aniline → Naphthanil OL) is in the range of RT-501-D but is acceptable in durability in alkyd formulations only.

K-1335 (2:5-dichlor-aniline → Naphthanil OL) is similar tinctorially to RT-427-D. It is durable in alkyd and lacquers, both masstone and metallic formulations. Another pigment, K-9995 (2:5-dichlor-aniline → Naphthanil ASD) is somewhat less attractive tinctorially than K-1335 but may be of interest as a similar type.

C- Experimental Thioindigoid Maroons

In 1940, the Orchem Department submitted several experimental substituted thioindigoids for evaluation. Although these products were tinctorially inferior to the Harmon Indo maroons, the possibility of their being available at a lower price level aroused interest in them. It is not yet known whether or not their tendency to bleed into white overstripe is an inherent property.

D-3898 (4:7:4':7'-tetra-chlor-thioindigo) is a light yellow, dull type similar to the original RT-503-D standard but is somewhat superior in durability. This product is too light and dull to be of interest in competition with the present Harmon standards but its excellent durability in masstones and metallics (shows less checking than RT-503-D) keep it in the picture.

D-4029 (tetra-methyl-thioindigo) is slightly darker and bluer than D-3898 but in other respects is similar. It darkens somewhat more on outdoor exposure than D-3898.

D-4031 (dichlor-tetra-methyl-thioindigo) approaches Harmon's MV-8 in depth and hue but is inferior in brightness. It also is showing up well in durability. This product has been requested by Parlin for further evaluation.

D-3901 (5:6:5':6' tetra-chlor-thioindigo) is a very dark blue type similar in this respect to Harmon's MV-4. It returns acceptable durability.

III. Competitive Pigments

A- Naphthanil Types

In addition to the orthodox Toluidine Maroon, RT-1, of the Harmon Color Company, other products have been examined from time to time which are of the same fundamental chemical composition, namely, meta-nitro-para-toluidine coupled with Naphthanil BS. These products have apparently been put on the market in an attempt to match the desirable Parma Wine shade by use of dry pigment. Three of these pigments, termed Iridescent Maroons, are similar tinctorially to RT-436-D:

- 1) E-4318 is slightly brighter and shows less bleed into white overstrips than RT-436-D. Upon outdoor exposure the competitive product fades to a distinctly blue hue in lacquer metallic.
- 2) E-4263 is similar tinctorially and in durability to RT-436-D. However, it is superior in bleed into white overstrips.
- 3) E-4319 is lighter than RT-436-D. Like the E-4318, it fades to a blue hue in lacquer metallics.

None of these products appear to have an appreciable advantage either tinctorially or in durability to RT-436-D. but the decreased bleed is a superior property. RT-153-P, Newark's low bleeding MBS Maroon, however, is approximately equal in this respect to competition. Parlin is evaluating an experimental variation on RT-153-P.

Kentucky Color Company's Toluidine Maroon 1021 appears to be chemically and tinctorially similar to RT-436-D and returns similar durability results.

Harmon's SP Toluidine Maroon MT-3 is believed to be the chemical equivalent of RT-492-D, (meta-nitro-para-toluidine coupled with Naphthanil ASD). Kentucky Color Company's Toluidine Maroon 12-H is also equivalent in color and durability to RT-492-D. The notable shortcomings of RT-492-D and its competitive equivalents are reactivity in alkyd systems and bleed into white overstripe. Nevertheless, the Harmon Color Company has used the pigment with some success in blends with other red and maroon pigments. An example of this combination is Harmon's Claret Maroon MV-7 which is believed to be a combination of the MT-3 with a Helio Fast Rubine Lake. A match for the Claret MV-7 can be obtained by a 10% RP-294-D and 90% RT-492-D dry mixture. Another tinctorial match is obtained by use of 30% RP-261-D and 70% RT-500-D. In lacquer the competitive product and the matching combinations show little change on exposure after six months. Polish back is poor, however.

Kentucky Color Company's Toluidine Maroon 38-H is the depth of RT-347-D but shows bad bleed into white overstripe and is reactive in alkyd type vehicles. By chemical spot tests it is known that it is a Naphthanil pigment but the exact chemical composition has not been determined. It has returned excellent durability in lacquer and alkyd systems in both masstone and metallics. The closest approach both tinctorially and in durability is the experimental product, K-8895, (meta-nitro-para-toluidine → Naphthanil MX).

B- Dark Toluidine Red Toners

Competitive products which are somewhat darker than our darkest toluidine red standard, RT-505-D, have frequently been encountered. These have been found to be mixtures of orthodex toluidine red shaded with a Naphthanil pigment. An example of this type is Kentucky's DD-1078 which has been matched tinctorially and durability-wise by a 5% RT-492-D and 95% RT-505-D blend.

A darker product, Harmon's R-10 (dark masstone versus RT-505-D) can be matched by a mechanical mixture of 30% RT-492-D with 70% RT-505-D. These products, both the match and the competitive, show acceptable durability in both alkyd and lacquer systems.

C- Lake Bordeaux B Types

Harmon's Victoria and Infrex Maroons have their counterparts in RT-347-D and RT-413-D, respectively. A counterpart for the dark manganese derivative, RT-521-D, has not been encountered to date.

The Kentucky Color Company has released a rosinated calcium toner coded #1024 Nusoft Maroon, which is similar to RT-292-D. This product is, as would be expected, softer than the

manganese counterpart but much inferior in durability, being especially poor in resistance to checking.

D- Thioindigoid Maroons

1. "Sulfanthrene" Red 3B Type

So far as is known there are three standard toners of this classification in the Harmon Color Company's line:

- a) Indo Maroon MV-8 light yellow type (somewhat darker and brighter than RT-503-D).
- b) Indo Maroon MV-1 darker, very slightly bluer than MV-8.
- c) Indo Maroon MV-4 very dark and blue believed to be a mixture of the thioindige maroon and a blue pigment, which is possibly copper phthalocyanine.

The Indo Maroon, MV-8, is the most desirable one of the three from the point of view of the F&F Department. These pigments are used for shading purposes only, being valuable for this purpose since in small amounts in blends they do not fade. RT-503-D has never successfully competed with the MV-8 (or MV-1) because of its light dull masstone. However, as discussed above, improvements in Orchem's "Sulfanthrene" Red 3B have been made and it now appears that both color and durability-wise, a pigment satisfactory for competitive purposes with MV-8 has been obtained. It is not certain whether or not the pigment of the MV-1 shade is desired by the trade. If so, further work will be required to obtain a darker shade.

Two other products of the Harmon Color Company, coded Indo Red R-44 and Indo Red R-47, are of the Para Red B color range. Although they have not been chemically analyzed they are suspected of being vat dyes. Since they bleed into white overstrips and are dull they do not appear to be of much interest at the present time. They also show considerable bronze and slight darkening on exposure in both lacquer and alkyd metallics.

E- Helio Fast Rubine Types

Lakes of this class are popular for shading automotive finishes as is indicated in the section following. In spite of their poor durability in masstone formulations, they can be used in small amounts to obtain very effective bright compositions with other more durable maroons and reds. Harmon's Alizarine Purple MV-2 is in the color range of RP-261-D. Its durability is similar to that of RP-261-D and RP-294-D in full masstone formulations. However, F&F

Philadelphia has recently reported that in certain blends after short time exposure MV-2 is somewhat superior. At the end of one year exposure, however, it does not appear to have sufficient advantage to warrant change over from their present standard, RP-294-D.

IV. Commercial Automotive Red and Maroon Finishes

In 1941 samples of eight commercial red and maroon automotive finishes, believed to be representative of all the important finishes of the red shades used at that time, were obtained and analyzed. These enamels were then matched as closely as possible with various combinations using our standard pigments and exterior exposures started. Durability comparisons are now available.

The following tabulation includes the commercial name of the enamel, the manufacturer and consumer. Yearly consumption for 1941 is given when known. The "pigmentation" is Newark's analysis. Matching enamels were prepared on the basis of these analyses. With durability information now available, other blending possibilities become obvious, and these are included for guidance of future work and sales promotion.

Ruby Red, Cook Paint & Varnish Co., Manufacturers,
Estimated consumption 1941, 26,000 gals.
(including Wine Tone Maroon) for Studebaker.
Pigmentation: Cadmium Red, thioindigo pigments.

An acceptable color match was made using Harmon's Indo Maroon MV-8, RT-499-D and lithopone. This match was equal in color retention and checked less severely.

Suggested combinations: The improved thioindigo, "Lithosol" Red 3B, D-4445, with RT-499-D.

Wine Tone Maroon, Cook Paint & Varnish Company.
Estimated consumption 1941, (including Ruby Red above) 26,000 gals. Studebaker.
Pigmentation: Cadmium red, thioindigo, Helio Fast Rubine Lake.

This is an excellent finish showing very little color change after one year's Florida exposure. All our proposed matches in this series have faded severely and therefore would not be in the picture against this competitive product.

Suggested combination: RT-521-D shaded with the improved "Lithosol" Red 3B, D-4445.

Bolero Red, Pittsburgh Plate Glass Company.
Estimated consumption 1941, 20,000 gals.
for Nash.
Pigmentation: Cadmium red plus Helio
Fast Rubine Lake.

A satisfactory match was obtained with a combination of RT-499-D, RT-521-D and lithopone. This match is an improvement in color retention compared to the commercial enamel.

Mandarin Maroon, Ditzler Color Company.
Estimated consumption 1941, 90,000 gals.
for Plymouth.
Pigmentation: Cadmium red, Helio Fast
Rubine Lake, Lake Bordeaux B (RT-413-D
type).

A combination of RT-521-D, RP-294-D and lithopone is better in color retention but does not polish up as well as competitive.

Suggested combination: RT-521-D toned with the improved "Lithosol" Red 3B, D-4445.

Regal Maroon, Cook Paint & Varnish Company.
Estimated consumption 1941, 92,000 gals.
for Chrysler, Dodge, DeSoto.
Pigmentation: Cadmium red, thioindigo,
Helio Fast Rubine Lake.

A combination of RT-499-D, Harmon's Indo Maroon MV-8 and RP-294-D produced a good color match somewhat superior in color retention to the competitive. This combination, however, does not polish back as well as the commercial enamel.

Suggested combination: RT-521-D, RP-294-D, shaded with the improved "Lithosol" Red 3B, D-4445.

Flare Red, Cook Paint & Varnish Company.
Estimated consumption 1941, not known.
For Chrysler, Dodge.

This finish was matched with a combination of RT-525-D, Harmon's Indo Maroon MV-8, lithopone and bone black.

The commercial finish is very close in shade to RT-521-D. Therefore, the suggested match is RT-521-D shaded as required with RT-525-D.

Sumac Red, Cook Paint & Varnish Company.
Estimated consumption 1941, not known.
For Chrysler, Dodge.
Pigmentation: Cadmium red, Helio Fast
Rubine Lake and TiO_2 .

This finish is very poor in checking resistance and fades considerably. A match of medium Cadmium Red, RF-294-D, black and lithopone, is superior in checking resistance but about equal in color retention.

The color is intermediate in depth between RT-499-D and RT-525-D. It is suggested, therefore, that it could be matched satisfactorily with a combination of these two extremes.

Buckeye Red, Ditzler Color Company.
Estimated consumption 1941, 3,000 gals.
for Willys Overland.
Pigmentation: Cadmium red, Lake Bordeaux B
(RT-347-D type), TiO_2 .

The finish is intermediate in depth between RT-499-D and RT-521-D but much bluer than either standard. The bad fade of the product indicates that it contains a large amount of white pigment. Matches made with 1) RT-347-D and lithopone; 2) RT-521-D, RT-499-D and lithopone are superior in color retention but check more than competitive.

An analysis of the pigmentation of the above commercial enamels reveals the following points:

- (a) All pigments used are known commercially.
- (b) All eight enamels contain cadmium red.
- (c) Helio Fast Rubine Lakes are present in six of the enamels.
- (d) Thioindigo maroon is present in four of the products.

Since the cadmium reds are used so widely, it is advisable to compare our closest standards, i.e., non-bleeding organic reds and maroons, as possible substitutes. In the above summary of the durability properties of the commercial finishes it is indicated that in many cases the organic reds RT-499-D, RT-525-D and RT-521-D may be used in place of the cadmium reds of their respective shades. In addition, matches have been made for five commercially available cadmium reds and maroons which vary in depth from the light red RT-427-D to the dark red RT-499-D:

Cadmium Maroon

This product is slightly lighter than RT-499-D. The latter has better checking resistance, gloss retention, and color retention since it darkens rather than fades as does the cadmium maroon. Probably the addition of a small amount of white pigment would give an exact match to the cadmium maroon.

Cadmium Red Dark

This pigment is darker and bluer than RT-525-D. A blend of RT-499-D, RT-525-D and lithopone is equal in depth but slightly yellower. This combination is equal in durability to the cadmium red.

Cadmium Red Medium

This product is lighter than RT-525-D. A match composed of Chrome Orange, YO-260D, RT-525-D, and lithopone is yellower than competitive and shows somewhat inferior color retention.

Cadmium Red Light and Cadmium Red Medium Light

Combinations of RT-525-D, Chrome Orange and lithopone are inferior in color retention to the competitors. There appears to be no satisfactory light organic red available at present for this range.

V. General

A- Pigment/Binder Study

One exposure series has been run to determine the effect of varying pigment to binder ratio in synthetic finishes. Standard dark red and maroons were exposed in ratios varying from 15 parts pigment/100 binder to 45 parts pigment/100 parts binder.

The most interesting result of this series is seen in the effect on RT-436-D (MNPT → Naphthanil BS) which is usually considered exceptionally poor in durability in alkyd vehicles. At the lower ratios, that is, 15/100 to 40/100 there is bad fading and checking. At higher ratios, however, in the region 45/100, checking and fade resistance have been improved markedly. Improvement in durability is significant since it suggests further study to use the NBS pigment in synthetic finishes.

B- Durability of Blends of Standards

At the request of the Sales Promotion group, a blending study was undertaken of standard reds and maroons

with each other and with cadmium reds, iron oxide and white pigments. Results of the exposure series in alkyd vehicle are now available.

RT-347-D - This pigment can be shaded with cadmium reds and maroons, RT-500-D, RT-499-D and RT-521-D to give durable combinations. It tends to fade in mixtures with "TI-PURE" LG, lithopone and zinc oxide. It is to be noted that the "TI-PURE" LG combination checks less than those made with the other two whites.

RT-521-D is similar in blending properties to RT-347-D. It can also be satisfactorily blended with small amounts of RP-294-D and RP-173-D. It tends to fade and check when mixed with TiO₂.

RT-499-D is showing satisfactory durability in all blends tested. These include combinations with iron oxide, cadmium reds and maroons, other organic red and maroon standards and "TI-PURE" LG.

RT-525-D is satisfactory in most of the combinations, except in a 50/50 blend with Y-469-D in which the organic pigment tended to fade, and in a blend with RT-347-D in which the latter faded.

RT-500-D is satisfactory in all blends tested which include mixtures with iron oxide, cadmium reds and maroons, other organic red and maroon pigments, and the white pigments, TiO₂, lithopone and zinc oxide.

C- Sales and Transfers, 1940-1943 inclusive.

<u>Code</u>	<u>Year</u>	<u>Sales</u>	<u>Transfers</u>
RT-499-D	1940	533 lbs.	12,286 lbs.
	1941	1772	17,228
	1942	498	4,277
	1943	<u>470</u>	<u>5,811</u>
		3273 lbs.	39,602 lbs.
RT-521-D	1940	305	5
	1941	3782	10
	1942	(-98)	none
	1943	<u>540</u>	<u>none</u>
		3529	15

<u>Code</u>	<u>Year</u>	<u>Sales</u>	<u>Transfers</u>
RT-347-D	1940	8407 lbs.	24,985 lbs.
	1941	7802	15,967
	1942	1369	7,726
	1943	954	0
		<u>18,532</u>	<u>48,678</u>
RT-354-D	1940	265	9,115
	1941	0	11,425
	1942	0	6,065
	1943	0	2,297
		<u>265</u>	<u>28,902</u>
RT-436-D	1940	4,007	2,848
	1941	8,298	760
	1942	213	0
	1943	942	0
		<u>13,460</u>	<u>3,608</u>
RT-135-P plus RT-153-P	1940	12	208,096
	1941	8,628	234,258
	1942	0	0
	1943	0	9,964
		<u>8,640</u>	<u>452,318</u>
RP-294-D	1940	1,382	1,044
	1941	1,699	2,927
	1942	109	1,374
	1943	51	0
		<u>3,241</u>	<u>5,345</u>

EXPERIMENTAL DETAILS

Reports and (or) panels from the following Newark exposure series were examined.

<u>Dark Red & Maroon Exposures</u>		<u>Year Exposed</u>
8-3034	RT-399-D vs. Competitive	1936
3047	New Red & Maroon Pigments	1937
3064	New Red Pigments	1937
3070	Durable Maroon Study	1938
3120	Maroon Blending Study	1938
3147	Evaln. of "TI-PURE" O in Maroons	1939
3161	Burgundy Trim Colors	1939
3163	New Maroons	1939
3175	Maroon Blending Series II	1939
3176	" " " III	1939
3179	Manganese Pigments from BON	1939
3206	RT-499-D	1939

Maroon Exposures (cont'd)

S-3207	Maroons in "TI-PURE" 0	1940
3219	Maroon Metallics	1940
3262	Improved Bord. Lake B Type Maroons	1940
3286	Boydell Bros. Maroon Evaln.	1941
3297	NBS Maroons - GE 2458 Masstones	1941
3298	" " " Metallics	1941
3299	" " Lacquer Masstones	1941
3300	" " " Metallics	1941
3301	Indo Maroons GE 2458 Masstones	1941
3302	" " " Metallics	1941
3303	" " Lacquer Masstones	1942
3304	" " " Metallics	1942
3305	Deep Tol.Type Maroons - GE 2458 Masstones	1941
3306	" " " " Metallics	1941
3307	" " " Lacquer Masstones	1942
3308	" " " " Metallics	1942
3309	Misc. & Expt'l Maroons GE 2458 Masstones	1941
3310	" " " " Metallics	1941
3311	" " " Lacquer Masstones	1942
3312	" " " " Metallics	1942
3320	Evaln. of Red Pigments K-1260 & RT-520-D	1941
3323	" " " " "	1941
3329	Maroon Toners	1941
3331	Pig./Binder - Maroons	1941
3340	Maroon Blending Study	1941
3345	Evaln. of K-1366 vs. RT-436-D	1941
3350	Evaln. of K-1448 - Sulf. Red Violet 2 RN	1941
3360	" " " "	1941
3365	Red Trim Paints	1942
3373	Misc. Maroons	1941
3379	Evaln. of Maroons & Reds Dulux Masstones	1942
3380	" " " " Metallic	1942
3381	" " " Lacq. Masstone	1942
3382	" " " " Metallic	1942
3386	" K-1553 Maroon	1942
3389	Commercial Maroon Matches	1942
3406	Evaln. of Pigments in Baking Vehicle	1942
3427	" of K-1715 (RT-501-D Type Dulux & Lacq.	1942
3428	" " " " "	1942
3461	" " NBS Maroons	1942
3462	" " " " "	1942
6710	" " K-1844 Mn. Salt of Rubine BG	1943
6775	" " BON-Colors Mn Salts	1943