

PROJECT ADMINISTRATION DATA SHEET

USE INITIATION SHEET AS TERMINATION SHEET

ORIGINAL REVISION NO. _____

Project No. E-27-801 ~~GTR/GIT~~ DATE 7 / 16 / 84

Project Director: Winston C. Boteler School/USE TE

Sponsor: Monsanto Company; St. Louis, MO 63167

Type Agreement: Letter Agreement dtd. 6/25/84

Award Period: From 6/18/84 To 9/8/84 (Performance) 9/8/84 (Reports)

Sponsor Amount:	<u>This Change</u>	<u>Total to Date</u>
Estimated: \$	_____	\$ <u>21,000</u>
Funded: \$	_____	\$ <u>21,000</u>

Cost Sharing Amount: \$ _____ Cost Sharing No: _____

Title: Personnel Agreement for Services of Mr. Winston C. Boteler

ADMINISTRATIVE DATA

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1) Sponsor Technical Contact:

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Monsanto Company

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Defense Priority Rating: n/a Military Security Classification: n/a

(or) Company/Industrial Proprietary: n/a

RESTRICTIONS

See Attached _____ Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval - Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of \$500 or 125% of approved proposal budget category.

Equipment: Title vests with _____

COMMENTS:

The Project Director is responsible for submitting a written Final Report to Monsanto at the end of the effort as well as interim reports as requested to Monsanto.

COPIES TO: _____ Sponsor I.D. #02.212.000.84.006

Project Director

Research Administrative Network

Research Property Management

Accounting

Procurement/EES Supply Services

Research Security Services

~~Report Coordinator to OCA~~

Research Communications (2)

GTRI

Library

Project File

Other Newton

WEAR-DATED CARPET RESEARCH

BY

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FOR

MONSANTO COMPANY

SUMMARY

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SF 347 171

The conclusions of the Wear-Dated Carpet research study can be summarized as follows:

1. Weight-density and ply twist are the most important construction parameters for minimizing appearance changes due to wear.
2. There is no correlation between the Simfloor laboratory tests and in-home wear.
3. The normal A.S.T.M. grade to be expected after 12 to 24 months is 2.9; after 24 to 36 months it is 3.5; after 36 to 48 months it is 3.8.
4. The greatest change in appearance occurs in the 0 to 24 month period.
5. The A.S.T.M. 1 to 5 grading system does not provide useful comparisons of grade 5 carpets, since most of the carpets graded 5's were much worse than the laboratory standards.
6. High weight-density and high ply twist minimize appearance changes, however, there is no way to predict potential failures, since 13% of all carpets inspected were graded 5's.
7. The definition of a "failure" based on the A.S.T.M. grade should be changed, since the majority of the customers with carpets graded 5's, where the floor sample was similar in appearance to the laboratory sample, were satisfied with the carpets.
8. Most customers expected the carpet to show some wear after years of use.
9. The majority of the carpet "failures" were due to matting.

10. Although more than 1200 carpets were inspected, only a few styles were found in sufficient quantity to provide meaningful data. The experimental error is $\pm 17\%$ for a population of 30 samples, whereas for a population of 155 it is only $\pm 4\%$.

11. The diversity of use in the homes makes it impractical to lump together the wear data from all rooms of the house.

12. Future research should concentrate on inspecting large numbers of carpets of specific ages and styles with predetermined construction parameters.

13. Future research should concentrate on carpets in family rooms and halls, since these are the only rooms where the use is consistent from house to house.

14. Future research should include independent grade determinations by two people to eliminate any individual bias.

INTRODUCTION

This report is based on 345 homes and 1203 carpets inspected and graded by Carol Chancey, Elizabeth Silhan, and Blakely Ward in various parts of the country during the summer of 1984. The grades assigned by the inspectors were normalized by dividing the grade by the age in months to obtain a floor performance index (F.P.I.), indicated as X in the calculations. Many calculations and correlations were made during the course of the project and those data are included in the accompanying project notebook. The experimental error was so large in the case of small sample numbers that only a few correlations have any validity. Notably, those correlations obtained by lumping together similar rooms or similar carpets are of statistical significance.

DISCUSSION OF RESULTS

A. Weight-Density and Ply Twist

While a number of correlations were attempted during the course of data gathering, it was only after all the data were tabulated that any meaningful relationships were obtained. The effect of ply twist level was established by comparing a number of carpets with ply twist levels of 3.50 and 3.80, respectively. The carpets used for this evaluation are listed on the next page.

Style	Weight-Density	Ply Twist
Walnut Circle	105,378	3.80
M5-382	101,242	3.80
Summer Magic	107,119	3.80
Acclamation	115,370	3.80
Nieuw Amsterdam	115,191	3.80
Believing	103,083	3.80
Beacon Hill	111,676	3.75
Final Touch	101,463	3.75
Favor	93,875	3.75

No. of samples = N=29

Floor Performance Index = \bar{X} = 0.08

Grand Bahamas	113,125	3.50
Haven Ridge	99,513	3.50
Briargate	95,666	3.50
Baxter Street	125,916	3.50
Ingenué	124,703	3.50

N = 91, \bar{X} = 0.11

The data show that the 3.80 ply twist group performs significantly better than the 3.50 ply twist group.

The same group of 3.80 ply twist level carpets was compared to the following group of 3.80 ply twist level carpets which had weigh-densities at the 70,000 level.

Style	Weight-Density	Ply Twist
Grand Occasion	73,316	3.80
Dynasty	74,413	3.80
Secrets	77,858	3.75
Come Alive	67,417	3.80
M5-305	78,301	3.80

$$N = 41, \bar{X} = 0.13$$

Compared to the 100,000 weight-density group with 3.80 ply twist level, the 70,000 weight-density shows much poorer performance. The conclusion is that both weight-density and ply twist level are important in minimizing appearance changes due to wear.

B. BCF

The BCF carpets, 106 in all, had a Floor Performance Index of .08. This is about the same F.P.I. as the high weight-density, high ply twist group including Walnut Circle, etc. and considerably better than the low weight-density, high ply twist group including Come Alive and the high weight-density, low ply twist group including Grand Bahamas. The performance of the BCF yarn carpets may seem anomalous when the low weight-density (55,000) and low ply twist level (3.20) are considered.

However, the average age of the BCF carpet is 2.4 years, while the average age of the high weight-density, high twist level group is 3.9 years and the age of the low weight-density, high ply twist level group is 3.5 years. Therefore, the BCF carpets should not be compared to the spun yarn carpets for at least another year or two.

C. Halls and Family Rooms

A comparison by age was made of all carpets, except BCF carpets in halls and family rooms. The results are as follows:

Age	N	\bar{X}	Spread
0-24	65	0.16	0.14-0.18
24-36	121	0.12	0.115-0.117
36-48	155	0.09	0.086-0.094
48+	12	0.07	0.055-0.079

Although the number of carpets older than 4 years is not significant, the data indicate a considerable leveling of appearance change in the third and fourth years. On this basis, it can be anticipated that the change in appearance of these carpets will be slight in the fifth year.

Where a sufficient number of samples was available, correlations were attempted between some individual styles as follows:

Style	WT.	Ply Twist.	\bar{x}	N
Walnut Circle	33.9	3.80	0.082	9
Baxter Street	42.0	3.5	0.10	43
Ingenué	42.0	3.5	0.10	27
Montara	54.9	3.50	0.08	16

Baxter St. vs. Montara: Significant Difference

Baxter St. vs. Ingenué: No Significant Difference

Baxter St. vs. Walnut Circle: No Significant Difference

Montara vs. Ingenué: Significant Difference

Montara vs. Walnut Circle: No Significant Difference

The correlations point out the influence of pile weight and weight-density in the case of Montara vs. Baxter St. and Montara vs. Ingenué. The lower weight-density high ply twist level Walnut Circle carpet shows about the same performance as the high weight-density low ply twist Montara carpet; however, the small number of Walnut Circle samples (9) renders these data somewhat inconclusive.

CONCLUSIONS AND RECOMMENDATIONS

The data provide conclusive evidence that high ply twist levels provide increased resistance to appearance changes due to wear. It is recommended that future Wear-Dated specifications include a minimum ply twist level requirement of 3.75 or 3.80. The exact level should be determined by experimental research. A minimum weight-density level cannot be determined from the data. However, the 70,000 weight-density level carpets with high ply twist levels performed satisfactorily. There was insufficient data in terms of age to make conclusions regarding the performance of the 50,000 weight-density level BCF carpets.

Laboratory experiments should be undertaken to devise a method of determining the twist level of spun yarns in carpets. Unless such a procedure is developed, the ply twist level specification will be impossible to enforce.

Another inspection should be made within the next year to provide more substantive information about the conclusions drawn from the 1984 research. The inspections should be confined to only a few styles. The 70,000 W-D level, 3.50 ply twist level carpets and the 70,000 W-D level and 100,000 W-D level carpets with 3.80 ply twist level should be inspected in enough locations to provide at least 100 samples in each category at each age level. In addition, enough 5 year old carpets should be inspected to provide statistically significant data at that age level. This would permit predictions of grade changes throughout the life of the carpet guarantee.

While the data do not indicate that there was an bias in the grading, the use of two independent graders at a location could minimize the possibility. The graders could compare their grades while they were still in the house, so that any conflicting assessments could be resolved.

It was obvious during the grading that many carpets would have graded 10 or more on a scale of 5. The laboratory standards do not look like carpets worn in service except in the lower grades. After looking at badly matted carpets graded 5, I think that it becomes harder to grade as a 5 a carpet which looks like the laboratory standard 5. Those carpets which were obviously badly matted and with which the customer was highly dissatisfied belong in a separate category from the laboratory standard grade 5 carpets.

A more realistic set of standards could be developed by using samples which had been in service in a home. This could be accomplished by taking carpet from Monsanto employees with test carpets where the age and condition of the carpets can be determined easily. The alternative is to develop a laboratory wear-test method which will duplicate wear conditions in the hall of a home. This seems to be an impossible task where the effects of soiling, vacuuming, and varieties of shoe soles are considered. The wear due to pivoting and turning must be included in any laboratory wear-test or floor test if any equivalence with in-home service is to be attained.