AN INVESTIGATION AND DESIGN

OF

A SET OF MAGNESIUM LUGGAGE.

Thesis by

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SUMMARY

The use of a metallic material for luggage permits a more simplified type of construction than does leather or fabric and in addition fabrication by high production methods is possible. Of the metallic materials available magnesium, with its low specific gravity, suggests itself to the designer as a luggage material worthy of investigation.

The magnesium alloy, Dow FS-la, is the most suitable and will be used as sheet which will be drawn to form the case. The closure will be of the same alloy shaped by extrusion and will be spot welded to the case.

A clear melamine-alkyd resin has been tested for abrasion and is suggested as the finish for the magnesium luggage.

A market survey made to determine the number of units that might be sold in 1947 indicates a potential market for about 50,000 units. A consumer survey has been made to determine consumer preferences and a functional study of luggage in use made to determine the advantages and defects of present luggage. The designed luggage depends for its appearance on the direct use of the material in a form dictated by the material and the functional aspects of luggage. The design is adapted to mass production methods without involving excessive tooling costs.

INTRODUCTION

Luggage design is one of the lesser known fields of activity of the industrial designer but it is a field in which he can be of service to the consumer.

The purpose of this investigation is to design for the traveler, luggage that is more convenient, durable and attractive though available at moderate cost.

New materials are developed and new methods of fabrication are devised which offer to the designer new possibilities for luggage. Magnesium, a material new to the luggage field, is investigated and a set of luggage is designed to take advantage of its characteristic properties.

In order to make a complete design investigation, the subject is divided into

> Market Survey Consumer Research Luggage in Use Material Research Design Solution,

In each phase of the investigation, the factors which influence the design of luggage are studied in order to incorporate them into the design solution. The market survey which follows is the first step in the investigation.

MARKET SURVEY

The size of the luggage market is of importance to the manufacturer and the designer because a knowledge of the size of the market determines the production processes to be used and the amount of new tooling that might be economically undertaken. A market survey was made in this study to determine the 1947 market demand for hand luggage.

As a preliminary step in the market survey the industry as a whole will be considered in order to provide a background for more detailed considerations.

The luggage trade was severely curtailed during the war years and 1946 operations, due to scarcity of materials, do not reflect the normal conditions within the trade.

Information on the luggage business was sought from the national trade associations - The Luggage and Leather Goods Manufacturers of America, National Luggage Dealers Association and the National Luggage Salesmen's Association but these have no available recent figures.

The last available complete government information is the 1939 census and this will be used in this thesis as representative of the normal conditions of the industry.

The complete census data pertaining to luggage is briefly summarized in Table I on the following page: TABLE I

1939 Census Data on Luggage

	No.of Manufact- urers Reporting	Total Sales
Suitcases, Trunks, Briefcases, all		
other luggage	329	\$36,826,000.
Cost of materials used Value of Products Value added by Manufacture	\$19,21 36,59 e 17,37	4,722. 1,482. 6,760.
Suitcases and Travel Bags	only Number	Value
Leather Non-Leather	1,596,814 5,178,490	\$ 8,910,642. 12,893,290.
	% Number	% Value
Leather Non-Leather	23 .6 76.4	40.9 59.1
	% 0 P	of Value f Total roduction
Suitcases and Travel Bags.	, nka Boston Baga	65.5
Hat Boxes, Radio Cases, Sa	ample Cases, etc.	34.4
Channels of Distribution		%
Manufacturers Sales: Direct to retail Wholesalers and Wholesale Branch Industrial User: Other	ler Jobbers nes s	71.0 16.2 5.6 5.1 2.1
		100.0
Retail Stores	% Total	Luggage Sales
Department Store Luggage Stores Furniture Stores Jewelery Stores Variety Stores Sporting Goods (es s Stores	39.8 39.3 11.1 6.4 2.1 1.3 100.0

These figures indicate that the luggage industry is not a large industry and that manufacturing costs represent about one half of the value of the goods produced. Suitcases and travel bags account for 65 percent of the value of total volume produced and that although $3\frac{1}{2}$ times as many non-leather bags are produced, the value of leather bags represents 40 percent and non-leather 60 percent of the total value of bags produced.

The main channel of distribution in the luggage business is from manufacturer directly to retailer (71 percent) although there is some wholesaler and jobber distribution (16) percent) in the trade.

Department stores and luggage stores represent the major retail sales outlets and account for approximately 80 percent of the luggage sold.

In an effort to predict the 1947 market for luggage, the following must be considered.

"Prospects for 1947, are that production will not reach the demand, because continuing shortages of wood, leather, rayon for linings and even metal fittings, and locks still exist."

> B. Judelle, Research Director "Luggage & Leather Goods" Magazine

"Industry members assert, when they are permitted to make leather luggage the backlog and current demand will be sufficient to allow them to produce at a high rate for at least three years."

> J.G.Schnitzer, Chief Leather Unit U.S.Department of Commerce

"Here are the Department of Commerce estimates on 1947 supplies and production based on the best data available: Luggage will reach new post-war sales peaks."

> Regional Commerce Bulletin U.S.Department of Commerce F ield Service, Los Angeles

"Careful and intelligent forecasting of the future shows that our industry may look forward to a probable annual retail sale approximating \$235,000,000. Further analysis shows the likelihood of some 20,000,000 new customers.

"There is even the possibility that the unfair "Luxury" tax on luggage may be dropped with a consequent stimulant to the consumer purchasing.

"It is indeed the better part of good judgement for all factors in our industry to give first consideration to the interests of the ultimate consumer.

"There is a general fear that if prices advance too much or unjustifiably, the resultant customer reaction will leave retailers with too much merchandise at prices the customer will refuse to pay."

> A. J. Mellin, Editor "Luggage & Leather Goods" December, 1946

Mr. Mellin's statement reflects the attitude of the luggage industry as a whole. Buyers and luggage store owners realize that there is a large potential market, but that prices keep the goods from moving as rapidly as desired.

It has been stated that while the O.P.A.

price controls were in effect new small luggage enterprises started and were granted a favorable price in excess of that in effect for established manufacturers. Some estimated that hundreds of new manufacturers entered the luggage business on reconversion from war work. As in other lines, the mortality of these newcomers is expected to be high when prices return to more normal levels and materials become more available. In an effort to obtain a correlation between the 1939 volume and 1947 volume of the luggage business, the following members of the luggage trade were asked how 1947 business would compare with the 1939 volume of business. Those asked and their replies are given below:

Luggage Buyer of Large Los Angeles Department Store:

"1946 was better than double 1939, in unit and dollar volume. 1947 is expected to increase over 1946, both in unit sales and dollar volume."

Luggage Buyer of Large Los Angeles Department Store:

"1947 is expected to be $2\frac{1}{2}$ to $3\frac{1}{2}$ times dollar volume of 1939."

Luggage Buyer, West Coast Mail Order House:

"In the industry as a whole, twice as many units sold in 1946 as in 1939, atfour times the dollar value."

A conservative estimate would place the 1947 demand at twice that of 1939, as will be seen in the market survey summary.

Luggage Types Available on the Market:

There is practically an infinite variety of luggage types on the market but the majority fall into the following classifications:

> Leather and simulated leather Fabric Canvas Paper or fibre Metal.

Leather

The highest quality luggage is made of leather and is found chiefly in man's bags - soft sided and semi-formed. The most popular leather is top grain cow hide aniline dyed. There is some pig skin shown although very little at present and some expensive bags are made of shell cordovan. In lady's bags which are formed over a bass wood or veneer box, a considerable number of better bags are of raw hide in natural or russet shades.

Simulated Leather

Simulated or artificial leather is used as a covering in man's formed and semi-formed bags at a much lower price range than leather.

Fabric

The most common type of luggage is fabric known also as "airplane linen" or "airplane canvas." The fabric covering is applied over a bass wood or veneer frame and the edges are protected with leather or simulated leather.

The fabric is usually cotton impregnated with plastic,cellulose nitrate being the most common but other plastics are in use also. The weave varies from a simple crash through twills to complex weaves and the colors vary from grays to brilliant stripes.

Canvas

Canvas luggage, as distinct from "airplane canvas," is used as a material for soft man's bags such as the folding Val-a-pak type and in man's bags as a substitute for leather. The edges and corners are bound with leather. Canvas luggage sells for a lower price than leather or fabric types.

Paper or fibre

The cheaper grades of luggage are made of paper and fibre and encompass the complete range from cardboard to paper filled plastic. This luggage is made down to a price and handled only in the low priced stores.

Metal

Metal luggage is of two types; one is very low priced suitcase of sheet steel that has not been made during the war, but is found in low priced luggage stores, as a copetitor of cardboard luggage. The other type of metal luggage is the Halliburton line of aluminum luggage which is in the present market. It is competitive with good quality fabric and medium price leather luggage. The stores that handle it say it is quite popular. One store buyer who did not handle it said it had a place in the future luggage market.

Luggage prices in many cases have been doubled and tripled over prewar prices. Seventy-five dollars for good quality man's leather bag is not unusual. One store owner said that customers who did not question the price of a piece of luggage before the war, now, when told the price of the pieces they are considering is \$50 to \$75, put off their buying.

Hide prices have doubled over prewar levels, cotton has doubled and wages and other materials all have increased necessitating an increase in luggage prices.

The Federal Excise Tax adds 20 percent to all luggage in addition to state or local taxes. In the case of a \$50.00 bag this becomes impressive: Price of bag \$50.00 Federal Tax (20%) 10.00 Sales Tax $(2\frac{1}{2}\%)$ 1.25 Price including taxes \$61.25

The effect of higher prices in luggage in view of discussion with buyers will find the consumer favoring the less expensive types and in some cases the consumer will not buy but will continue to use his present luggage.

SUMMARY

In 1939 there was produced 6,775,304 suitcases and travel bags. The editor of "Luggage and Leather Goods" estimates 20,000,000 units will be sold in 1947. The buyers of luggage for the local department stores and mail order houses expect $2\frac{1}{2}$ times the 1939 sales or 16,000,000 units. The luggage manufacturer with a 1939 record of sales will base his 1947 production at twice his 1939 figure if he thinks his position in the market is the same as in 1939.

The manufacturer new to the luggage field or producing a new item, such as magnesium luggage, has a

much different problem. As will be seen from the information supplied by the store buyers in the consumer research section about one percent of the luggage sold is metal. With a capable sales organization and good retail outlet coverage, the magnesium luggage manufacturer might expect to sell about one third of one percent of the total market or about 50,000 units. This figure is adequate to justify developing and tooling costs. Sales by the manufacturer will be directly to the retail outlet and department stores and luggage stores will account for 80 percent of the sales.

The number of units sold will be dependent upon the price. The most favorable market will be for items in the \$20 - \$25 range and the size of the market will decrease rapidly with price increase.

CONSUMER RESEARCH

In order to produce an acceptable design the designer must consider the conditions at the point of sale and the factors considered by the consumer in choosing luggage. In this study the consumer research is divided into two parts: Buying Habits and Customer Preferences. The consumer research for this thesis was done by a study of sales methods of various stores and by interviews with buyers or proprietors of the following stores:

> The May Company Bullock's, Downtown Herbold's, Pasadena Gump's, Pasadena Sears Roebuck Company Broadway Luggage Shop, Pasadena

This group handles all classes of luggage from the lowest to the highest price and serves all buying classes. As an illustration - one store handles a two piece set of man's leather luggage priced at \$323.00 while one of the other stores handles a two piece set of luggage at \$3.55. The buyer or proprietor was interviewed and

asked the following seriew of questions:

- Q: At what season is most luggage sold?
- A: All: During the summer vacation season and at Christmas time for gifts.
- Q: Is luggage buying done equally by men and women?
- A: All: More by women. One buyer estimates eight out of ten buyers are women. The reasons suggested: women are better shoppers and do more of the family buying.
- Q: Does the man or the woman make the decision when buying luggage for the family.
- A: All: The woman

Q: What does the man look for in luggage? A: All: Practicality.

- Q: What does the woman look for in luggage? A: All: Style and price.
- Q: What percentage is done for business trips? A: 25 to 40 percent.
- Q: What percentage is done by vacationists? A: 60 to 75 percent.
- Q: Do guarantees and warantees influence the buyer? A: All: Secondary. Confidence in store is primary.
- Q: Has the war changed buying habits? A: All: No.

In the interviews discussed in the preceeding section, the following questions were asked to determine customer preferences in luggage:

Q:	What factors influence the customer's choice of
A:	Appear- Brand ance Price Name Weight Other
	Gump's231May Company123Bullock's123
	shop 2 1 3 Herbold's 1(85%) 2 Impor- Impor- tant tant only in choosing between
	Sears Roebuck 1 2
Q:	What percent (in units) of luggage sales in 1947 do you expect to be
	Leather Fabric Metal Paper
A:	Gump's 30-40 60-70 1 ¹ / ₂ May Company 35 60 1-5 Broadway Luggage
	Shop 35 65 Herbold's 20 80 Sears Roebuck 15 50 5-10 15-20
ଦିଂ	What sizes of hand luggage are most popular?
A :	All: Lady's Man's
	21" Overnighter 24" Two-suiter 21" Wardrobe
Q:	What types of lining are most popular?
Aē	Lady's Man's Rayon Linen or Crash
Q: A:	What colors in linings are preferred bymmen? All: Tans to oyster gray.
Q: A:	What colors in linings are preferred by women? All: Browns, tanş blues; least popular: red, yellow and green.

	experience?			
A:	-	Lady's		Man's
Gump's May Company Bullock's Broadway Luggage		21" 21" 21"	Wardrobe Overnighter Wardrobe	Two-suiter Val-a-pak Two-suiter
	Shop Herbold's	29" 21" and	Fortnighter Overnighter l Wardrobe	- Gladstone before war
	Sears Roebuck	21 m	Overnighter	535
ୄୡୄ	What, in your opin: years?	ion,	will luggage be lil	ke in five
A :	Gump's: Leather, s May Company: More Bullock's: No com Broadway Luggage Sl	so ft men nent. hop:	sided instead of ve to canvas for bette Leather, fabric, a	eneer formed. er wear. luminum also;
	Herbold's: Leather Sears Roebuck: Sar	ame a r and ne as	as now, 1 fabric as now, 5 1939.	

Q: What was the best selling item of luggage in your

SUMMARY

Most of the luggage buying is done by women and the most important considerations in their selections are appearance and price. The male customer considers the practical aspects of luggage. Approximately 65 percent of the luggage sold will be fabric luggage and 30 percent will be leather, the remainder will be paper and metal. The most popular sizes are the lady's 21 inch overnight bag and 21 inch wardrobe; the most popular man's item is the 24 inch two-suiter. As a result of this research the designer will make every effort to design luggage of attractive appearance for the lady's sizes and with practical features in the man's line. The trade and consumers are quite well satisfied with conventional types and anticipate no revolutionary changes. This indicates to the designer that too radical departures may meet with sales resistance and require extensive advertising and sales promotion efforts.

LUGGAGE IN USE

A study of luggage in use was made to determine

- a) the method of handling luggage in travel in order to design luggage of greater convenience,
- b) the weight of the various size bags when filled in order to design bags of sufficient strength,
- c) the weak points of present luggage and the causes of failure in use in order to design luggage without these shortcomings.

a) Luggage handling methods:

Automobile travel - Hand luggage is well adapted to automobile travel since all but the largest pieces can be stowed conveniently in the rear seat, available enroute and free of damage because of the upholstered surfaces of the car interior. Hand luggage when carried in the trunk is liable to damage from tires, tools, grease and sand.

Bus travel - Modern busses have convenient facilities for both short haul and long distance travelers. Ample compartments, well lighted, are located under the seats at floor level. They are

 $17\frac{1}{2}$ inches high and designed to protect the luggage. Overhead racks are constructed of polished rods or stainless steel sheet to prevent damage to luggage. They measure $8\frac{1}{2}$ in. high and extend $16\frac{1}{2}$ in. from the side wall. Enlarged dust proof and watertight exterior compartments will accomodate pieces up to 24 in. x 24 in. x 45 in.

Railroad travel - Railroad car builders are incorporating many features to aid in handling and stowing baggage in the newer cars. The Pullman seat has a space 9 in. x 16 in. x 28 in. beneath it sufficient to handle most hand luggage and in the coaches and chair cars, in addition to the overhead racks, provision is being made for stowing luggage at the end of the coach in a compartment capable of handling the larger pieces. Bedrooms, roomettes as well as drawing rooms on the new sleeping cars are equipped with ample overhead space for all luggage.

There is a trend toward mechanizing the handling of checkable luggage by the installation of conveyor belts and mechanical lifts. In order to become more familiar with luggage handling by railroads the facilities of the Los Angeles Union Depot were studied and the General Baggage Agent, Mr. M. P. Livingstone, was consulted on baggage handling problems.

The traveler with only non-checking luggage either carries it to the car himself or gives it to a red cap who delivers it to the car on a steel luggage cart. The car porter places the luggage at the passenger's seat or in the luggage compartment. It is carefully handled through this method and is seldom damaged.

The checkable luggage is presented at the baggage counter and the train indicated on the tag. It is handled mechanically as much as possible and is liable to damage since it is stowed in the baggage car and loaded and unloaded as rapidly as possible.

The general baggage agent was asked the following questions:

- Q: How many pieces of luggage does the average train traveler have?
 A: Two pieces.
- Q: Is the tendency of travelers to have more or less luggage than formerly?A: Less larger pieces and more smaller pieces.
- Q: Is the tendency to check through more or less? A: Checking through less.

Q: The luggage space in the passenger car is designed to hold how many pieces for each passenger?A: Two or three pieces for each passenger.

Air travel - The most phenomenal growth of travel is exhibited by the air lines.

"Air passenger traffic jumped 70 percent reaching eight times the 1939 rate. Air passenger miles were about 40 percent as great as Pullman traffic."

> U.S.Department of Commerce Field Service, Los Angeles April 1, 1947, Vol.1, No16.

To study air line luggage handling problems two and a half days were spent at the Los Angeles Municipal Air port in the baggage rooms of the United Air Lines and T.W.A.

Air line baggage is presented at the downtown ticket office and brought to the field in busses or presented at the field to be weighed and stowed in the baggage compartment of the plane.

Plane baggage facilities vary with the plane as do handling methods. The two engine planes have the baggage sections aft of the pilots compartment below the floor level. The compartments are loaded and unloaded by hand. The new Douglas DC-6 airliners have eight preloaded cargo containers - dural baskets 34 in. wide by 26 in. deep and 72 in. long which go into two compartments located fore and aft within the fuselage. An overhead monorail system is designed for handling the baskets and mechanical loading devices permit loading and unloading without interference with other service activities.

Lockheed has designed a supplementary cargo carrying unit which can be attached to the underside of the Constellation in 30 seconds. It will handle any type of baggage and become immediatly available for loading and unloading of baggage when the plane lands. With its use it is claimed the baggage can be delivered

to the deplaning passenger within five minutes.

In unloading the two engine transport a metal chute is used on which the baggage slides down from the baggage space to ground level. This chute unless carefully maintained in smooth condition can cause damage to luggage by scratching or cutting the side. Occasionally a piece of luggage will drop from the chute to the ground - a distance of up to 15 feet.

Steamer travel - No limitation on the weight or size of hand luggage is imposed by shipboard travel and the luggage is carefully handled and stowed in the passenger's stateroom.

TYPES OF LUGGAGE USED BY AIR TRAVELERS

The weight of various types of luggage in actual use is of importance to the designer and the air lines present the only convenient means of determining the weight of the bags as used in actual travel.

In order to obtain data on a large number of bags, a study was made at the United Air Lines and the T.W.A. baggage rooms at the Los Angeles Municipal Airport. The air line identification tag attached to the baggage gives the weight of the bag. From this the size and type of bag plus the weight was readily recorded.

The data obtained is presented in Tables II and III on the following pages.

An examination from the point of view of materials used for luggage reveals a surprisingly close correlation between the bags in actual use and the sales reported by the store buyers in the consumer research.

		0%	Fabric	%	Leather
Luggage	sales		65		35
Luggage	in use		53		34

If leatherette and canvas are added to fabric, we have fabric 62 and leather 34 percent.

TABLE II

TYPES OF LUGGAGE USED BY AIR TRAVELERS

		Number of Units					đ		
Indule	Fabri	Lea c et	ather- te	Leather	Paper	Metal	Total	% Ladys Units	70tal Units
21"Overnighter 18"Overnighter 16"Overnighter 21"Wardrobe 24"Wardrobe 26"Wardrobe 29"JK Wardrobe Hat & Shoe Box Round Hat Box	27 ·7 14 7 5 2 2 1		1 1	4	l		32 8 15 7 5 8 1	43 11 20 10 7 4 3 1	21 5 10 5 3 2 1
Total Lady's	66		3	4	1		74	100	48
<u>Man's</u> 21" Overnighter 18" Overnighter 24" Two-suiter 26" Two-suiter 28" Wardrobe Gladstone Val-a-pak Car Suitcases Club Bags Brief Cases Total Man's Grand Total	5 9 1 1va.s 15 81	8 8	1 2 1 4 7	6 3 12 1 15 4 4 3 48 52	2* 2 3	1 1 2 2	7 20 11 15 8 7 4 3 79 152	Man 9 25 14 19 10 9 5 4	's 2 13 7 10 55 2 2 52 100
<u>%Units</u>					т.			* *	
Lady's Bags	89	0	4	5	l	0			
Man'sBags	19	10	5	61	2	2			
All Bags	53	5	4	34	2	1			

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TABLE III

WEIGHT OF LUGGAGE USED BY AIR TRAVELERS.

Average Weight in pounds.

	Tebrio	Leather-	Toothom	Donom	AV	erage
LADY'S	FADLIC	eule	reg citer.	raper	Metar	Wergiic
21" O vernight 18" Overnight	17 14	14*	16	8		17 14
16" Overnight		11*				
21" Wardrobe 24" Wardrobe 26" Wardrobe 29" Wardrobe	25 25 20 43**	21*				25 25 20
Hat & Shoe Box Round Hat Box	8*		26*			
MAN'S						
21" Overnight 16" Overnight		24*	20 12			20 12
24" Two-suiter 26" Two-suiter	31 31	25* 20*	32 29		Al.25*	31 31
28" Wardrobe	30*					
Gladstone				27		27
Val-a-pak (Canvas only)	26					26
Suitcases				28		28
Club Bags				16		16
Briefcases				20		20

* Insufficient data for average- single weight reported ** Believed to be used as a sample case - not representative

In the case of lady's bags, fabric definitely dominates and since the leather bags reported were raw hide there is a negligible amount of leather (as we think of it in man's luggage) in lady's use.

Man's luggage in use shows a predominence (61 percent) of leather types and only one third as much fabric luggage.

Luggage Sizes

Of the 153 pieces of luggage included in this study, a fact worthy of especial notice is the almost equal division of pieces of man's and lady's luggage -79 and 74 respectively.

Of the 17 sizes of luggage reported, three sizes account for 51 percent of the total. These same three sizes were reported by the store buyers as the most popular. They are:

Lady's 21 in. overnighter
 Lady's 21 in. wardrobe
 Man's two-suiter.

Gladstone bags and suitcases, considered obsolescent items, represent 15 percent of the total bags and 28 percent of the man's bags. Their obsolescence results from the fact that they do not keep the contents wrinkle-free as does a two-suiter or wardrobe.

Weight

The study summarized in Table III on the factor of weight gives average figures for the most common types of bags when used for air travel. There may be a slightly lower average weight for air travel as against automobile or train but the difference is probably very slight.

Some average weights of use in design may be

summarized	Average Weight (pounds) of bag filled.
Lady's 21 in, overnighter Lady's 21 in, wardrobe Man's 21 in, overnighter Man's two-suiter	17 25 20 31

New top quality bags representative of two sizes and three types of materials were weighed empty and the results are as follows:

Lady's 21 in. wardrobe Aluminum Fabric	10 9	pounds pounds
Man's Two-suiter	-	-
Aluminum	12	pounds
Fabric	12	pounds
Leather (Ven.frame)	13	pounds
Leather (soft sided)	10	pounds

It can be seen that there is very little difference in the weight of the finished bag regardless of the material used.

Defects in Present Designs

In order to find the deficiencies in present luggage, the store buyers and the baggage agent at the Los Angeles Union Depot were asked specific questions concerning the weak points of present luggage in service.

The questions asked and the answers are as

follows:

Q:	What parts of luggage	fail most often in service?
A:	Sears Roebuck	Locks
	Gump's	Hinges, locks, hand loops
	Bullock's	Handles and locks
	Herbolds	Locks
	Broadway Luggage Shop	Handles, loops, locks,
	201 information indext 200	catches
	May Company	Locks, post type handle
		holders and bag corners.

Questions asked the general baggage agent, Los

Angeles Union Depot:

- Q: Which type of luggage, in your opinion, resists wear best?
- A: Wood frame fabric covered.
- Q: What, in your opinion, are the most common shortcomings in luggage from the baggage agents point of view?
- A: 1. Breaking plastic handles, 2. Spot welds on locks.
- Q: What part of luggage is the chief point of failure in use?
- A: 1. Handle 2. Locks Material when not wooden construction throughout.

Q: What is the chief cause of most failures: Overpacking? Weak material? Weak hardware? Abuse? Accidents?

- A: Overpacking. Flat irons being heavy and pointed often cause damage when not secured properly.
- Q: What type of accident in handling most frequently causes damage to luggage?
- A: Dropping on corner.

- Q: What percent of luggage is delayed due to loss of baggage tag?
- A: Five percent of luggage. Of the baggage delayed, 75 percent has no identification on it.
- Q: Would delay or loss best be prevented by
 - 1) Name and address plate built into luggage?
 - 2) Name and address tag attached to luggage?
 - 3) Initials or name stamped on luggage?
 - 4) Other?
- A: 1) Name and address plate built into luggage.
 - 2) Name and address tag attached to luggage.
 - 3) Initials or name stamped on luggage.
- Q: What, in your opinion, will luggage be like in five years?
- A: There will be a great improvement, in materials and construction. Aluminum luggage has a future - it is light and suitable for train and plane.

The baggage handlers at the Los Angeles Airport were asked which part of luggage failed most in service and their answer was handles. They also expressed the opinion that luggage with rounded edges and corners was less susceptible to damage than that with sharp edges and corners. Asked about aluminum luggage, they said it was new and they were seeing more pieces as time goes on. They liked it because of its rounded corners.

SUMMARY

As a result of the study of luggage in use the following conclusion of design importance were made:

Luggage facilities in trains, busses and aircraft and the handling equipment at depots and terminals are designed for present luggage sizes. Users of luggage

find the present sizes adequate to their use. The design of new luggage should not depart too far from present sizes. A limited line of three pieces would consist of a lady's 21 in. overnighter and 21 in. wardrobe and a man's two-suiter. The sizes of a complete nine piece line is given under the Design Solution.

The average weights of present bags are

	Empty (pounds)	Filled (pounds)
Lady's 21 in. overnighter	8	17
Lady's 21 in. wardrobe	9-10	25
Man's 21 in. overnighter	9	20
Man's two-suiter	10-13	31

This indicates to the designer the range within which the weight must be to be competitive. The average weight filled serves as a starting point to determine the load which the bag must carry.

The common points of failure are handles and locks. The chief cause is overpacking about which the designer can do very little except to make the hinges and catches as strong as possible.

The most common accident is dropping the bag on the corner. Luggage with rounded edges and corners is less liable to damage from this source.

Delay in recovery of a lost bag can be best prevented by a name plate built into the luggage.

MATERIAL RESEARCH

Present luggage materials - leather and fabric have many inherent advantages; leather possesses a flexibility and toughness that particularly suit it for luggage use. Fabric, when coated with plastic, demonstrates a durability adequate to use as a luggage material. Simulated leathers are the subject of intense research and new improved types are being produced every year. These new leathers have not only very good resistance to wear but it is hard to distinguish the better types from real leather.

A new luggage material was sought not because of the properties of fabric, real or simulated leather but because of disadvantages of construction of luggage when using these materials. Soft-sided leather luggage is essentially sewn together and lacks rigidity. This lack of rigidity prevents tight dust proof and moisture proof closure and subjects hinges and catches to misalignment. The veneer box luggage covered with fabric, leather or artificial leather likewise lacks rigidity though not to so great an extent. The corners of this type of bag are the critical points for wear and the vulnerable spots when the luggage is dropped. A metallic material, it was thought, would have advantages over these types. These advantages are

1. It would permit a more simplified construction,

2. It would be adapted to high production methods.

The materials considered were steel, aluminum and magnesium. Steel sheet, while possessing high strength properties and ease of fabrication, would have weight disadvantages if used in thicknesses sufficient to prevent denting. Aluminum has been successfully adapted to luggage use and magnesium had not been so adapted so it was decided to investigate the possibilities of magnesium as a luggage material. The weight-stiffness ratio of magnesium permits fabrication in magnesium with thicker sections for the same or lighter weight.

The obvious form in which to use magnesium for luggage is in sheet. The sheet may be formed and the edges welded by helium arc or riveted. This method is used on a set of magnesium luggage which has gone into production recently. The sheet edges are riveted to cast corner posts.
PROPERTIES OF MAGNESIUM ALLOY DOW FS-la

Composition of Magnesium Alloy Dow FS-la:

2.5	to	3.5
		0.20
0.7	to	1.3
		0.30
		0.05
		0.005
		0.005
		0.3
	Rer	nainder
	2.5	2.5 to 0.7 to Ren

Tension:

Ultimate Strength Typical Spec. Min.	37,000 32,000	psi psi
Yield Strength* Typical	22,000	psi
Elongation in 2 inches Typical Spec. Min.	219 129	1010
Compression Yield Strength*	16,000	psi
Shear Ultimate Strength	21,000	psi
Hardness Brinell 500 kg Load 10 mm Ball Rockwell E	56 67	
Endurance Limit 500 x 10^6 Cycles	12,000	psi
Specific Gravity	1.77	
Weight - pounds per cu. in.	0.064	
Melting Point	1160 [°]	F

* The stress at which the stress-strain curve deviates 0.2% from the modulus line.

Another method of utilizing sheet is to obtain the form desired by drawing. Magnesium alloy sheet, when heated, permits drawing to luggage depths in a single draw. This offers to the designer the inducement of low handling costs and though die costs may be high they would be absorbed in a large run without adding an excessive amount to each piece.

Finishes for Magnesium

There are various types of finishes available to the designer for use on magnesium alloys each well suited to a particular purpose - they are

> Mechanical Chemical Electro-chemical Electroplated Painted.

Of the mechanical finishes, polishing and buffing can be used to produce an attractive bright metallic luster on magnesium. If protected with a clear lacquer, this type of application finds a field in decorative finishes. Sand and shot blasting, scratch brushing and similar finishes may also be used for special effects.

Electro-chemical or chemical treatment of magnesium will not produce coatings of hardness comparable with anodized aluminum. They do produce protective coatings in neutral shades that may be colored by organic dyes.

Some electroplating has been done but it is still in the process of development. Chromium plating of magnesium is not commercially available at the present time although some work is being done on it by Dow.

Painted finishes offer a wide range of possibilities on magnesium. The appearance and sales appeal of magnesium alloy articles can often be enhanced through the use of novelty finishes by means of which many interesting effects are obtainable. Although the term "novelty" might imply a lack of durability, many of these finishes have a permanent place in the field of metal finishing and provide good protection as well as appearance. These materials very often reduce finishing costs since their natural roughness obviates the necessity for surfacing and sanding operations so often required in gloss enamel finishes. Many novelty finishes are self-performing and yield crystallized, cracked, checkered, mother-of-pearl, leather, hammered metal or wrinkled effects without further treatment.

Baked Japan and color coats are used for various kinds of product finishing. The materials are available in different lusters varying from flat to high gloss. Rapid finishing, excellent adhesion and good wear resistance are some of the advantages of baked finishes and a clear finish applied to the luggage designed would enhance the sales appeal of the luggage and aid in conveying the factor of lightness to the consumer.

A study was made of various coatings applicable and the most promising seemed to be a melamine formaldehyde alkyd resin type.

Melamine resin adds durability to alkyd coatings as well as other desirable features of shorter baking schedules, harder films, better wear and chemical resistance. Melamine resins are unique in this respect; they are the only hard resins which actually improve the durability of the alkyds.

No published data of melamine coatings on magnesium were available so a study was made of a melamine-alkyd resin. The study follows:

Test of Melamine Baking Finish

A melamine baking finish (SV 142 Leon Finch Co.) composed of 25 percent melamine resin and 75 percent alkyd resin in Butanol was studied on magnesium.

In a preliminary test magnesium sheet samples were alkaline cleaned in a solution whose composition was

Trisodium Phosphate	4 oz.
Sodium Carbonate	4 oz.
Soap	el oz.
Water	to make a gallon.

The bath was maintained at 180-210° F and the samples were immersed 5 to 10 minutes. After the alkaline cleaning the samples were rinsed and immersed in a bright pickle solution whose composition was

Chromic Acid	1.5 pounds
Magnesium Nitrate	4.0 ounces
Calcium Fluoride	0.75 ounces
Water	to make a gallon.

The samples were immersed from 2 to 5 minutes in the solution then thoroughly rinsed and dried.

After painting with the melamine finish, the samples were air dried for 45 minutes and baked at $250-275^{\circ}$ F. for one hour.

N°1 to N°22 These preliminary samples, were used in order to develop a technique in acid treating, spraying and

baking. The treatment given each of the twenty-one samples is given in the appendix.

The chemically treated samples produced unsuitable finishes and it was decided to use mechanical cleaning and surface preparation.

Samples 4 in. x 4 in. of .072 in. sheet were prepared with a $\frac{1}{4}$ in. hole drilled in the center. Mill scale and surface imperfections were removed by the use of emery paper followed by a bright buffing on a cloth wheel. A satin brushed finish was then applied with fine emery paper. The buffing compound and surface dirt was removed by cleaning twice in acetone followed by rubbing with a clean dry cloth.

The samples were then spray painted with the melamine resin, following which they were air dried for 45 minutes, then baked at $250-275^{\circ}$ F for 60 minutes. The samples were then weighed on a laboratory precision balance and run for 1,000 cycles on the Taber Abraser with a 1,000 gram weight on each CS-10 wheel. At the completion of the test the samples were again weighed and the loss in weight is shown in Table IV and summarized below: Sample Nol. Loss in weight

25	TD*D	шg
26	14.0	mg
27	18.0	mg
28	16.0	mg
29	18.0	mg



MAGNESIUM SAMPLES ON RACKS PREPARATORY TO SPRAYING



MAGNESIUM SAMPLES ON RACKS FOR BAKING FIG. 1



TABER ABRASER IN OPERATION



SAMPLES SHOWING ABRADED RINGS FIG. 2

These values show a loss of approximately one-half that of a baked enamel (Sample D, Appendix F) and one half that of uncoated magnesium.

In order to determine approximately what thickness of the coating is worn off in 1,000 cycles. The middle of the path over which the abrading wheels would travel as measured and marked on the back of the sample. Four marks were made on this path 90° apart and by means of micrometer calipers the thickness of sheet and coating before abrasion was measured at each point. After abrasion the total thickness at each point was again measured. From these measurements, as shown in Table V, an approximate decrease in coating thickness in 1,000 abrasion cycles was obtained. An average decrease would be about 0,0007 in. but the large decrease in sample No. 27 cannot be explained.

Samples of thin sheets to which the resin had been applied have been bent through 90⁰ and returned to their original shape with no tendency to chip or flake off indicating good adhesion to the metal.

The study of various alkyd-melamine combinations to find the one possessing, in the highest degree, all the required properties must be left to another study. This type of resin combination appears to be

TABLE IV

LOSS IN WEIGHT DUE TO ABRASION

Sample Number	Weight Before* Abrading (grams)	Weight After* Abrading (grams)	Loss in Weight (grams)	<u>Loss(mg</u>) 1,000 cy.
25	35.3355	35.3200	.0155	15.5
26	35.3635	35,3495	.0140	14.0
27	35,5825	35,5645	.0180	18.0
28	36.0210	36.0050	.0160	16.0
29	36.0165	35.9985	.0180	18.0

* Weights shown include weight of copper hook (0.5585 gms) by which samples were held in balance.

TABLE V

DECREASE IN COATING THICKNESS IN INCHES FOR 1,000 ABRASION CYCLES

			-		
Point of Measurement*	No.25	No.26	No.27	No.28	No.29
90 [°]	.0007	.0007	.0011	.0007	<i>。</i> 0 0 04
180 [°]	•0004	.0006	.0011	.0013	.0007
270 ⁰	。0006	.0007	.0007	<i>_</i> 0006	.0005
360 ⁰	.0007	ø0008	.0011	.0005	.0009

* 0^oand 360^o line was arbitrarily chosen as the line between the center hole and small hole at the top of the sample. The angles are measured clockwise from this line.on the back of the plate.

Sample

well suited for use on magnesium luggage because it not only protects the magnesium from corrosion but possesses the additional characteristics of adhesion, resistance to abrasion, color retention and resistance to water spotting and chemicals.

DESIGN SOLUTION

In the solution of the luggage problem, the designer has the Market and Consumer Surveys and the Material Research and must from these and from rational considerations produce an effective and pleasing design.

From market survey and consumer survey, the designer concludes what the trade and consumer like and dislike about present luggage. The materials research determines the advantages and limitations of his materials. In the rational considerations of functional, psychological and aesthetic factors, the designer opens the way to new ideas.

Rational Considerations in Luggage Design

a. Functional Factors:

A piece of hand luggage must have:

1.	Capacity	Sufficient to carry the clothes and articles for which it was made.
2.	Protection	For the contents from the elements and dirt.
3.	Convenience	In carrying; to fill and empty; to open and close; to stow in carriers, cars, luggage racks, etc.

4.	Strength	To resist damage to con- tents; to case itself;in handles and fittings.
5.	Durability	To resist wear.
Psycholog	ical Factors:	
Its app	earance should sugg	est:
6.	Its function	By showing the factors listed under a. It must appear to be a piece of luggage.
7.	Lightness	To as great a degree as possible without compro- mising its appearance of strength and durability.
8.	Convenience	Inuse - functional conven- ience alone is not enough, it must seem convenient also.
9.	Security	It must seem strong.
10.	Suitability	For use by men and women - in a single line it should appeal to both men and women.
Aesthetic	Factors:	

In appearance it should be:

11. Pleasing in appearance - Of good taste in materials and color appealing to pride of ownership.

12. Simple straightforward use of materials devoid of applied ornamentation.

Design of Basic Shape

b.

C.

1. Luggage is essentially a container to hold clothes and accessories used in travel and at destination.

- 3. Containers suitable for other articles are boxes.
- 4. The bag has resilience but when subjected to prolonged pressure garments will wrinkle.
- 5. The box will resist crushing but is weak at the flat sides and corners.
- 6. Both of these considerations can be minimized by a box with rounded edges

a) sides may be arched b) the corners rounded.

- 7. As an alternative to the above, the structure may be made of thicker section and the corners reinforced from within and protected with outside corner pieces (as in trunks and leather luggage.)
- 8. Internal bracing decreases capacity and may add to weight.
- 9. External bracing, unless carefully faired in to main structure, presents opportunity for broken up appearance and production difficulties.
- 10. Rounded sides seem preferable from structural point of view.
- 11. Rounded corners and edges decrease the volume of the case.
- 12. The loss in capacity is not directly proportional to the loss in volume as would be the case if sharp cornered objects were to be packed in the case since clothes and accessories will conform to the rounded corners.
- 13. The basic shape then is an arched box with rounded edges and corners.

MATERIALS

- 1. Metallic materials like magnesium sheet are suitable for luggage when
 - a) formed b) drawn
- 2. Drawing possesses the following advantages:
 - 1. Fewer production steps involved, 2. Closer finished tolerances possible,
 - 3. More unified structure,
 - 4. Welding and riveting avoided with improved finished appearance.
- 3. The basic shape derived from rational considerations is well adapted to production by drawing.

We have derived a basic shape as a starting point and drawing of sheet as a means of fabrication.

SIZE

The size of existing luggage by test and by consumer preference in adequate to its function so the basic sizes should not depart too far from this.

The tendency to make the luggage narrower to stay close to the body seriously limits capacity and efforts to offset this by increasing height or width makes the bag less convenient to control while walking.

A consideration of the functional uses and advantages and shortcomings of present sizes determine the sizes for the luggage designed and a nine piece set will be in the following sizes:

Length	Height	Width
--------	--------	-------

1.	Lady's 21" Overnighter	21	131	7
2.	Lady's 18" Overnighter	18	13	6글
3.	Lady's 21" Wardrobe	21	17	9
4.	Lady's Traincase	13	7불	9
5.	Lady's Hat & Shoe Box	18	18	11
6.	Pullman Case	26	16	8클
7.	Man's Two-suiter	24	18늘	8
8.	Man's 21" Overnighter	21	14	7
9.	29" Wardrobe	29	16	9

HANDLE

The handle of a piece of luggage is possibly the most important single factor in its design because it is

Functionally	63874	the longest sustained point of contact with the user.
Aesthetically	-	it is the focal point of attention in observing a bag.

It is necessary that the designer consider

all of the factors in handle design such as

1. Comfort of grip:

a) Is cross section adequate to

- 1) Conform to hand under load,
- 2) Suit long and short fingers,3) To enable fingers to close
- proper degree long finger nails of women.
- b) Is the length correct

 - 1) To fit a large hand, 2) To center hand in handle
 - 3) For use with gloves.
- c) Are there ridges or seams to rub or cause discomfort.

- d) Is the material of handle best suited for tactile qualities.
- e) Is material suitable in warm or cold climates.
- f) Does it have the required degree of rigidity or resilience.
- 2. Handle Strength:
 - a) Does it have required strength to carry the load.
 - b) Is it capable of withstanding hard usage.
- 3. Handle Suspension:
 - a) Does it facilitate control of the bag in use.
 - b) Is it designed to carry load and stand wear.
 - c) Does it permit handle to lay flat on bag.
 - d) Is it in the way when bag is being filled or emptied.
 - e) Is its shape such that it will damage other bags that may be rubbed against it.

Psychological Factors

- 1. Does it look like a handle.
- 2. Does it look comfortable.

3. Does it look strong.

Handles of existing luggage were tried and handles made and teted on a heavily loaded bag. As a result of this handle study one size handle for man's luggage and one size for lady's luggage were designed which conform to the factors discussed above.

An opaque thermoplastic resin was chosen as the handle material because of its light weight, resistance to shock, ease of cleaning, feeling of cleanliness, low cost and ease of fabrication.

Reinforced with a metal strip in which the handle pin bushings are set, the plastic will have the load spread over a larger area and will not be distorted.

Handles and loops are one of the greatest points of failure in use.

The maximum of protection to handle and loops with the maximum comfort in handle can best be achieved by insetting a hand-fitting handle. This is easiest done in metal luggage - difficult in wooden luggage and impossible in leather type construction. It was decided then to use this type of handle inset, made as a second draw after the case is drawn. The designed inset has been kept to a minimum to maintain bag capacity and facilitate the second draw.

CLOSURE:

The majority of present bags have unsatisfactory systems of closure. Leather bags close by simply overlapping the edges and box frame bags usually have a stepped edge. A tongue and groove type of closure is superior to the above types in that it

- 1. Adds rigidity to the structure which makes bag less liable to damage,
- 2. Maintains catches and locks in alignment,
- 3. Excludes moisture and dust more effectively.

In the magnesium luggage designed, this

closure is composed of two magnesium alloy extrusions and is spot welded to the case with a one in.spot spacing.

HARDWARE:

Hinges: A piano type hinge is used for rigidity and strength.
Catches: The catches and locks are of the conventional type spaced so that the fingers are not struck when the catch is opened, The catches and locks are designed to be harmonious with the case and be of adequate strength. Locks and catches of conventional design, if made of good material, will last the life of the luggage.

Locks and catch troubles arise from poor materials and spot welding the lugs on the catches. Overpacking and misalignment due to a non-rigid case weaken

LINING:

The linings in the man's cases will be of good quality cotton crash in a pale tan tint. The linings of the women's cases will be of heavy rayon in warm brown colors.

locks and catches.

NAME PLATE:

One of the shortcomings of luggage is the lack of adequate means of identification. Loss of bags and delays in delivery are due in part to the absence of the owner's name and address. In the designed bag, a name plate will be located in the handle inset. The plate will be covered with a cap upon which the initials of the owner may be placed.

FINISH

The case will have a scratch brush finish and a clear melamine-alkyd baked coating. This resin combination gives a hard mar-proof surface with adequate protection to the magnesium alloy.

To prevent excessive scuffing and abrasion on the sides, a bead is raised so that if the case should slide along a rack or chute the wear will be taken by the bead rather than the whole surface. It also serves to strengthen the case and relieve the austerity of the lines.

The possibilities of using magnesium alloy sheet for the box and covering the surface with fabric, artificial leather or spun glass cloth were investigated and it was decided that the cost of finishing the magnesium would be less than the cost of the added covering. Also the additional weight to the luggage was considered undesirable. The complete possibilities of covered magnesium luggage might be worthy of exploration by some other designer.





FABRICATION OF THE DESIGNED LUGGAGE

The fabrication of the designed luggage is better suited to a metal product manufacturer than a leather goods or luggage maker as they are tooled at present. Hydraulic presses can be readily adapted for magnesium use by the application of gas heat or electric heat to the dies. The other conventional metal working equipment is readily adapted to use on magnesium.

The literature on the fabrication of magnesium is quite extensive as can be seen from the bibliography.

No purpose would be served in going into the field of magnesium fabrication in this thesis. Only the steps involved in making the designed luggage will be considered.

Each side of the designed case will be drawn in a hydraulic press from .064Dow FS-1a magnesium alloy at 600[°] F. using the same dies for both sides. The handle inset would be shallow drawn in a heated die before the piece cooled from the first draw.

The edge closure will be two extrusions in Dow FS-1 alloy formed hot and spot welded with one inch spacing to the case.

The total weight of the magnesium alloy used in a 21 in. x $13\frac{1}{2}$ in. x 7 in. case of .064 sheet would be



less than six pounds.

The brush finish will be applied after all fabrication is completed. The melamine coating will be sprayed and the case baked by means of infra red lamps.

The lining will be inserted after the handle and hardware have been installed.

Design Calculations:

In order to determine the thickness of the sheet to be used in the case, the following assumptions are made:

That points of local strain such as the handle supports can be reinforced by small backing plates leaving the large areas of the sides as the weak point. Severe or unusual strains such as dropping from a 15 foot height or impact against a sharp object are not considered as normal loads and must be neglected. The stacking of other bags on the designed bag is normal however and in use as many as five bags may be stacked upon a single bag. The weakest point for this type of load is the sides of the bag and the deflection of the center of this area will determine the thickness of the sheet to be used. No formula has been found to exactly suit the designed shape. The formula given by Timoshenko* for a flat plate with fixed edges and uniformly loaded is the closest approximation. The area considered is that within the bead on the largest case (a = 15 in. b = 17 in.) The load applied is assumed as 150 pounds or that caused by the weight of five thirty pound cases.

Timoshenko's formula is

$$(w)_{max} = 0.0164 \frac{qa^4}{Eh^3}$$

for materials whose Poisson's ratio $-\sqrt{-0.3}$ and whose ratio of sides b/a = 1.1where

$$(w)_{max} = \frac{0.0164 \times \frac{150}{255} \times 50,620}{6.5 \times 10^{6} \times 0.64^{3}} = 0.288 \text{ in.}$$

The maximum bending stress is well within the elastic limit as shown by the following:

* "Theory of Plates and Shells" Chapter VI, pg. 229

The equation for the maximum bending moment as given by Timoshenko is

$$M = .0581 \text{ qa}^2$$

from which

$$S = 0.187 \frac{qa^2}{h^2} = Maximum unit stress$$

 $S = 0.187 x \frac{\frac{150}{255} x 255}{064^2} = 6030 \text{ psi}$

which is within the elastic limit. The .064 in. sheet will weigh 25 percent more than 0.051 in. sheet but will show only half as much deflection.

Before investing in dies a shape as close as possible to the designed bag should be made of 0.064 in. sheet and tested under load to find the actual resistance not only in bending but to impact also.

DESIGN SUMMARY

The designed luggage will be made from .064 in. magnesium alloy sheet drawn to form the case and will be finished in a clear melamine resin. A man's 24 in. x 18 in. x 8 in. two-suiter has been fully developed as a model for the complete set.

The salient features of the designed luggage may be enumerated as follows:

- 1. It is designed for mass production.
- 2. An attractive appearance is achieved in the clean direct use of the material and a feeling of lightness suggested in the form of the case.
- 3. It is designed for durability.
- 4. The inset handle protects a most vulnerable point in the luggage.
- 5. The edge closure gives the case rigidity and protects the contents.
- 6. The handle is designed for ease in carrying and control of the bag.
- 7. It is suitable for use by men and women.
- 8. The incorporated name plate assures return to the owner when misdirected.

The designer has made an attempt to use magnesium for a purpose to which it is suited by its unique physical properties and to fabricate it in a manner to best take advantage of these properties in luggage use. The often repeated "Form Follows Function" finds an illustration in this design which depends for its appearance on its form and the metallic quality of the material. A piece of luggage lasts about eight years in service and an effort has been made to avoid faddish or transient styling, and to design a bag that is distinctive and useful.

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APPENDIX

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Table of Contents of Appendix	A
Bibliography	В
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Correspondence	D
Treatment of Preliminary	
Samples	F

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J. G. McGowan	American Magnesium Company Los Angeles
Charles Miller	Northrup Aircraft Corp. Hawthorne, California
Orville Shantz	Gump's, Pasadena
C. D. Dickson	Sears Roebuck & Company Los Angeles
J. L. Harris	Bullock's, Los Angeles
R. D. Herbold	Herbold's, Pasadena
Leo Garfield	Broadway Luggage Shops Pasadena
G. A. Casto	The May Company,Los Angeles
M. P. Livingstone	General Baggage Agent Los Angeles Union Depot
J. N. Stone	American Cyanamid Company Azusa, California
L. Cota	Leon Finch Company Los Angeles
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Maurice Levitan	Exec.Şecty.,Luggage & Leather Goods Mfgrs. Ass'n,220 5th Ave.,New York City

MANUFACTURERS

Hartman Company	Racine, Wisconsin
Oshkosh Trunk &	
Luggage Co.	Oshkosh, Wisconsin
Wheary Company	Racine, Wisconsin
Independent Trunk	
& Bag Company	Petersburg, Virginia
U.S.Luggage &	
Leather Products	29 West 34thSt., New York City
Schwayder Bros.	4270 High St., Encorse Sta., Detroit, Mich.

HARDWARE

The Excelsior Hardware Co.Stamford, Conn.Horn Luggage Div.RiceStixCo.St. Louis, Mo.Milwaukee Stamping Co.816 So. 72nd StreetNational Brass Co.Stamford, ConnYale & Towne Mfg. Co.Grand Rapids, Mich.Yale & Towne Mfg. Co.Stamford, ConnAmerican Hardware Corp.New Britain, Conn.Brainerd Mfg.Co.East Rochester, N.Y.North & Judd Mfg. Co.New Britain, Conn.Eagle Lock Co.Terryville, Conn.

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PREPARATION OF PRELIMENARY SAMPLES

	Sample Preparation					Abrasion	Test	
Sample No.	Buffed	Brushed	Alk. Clean	Pickled Time(Min)	Baked275 ⁰ Time(Min)	Wt.Loss Mg	Cycles	Loss mg/ 1000cy.
1. 2. 3.	x x x		x	ର ଜ ଜ ଜ ଜ	60 60 40	25 20 12	$1400 \\ 600 \\ 300 \\ 700$	18 33 40
4° 5°	x x	x		2	60 40 60	13 10	800 500	16 20
7. 8.	Reject	ted x	77	72	60	11	400	27
10. 11.	x	x	A	ð	60 40	16 31	700 1600	23 19
12.	x x			2	60 60	10 26	300 1600	33 16
14. 15. 16.		x x	x	ະ 2	60 40 60	15 25 16	1000 1000 300	15 25 53
17. 18.	x x				60 100	17	1100 600	15
19. 20. 21.	, x , x Rejected				60 80 60	12 15	700 1900	17 8
22. D	Steel	0.11.0		-)	60	52 22	1700 600	31 37
Mag. (Back of #4 buffed only)						44	1000	44

All samples air dried 45 minutes before baking.

Melamine Resin, SV142, Leon Finch Company 25% Melamine 75% Semioxidizing Alkyd Resin Butanol Solvent.

Abrasion test on Taber Abraser (Research model) 1000 gram weight on each CS-10 wheel.