D10

N79-31176

FIRE RESISTANT AIRCRAFT SEAT PROGRAM

PRESENTED

AT

JOINT NASA/INDUSTRY STEERING GROUP UPDATE
AND REVIEW MEETING March 1 & 2, 1979

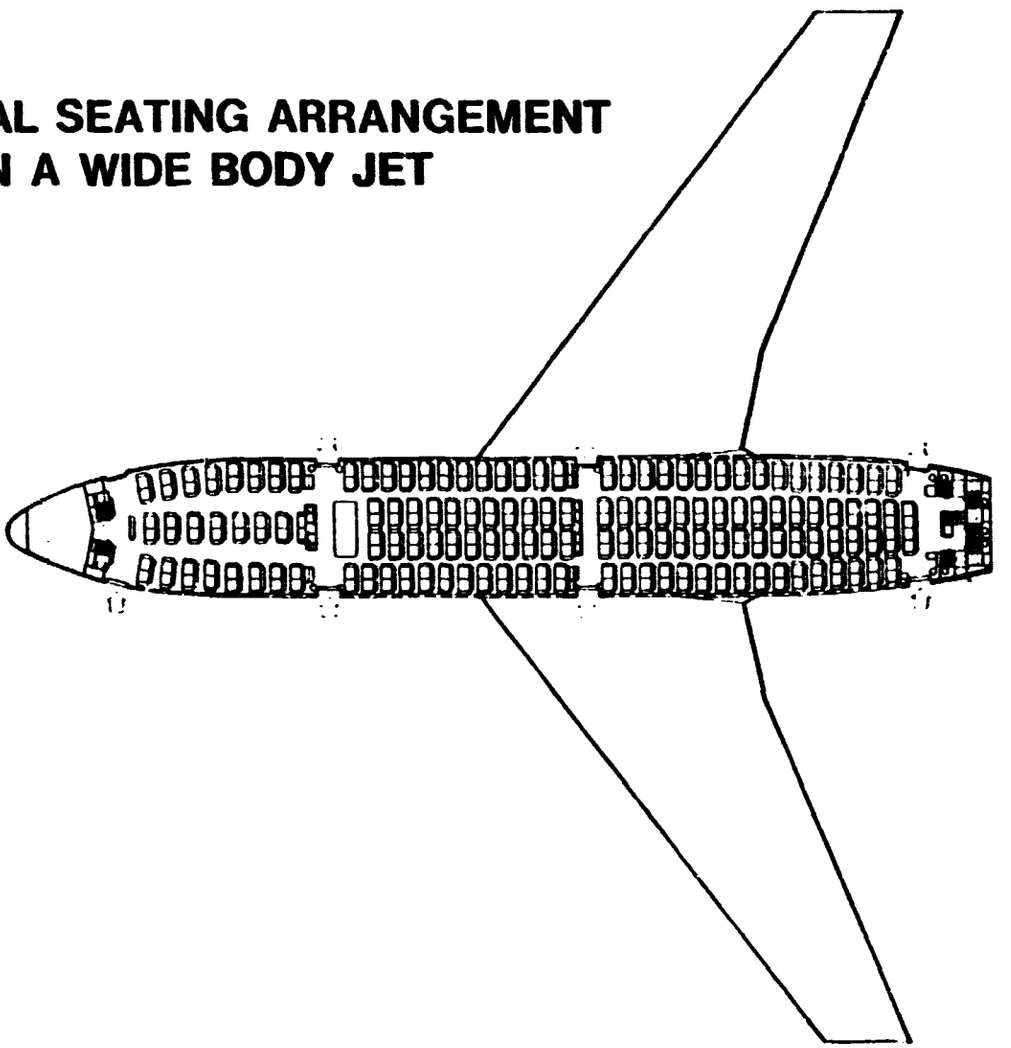
Larry L. Fewell

Project Director

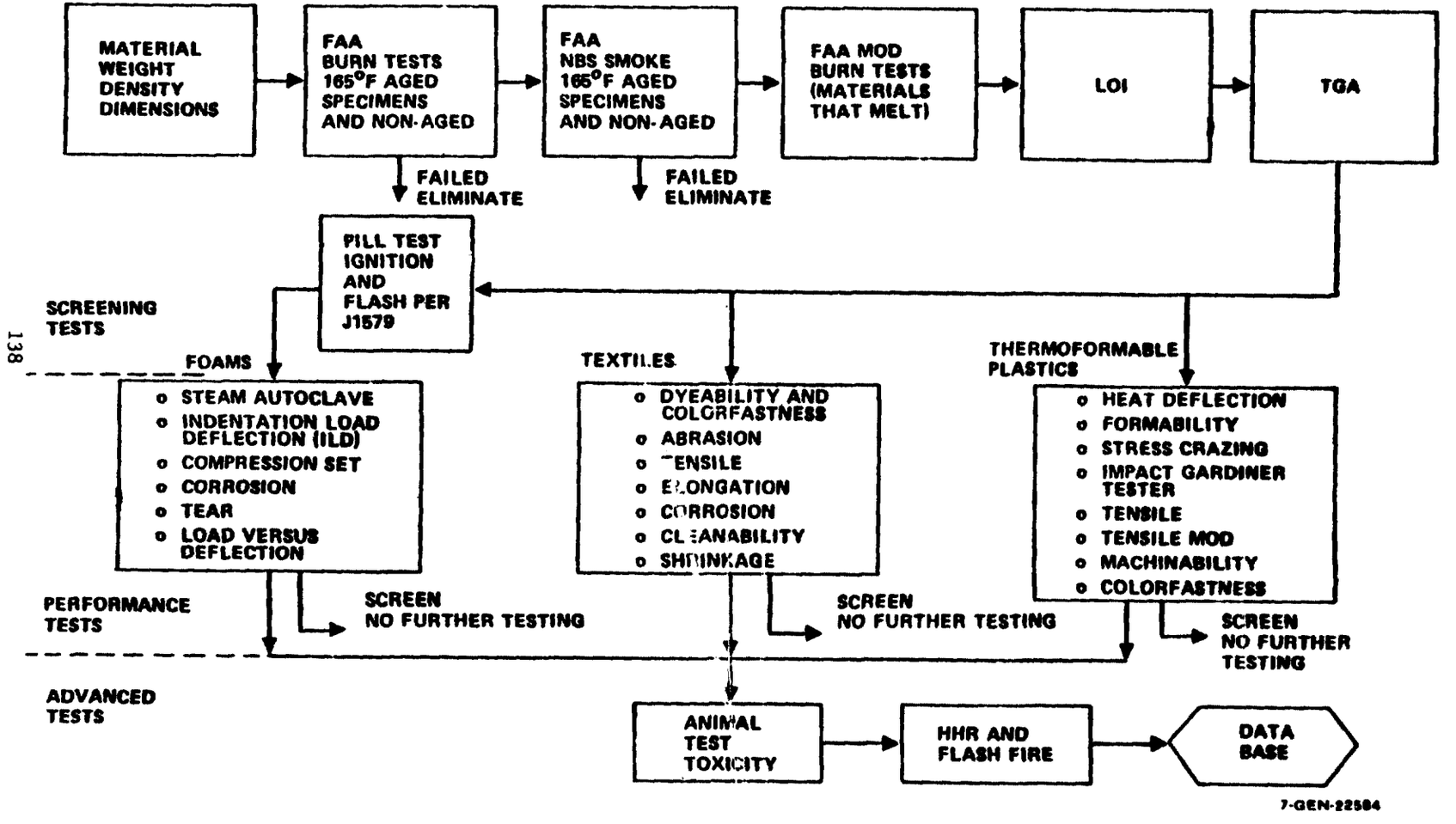
FIRE RESISTANT AIRCRAFT SEAT MATERIALS

LARRY L. FEWELL
PROJECT DIRECTOR

TYPICAL SEATING ARRANGEMENT ON A WIDE BODY JET

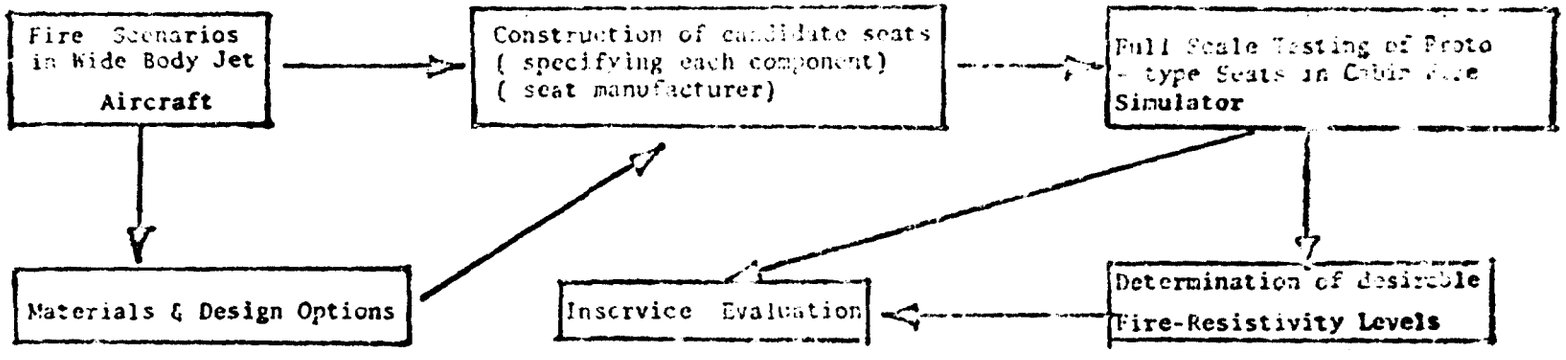


PHASE I MATERIAL TEST PROGRAM

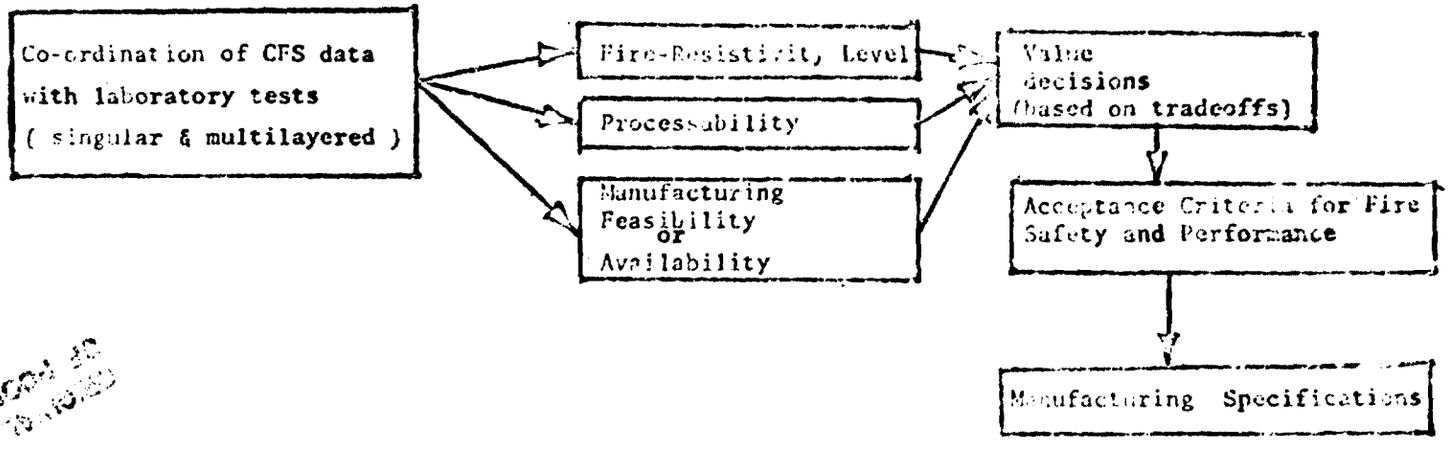


FIRE - SAFE AIRCRAFT SEAT PROGRAM

Phase II



Phase III



CANDIDATE MATERIALS TESTED

MATERIAL NUMBER	PRODUCT NUMBER	MATERIAL DESCRIPTION	TRADE NAME	SUPPLIER
100	ST7193-29	100% NYLON, AIRGARD TREATED 11.4-12.6 OZ/YD^2 LANDSCAPE FABRIC	LANDSCAPE	COLLINS & AIKMAN CORP.
101	20787	52.5% KERMEL/47.5% WOOL 277 gm/m^2	–	H. LELIEVRE, PARIS
102	OL618	100% COTTON DOUBLEKNIT 10 ± 5% OZ/YD^2 (LI SPEC 33)	–	LANGENTHAL INTERNATIONAL CORP.
103	69-407	100% NOMEX 8.4-9.7 OZ/YD^2 TULSA (DRAPERY FABRIC)	TULSA	COLLINS & AIKMAN CORP.
*104	ST7427-112	90% WOOL/10% NYLON FABRIC 12.2 TO 14.0 OZ/YD^2 SUN ECLIPSE	SUN ECLIPSE	COLLINS & AIKMAN CORP.
105	7979	50% KYNOL/50% NOMEX 10.7 OZ/YD^2 FABRIC	"NO BURN" FABRIC	COLLINS & AIKMAN CORP.
106	NYLON GOLD 1902	NYLON GOLD/VONAR 3 NEOPRENE FOAM BACKING	–	DUPONT DE NEMOURS
107	URETHANE COATED NYLON	URETHANE ELASTOMER COATED NYLON FABRIC	–	REEVES BROTHERS
108	NO. 300 COTTON KNIT FABRIC	COTTON KNIT FABRIC, COLOR 23 JASMIN	–	LANGENTHAL INTERNATIONAL CORP.
109	NO. 340 COTTON KNIT FABRIC	COTTON KNIT FABRIC SQUARE KNIT	–	LANGENTHAL INTERNATIONAL CORP.
110	2069	KERMEL 39%/WOOL 61%, COLOR 2 ROUX FABRIC 575 g/m^2	–	H. LELIEVRE, PARIS

CANDIDATE MATERIALS TESTED (CONT'D)

MATERIAL NUMBER	PRODUCT NUMBER	MATERIAL DESCRIPTION	TRADE NAME	SUPPLIER
200	NO. 24	100% KYNOL FABRIC TWILL WEAVE	KYNOL	AMERICAN KYNOL, INC
201	NO. 1110	70% KYNOL/30% NOMEX PERMANENT PRESS FINISH 6.2 OZ/YD^2	KYNOL	AMERICAN KYNOL, INC
202	NO. 1090	70% KYNOL 30% NOMEX 4.6 OZ/YD^2 WITH PERMANENT PRESS FINISH	KYNOL	AMERICAN KYNOL INC
203	B-104S	100% KYNOL BATTING ON POLYESTER SCRIM-NEEDLE PUNCH	KYNOL	AMERICAN KYNOL, INC
204	40-9010-1	PBI FABRIC NATURAL UNSTABILIZED 5.1 OZ/YD^2 2 x 1 TWILL	–	CELANESE FIBERS MARKETING CO.
205	40-4010-1	PBI BATTING 4 OZ/YD^2 NATURAL UNSTABILIZED FROM STAPLE	–	CELANESE FIBERS MARKETING CO.
206	35-4020-1	BLACK BATTING 4 OZ/YD^2 (PROPRIETARY)	–	CELANESE FIBERS MARKETING CO.
207	KYNOL ON REMAY SCRIM BATTING	REMAY SPUN BONDED POLYESTER FABRIC NEEDLED WITH 100% KYNOL FIBER ..8 OZ/YD^2	"FLAMEOUT"	DAN RIVER, INC
208	NEOPRENE FOAM	1/16 IN. NEOPRENE FOAM WITH 1-2 OZ/YD^2 COTTON SCRIM	VONAR NO. 1 INTERLINER	DUPONT DE NEMOURS
209	NEOPRENE FOAM	2/16 IN. NEOPRENE FOAM WITH 1-2 OZ/YD^2 COTTON SCRIM	VONAR NO. 2 INTERLINER	DUPONT DE NEMOURS

CANDIDATE MATERIALS TESTED (CONT'D)

MATERIAL NUMBER	PRODUCT NUMBER	MATERIAL DESCRIPTION	TRADE NAME	SUPPLIER
210	NEOPRENE FOAM	3/16 IN. NEOPRENE FOAM WITH 1-2 OZ/YD^2 COTTON SCRIM	VONAR NO. 3 INTERLINER	DUPONT DE NEMOURS
211	NYLON GOLD 1902	SEE NO. 106		
212	UPHOLSTERY FABRIC	DURETTE UPHOLSTERY FABRIC	DURETTE	FIRE SAFE PRODUCTS
213	SE5559	ELASTOMER, SILICONE RUBBER S.G. 1.33	-	GENERAL ELECTRIC (WATERFORD, NY)
214	NOMEX III	ARAMID FABRIC	NOMEX III	DUPONT DE NEMOURS & CO.
215	KERMEL	KERMEL FABRIC 250 gm/m^2 AMIDE-IMIDE	KERMEL	RHODIA, INC
216	400-11	DURETTE BATTING	DURETTE	FIRE SAFE PRODUCTS
217	400-6	DURETTE DUCK 4.4 OZ/YD^2	DURETTE	FIRE SAFE PRODUCTS
218	410-13	DURETTE DUCK BLACK	DURETTE	FIRE SAFE PRODUCTS
219	400-37	DURETTE TWILL	DURETTE	FIRE SAFE PRODUCTS

CANDIDATE MATERIALS TESTED (CONT'D)

MATERIAL NUMBER	PRODUCT NUMBER	MATERIAL DESCRIPTION	TRADE NAME	SUPPLIER
220	35-4025	PREOXIDIZED BATTING 400-8		CELANESE FIBER MARKETING CO
221	S470	NOMEX III DUAL FABRIC, NATURAL 7.5 OZ/YD^2		SOUTHERN MILLS, INC SENOIA, GA
222	40-9031-2	WOVEN PBI FABRIC HEAT STABILIZED 4.2 OZ/YD^2, 2 x 1 TWILL MADE FROM THERMALLY STABILIZED PBI YARN		CELANESE FIBER MARKETING CO

CANDIDATE MATERIALS TESTED (CONT'D)

MATERIAL NUMBER	PRODUCT NUMBER	MATERIAL DESCRIPTION	TRADE NAME	SUPPLIER
300	FG215	GLASS FIBER BLOCK CUSHION EDGE GRAIN BLOCKING OF GLASS FIBERS	–	EXPANDED RUBBER AND PLASTICS CORP.
301	R-207080	APN PHOSPHAZENE OPEN CELL FOAM 0.14 g/cc	APN FOAM	FIRESTONE TIRE & RUBBER CO.
302	9907-13	URETHANE FOAM, FLEXIBLE	HYPOL	W. R. GRACE & CO.
303	EXP1408	SILICONE RUBBER SPONGE 11 LB/FT^3	–	KIRKHILL RUBBER COMPANY
304	14183-B	SILICONE RUBBER SPONGE 11.8 LB/FT^3	MOSITES	MOSITES RUBBER CO., INC.
305	NO. 510	SILICONE RUBBER SPONGE 0.21 gm/cc	–	SILICONE ENGINEERING LTD. ENGLAND
*306	H-45C	URETHANE FOAM 0.03 gm/cc	–	E. R. CARPENTER CO., INC
307	HL1-7-77	NEOPRENE FOAM, OPEN CELL	–	TOYAD CORP.
308	KAYLON FIRM	NEOPRENE FOAM, OPEN CELL 0.14 gm/cc	KAYLON	UNIROYAL INC.
309	9FR618B	SILICONE SPONGE 9.4 LB/FT^3		KIRKHILL RUBBER

CANDIDATE MATERIALS TESTED (CONT'D)

MATERIAL NUMBER	PRODUCT NUMBER	MATERIAL DESCRIPTION	TRADE NAME	SUPPLIER
310	LS FORMULA T1218	NEOPRENE FOAM 7.5 PCF		TOYAD CORP.
311	3-6551/ 96081/KYNOL	SILICONE FOAM CEMENTED TO KYNOL FABRIC WITH 96-081 ADHESIVE 103 OZ/YD^2		DOW CORNING
312	TOSIL SILICONE	SILICONE FOAM FROM JAPAN (GE AFFILIATE) 18.9 LB/FT^3	TOSIL	GE
313	E-300	URETHANE FOAM, FLAME RETARDED 3.1 PCF	EMPIRE	CREST-FOAM CORP. MOONACHIE, NJ
314	T-47FR	URETHANE FOAM	TEMPER FOAM	EDMONT WILSON REP CMS ASSOCIATES, CMS INC. ENCINO, CA
315	200	POLYIMIDE FOAM NAS 9-15050		SOLAR TURBINES INTERNATIONAL SAN DIEGO, CA VIA NASA HOUSTON

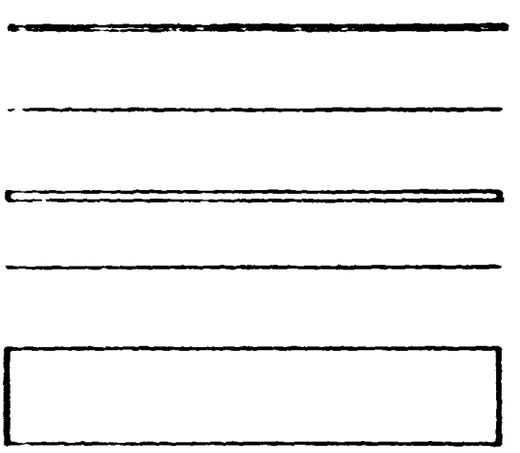
CANDIDATE MATERIALS TESTED (CONT'D)

MATERIAL NUMBER	PRODUCT NUMBER	MATERIAL DESCRIPTION	TRADE NAME	SUPPLIER
400	170	SILICONE ADHESIVE	SYLGARD	DOW CORNING CORP.
401		CARPET MOD ACRYLIC	BRUNSWALL	BRUNSWALL CORP.
402		POLYPHENYLENESULPHONE PPS THERMOPLASTIC	RADEL	UNION CARBIDE
403	57-1825	ABS THERMOPLASTIC SHEET	ROYALITE	UNIROYAL
404	10052-72D	RIGID URETHANE FOAM	HYPOL	W. R. GRACE & CO.
405	885	ADHESIVE	KWIKSTIK	COLUMBIA CEMENT CO., INC. 159 ITANSE AVE. FREEPORT, NY 11520
406	R1275N/F	ADHESIVE		COLUMBIA CEMENT CO., INC. 159 ITANSE AVE. FREEPORT, NY 11520
407	2332 N/F	ADHESIVE (NEOPRENE)	CON-BOND	COLUMBIA CEMENT CO., INC. 159 ITANSE AVE. FREEPORT, NY 11520
408	EC 4715	ADHESIVE	CONTACT BOND	3 MC ADHESIVE, COATING & SEALERS DIVISION
409	RTV 133	ADHESIVE, SILICONE		GENERAL ELECTRIC WATERFORD, NY

MATERIALS DROPPED AS CANDIDATES

	MATERIAL	PROBLEM
(200,201,202)	KYNOL FABRICS	POOR WEAVE AND COLORFASTNESS COLOR AVAILABILITY
(102)	COTTON KNIT	COLORFASTNESS
(103)	NOMEX FABRIC	COLORFASTNESS
(106)	VONAR-BACKED NYLON	NO LONGER AVAILABLE
(107)	URETHANE-COATED NYLON	LOW STRENGTH (TEAR)
(204, 205)	PBI FABRICS	THERMAL SHRINKAGE
(206)	BLACK BATTING 40-4010-1	EXTREME TOXICITY
(207)	KYNOL NEEDLED TO REMAY	THERMAL WEIGHT LOSS
(212)	DURETTE UPHOLSTERY FABRIC	COLORFASTNESS
(215)	KERMEL FABRIC	THERMAL SHRINKAGE
(301)	R-207080 APN PHOSPHAZENE FOAM	LOW STRENGTH
(302)	HYPOL URETHANE FOAM	HIGH SMOKE GENERATION
(304)	14183-B SILICONE FOAM	HIGH HEAT RELEASE
(305)	510 SILICONE FOAM	FAILS BURN TEST
(308)	KOYLON NEOPRENE FOAM	FAILS SMOKE GENERATION

FUTURE SEAT COMPONENTS



DECORATIVE FABRIC COVER

SLIP SHEET (TOPPER)

FIRE BLOCKING LAYER

CUSHION REINFORCEMENT

CUSHIONING LAYER

NOTE: SOME COMPONENTS MAY NOT BE INCLUDED IN ALL DESIGNS

DECORATIVE FABRIC COVER

KEY REQUIREMENTS — *COLORFAST
COLOR AVAILABILITY
RESISTANCE TO IGNITION
LOW FLAME SPREAD
WEARABILITY
LOW TOXICITY
LOW SMOKE GENERATION

CANDIDATE MATERIALS —

(100)	ST-7793-29	AIRGARD-TREATED NYLON	C&A
(101)	20787	KERMEL 47 PERCENT WOOL 53 PERCENT BLEND LELIEVRE	

*GO-NO GO REQUIREMENT

SLIP SHEET

KEY REQUIREMENTS — LOW WEAR
LOW FRICTION
IGNITION RESISTANCE
LOW FLAME SPREAD
LOW TOXICITY
LOW THERMAL SHRINKAGE

CANDIDATE MATERIALS —

(214)	NOMEX III	ARAMID 254 g/m^2	DUPONT
(217)	400-6	DURETTE DUCK	FIRE SAFE PROD.

FIRE BLOCKING LAYER

KEY REQUIREMENTS — BURN RESISTANCE
LOW SMOKE GENERATION
LOW HEAT RELEASE
LOW FLAME SPREAD
LOW TOXICITY
LOW THERMAL CONDUCTIVITY
GOOD CHAR FORMATION

CANDIDATE MATERIALS

(203)	13-104	KYNOL NEEDLE PUNCH BATTING	AMER KYNOL INC.
(210)	VONAR NO. 3	NEOPRENE FOAM INTERLINER	DUPONT
(214)	NOMEX III	NOMEX FABRIC	DUPONT
(216)	400-11	DURETTE BATTING	FIRE SAFE PROD.

CUSHIONING REINFORCEMENT

KEY REQUIREMENT — WEAR RESISTANCE
BURN RESISTANCE
COMPATIBILITY
(i.e., ADHESION STIFFNESS CEMENTABILITY)
LOW TOXICITY

CANDIDATE MATERIALS —

(213)	SE-559	SILICONE ELASTOMER.	GE
(214)	NOMEX III	FABRIC	DUPONT
(217)	400-6	DURETTE DUCK FABRIC	FIRE SAFE PROD.

CUSHIONING

KEY REQUIREMENTS — LOW TOTAL HEAT RELEASE
LOW TOXICITY
LOW SMOKE GENERATION
LOW FLASH PROPENSITY
(LOW WEIGHT LOSS)
● BREAKDOWN RESISTANCE

CANDIDATE MATERIALS —

(30/)	HL 1-7-77 NEOPRENE FOAM	TOYAD CORP.
(300)	FG 215 GLASS FIBER BLOCK	EXPANDED RUBBER
(303)	EXP 1408 SILICONE FOAM	KIRKHILL RUBBER
*	LS NEOPRENE FOAM	TOYAD CORP.
*	9 FR 618 SILICONE FOAM	KIRKHILL RUBBER

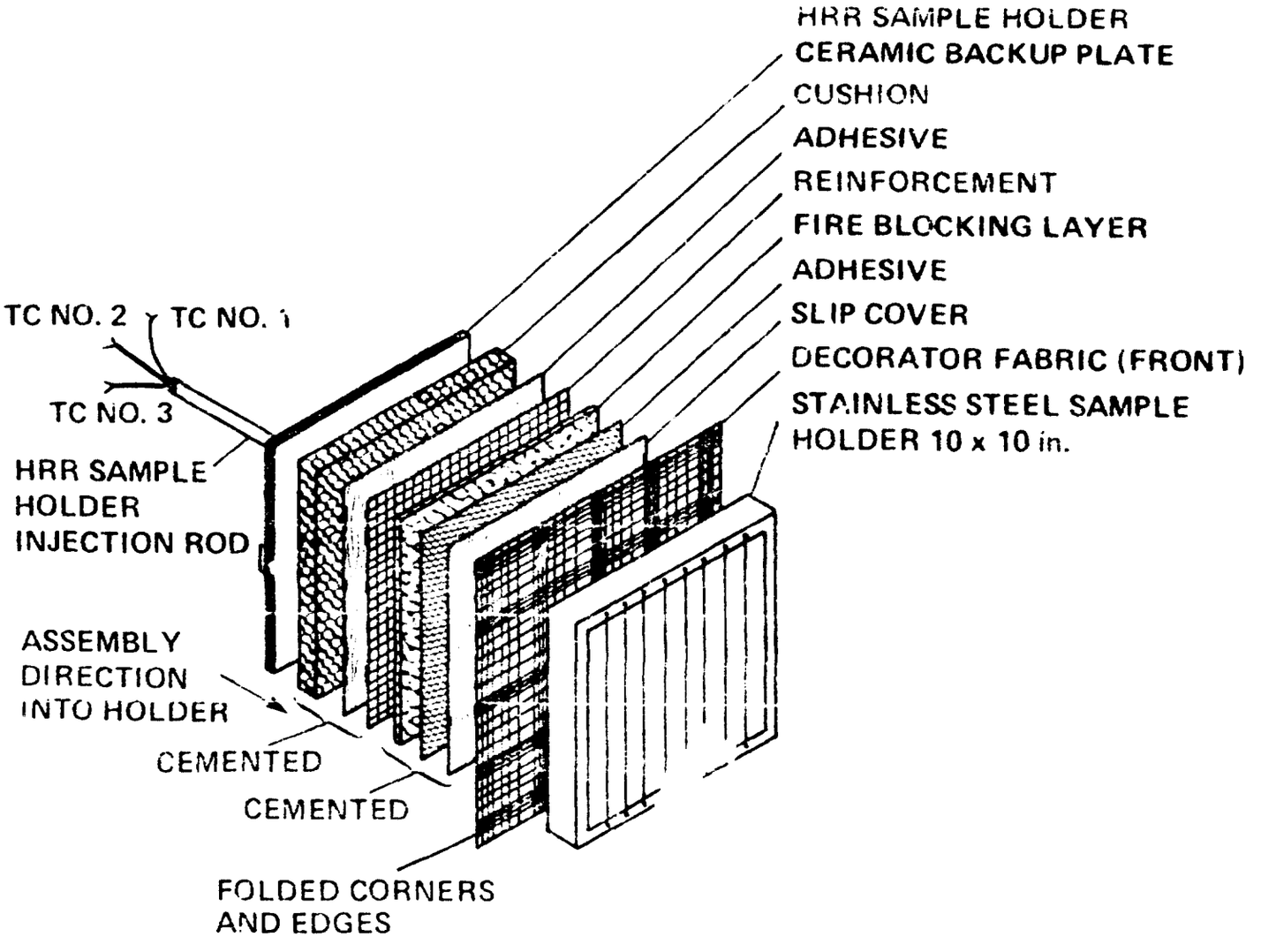
*NOT SCREENED TO DATE

HEAT RELEASE RATE TESTING

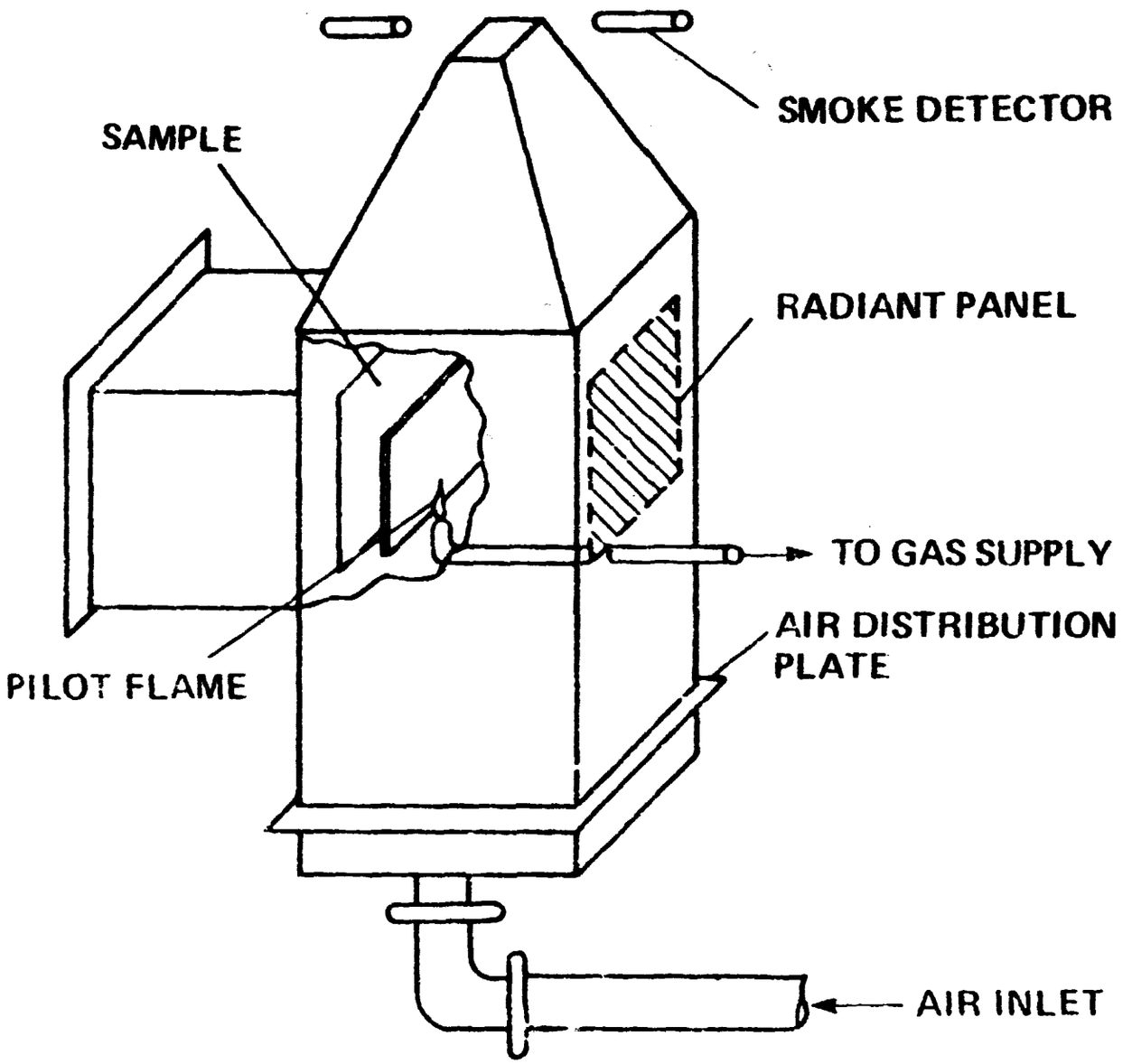
PART 1 STANDARD CUSHION LAYER OF GLASS BLOCKING WITH VARIOUS UPPER LAYERS

PART 2 SELECTED UPPER LAYERS FROM PART 1 WITH VARIOUS CUSHION LAYERS

TYPICAL MULTIPLE LAYER TEST SPECIMEN



OSU HEAT RELEASE APPARATUS



MATERIALS UTILIZED IN THE CONSTRUCTION OF MULTILAYER ASSEMBLIES

SAMPLE NO.	SAMPLE FORM	GENERIC NAME	MATERIAL DESCRIPTION	MATERIAL DENSITY	FUNCTION IN MULTILAYER ASSEMBLY
1	FABRIC	AMIDE-IMIDE WOOL	52.5% KERMEL/47% WOOL	290 g/m^2	DECORATIVE COVERING LAYER
2	FABRIC	WOOL/AMIDE	90% WOOL/10% NYLON	457 g/m^2	DECORATIVE COVERING LAYER
3	FABRIC	ARAMID	NOMEX III	254 g/m^2	SLIP COVER CUSHION REINFORCEMENT
4	BATTING	CHLORINATED ARAMID	DURETTE	–	FIRE BLOCKING LAYER
5	FOAM	POLYCHLORO-PRENE WITH COTTON SCRIM	0.475 cm THICK POLYCHLOROPRENE	954 g/m^3	FIRE BLOCKING LAYER
6	DUCK	CHLORINATED ARAMID	DURETTE	–	CUSHION REINFORCEMENT
7	FABRIC	NOVOLOID	KYNOL	213 g/m^2	FIRE BLOCKING LAYER

MATERIALS UTILIZED IN THE CONSTRUCTION OF MULTILAYER ASSEMBLIES (CONTINUED)

SAMPLE NO.	SAMPLE FORM	GENERIC NAME	MATERIAL DESCRIPTION	MATERIAL DENSITY	FUNCTION IN MULTILAYER ASSEMBLY
8	FABRIC		SILICONE ELASTOMER ON GLASS FABRIC	–	CUSHION REINFORCEMENT
9	ADHESIVE		R2332 NF	--	CEMENT
10	ADHESIVE		RTV 133	–	CEMENT
11	FOAM	URETHANE	POLYURETHANE FOAM	0.20 g/cm^3	CUSHION
12	FOAM	GLASS	GLASS FIBER BLOCK CUSHION	0.03 g/cm^3	CUSHION
13	FOAM	IMIDE	POLYIMIDE FOAM	0.06 g/cm^3	CUSHION
14	ELASTOMER	SILICONE	SILICONE RUBBER SPONGE	0.19 g/cm^3	CUSHION
15	FOAM	POLYCHLORO-PRENE	LOW SMOKE NEOPRENE FOAM	0.14 g/cm^3	CUSHION

MULTILAYER MATERIALS WITH GLASS FIBER BLOCK BACKING

ML SPECIMEN NO.	ADHESIVE	FIRE BLOCK	REINFORCEMENT	ADHESIVE
1	R2332NF	B1045 KYNOL	NOMEX III	SAME
2	R2332NF	B1045 KYNOL	DURETTE DUCK 400-6	SAME
3	R2332NF	B1045 KYNOL	SE5559 ON GLASS FABRIC	RTV 133
4	R2332NF	VONAR #3	SE5559 ON GLASS FABRIC	RTV 133
5	R2332NF	VONAR #3	NOMEX III	SAME
6	R2332NF	VONAR #3	DURETTE 400-6	SAME
7	R2332NF	DURETTE BATT 400-11	SE5559 ON GLASS FABRIC	RTV 133
8	R2332NF	DURETTE BATT 400-11	NOMEX III	SAME
9	R2332NF	DURETTE BATT 400-11	DURETTE DUCK 400-6	SAME

ALL ML SPECIMEN CONTAINED 52.5% KERMEL WOOL BLEND WITH NOMEX III SLIP COVER.

MULTILAYER MATERIALS WITH POLYMERIC FOAM BACKING

ML SPECIMEN NO.	ADHESIVE	FIRE BLOCK	REINFORCEMENT	ADHESIVE	CUSHION
10*	–	–	–	R2332NF	URETHANE FOAM H45C
11@	–	–	–	R2332NF	URETHANE FOAM H45C
12	R2332NF	DURETTE BATT 400-11	NOMEX III	SAME	POLYIMIDE FOAM
13	R2332NF	DURETTE BATT 400-11	NOMEX III	SAME	SILICONE FOAM
14	R2332NF	DURETTE BATT 400-11	NOMEX III	SAME	AL S-NEOPRENE FOAM
15	R2332NF	DURETTE BATT 400-11	NOMEX III	SAME	AL S-NEOPRENE FOAM CORED
16	R2332NF	DURETTE BATT 400-11	NOMEX III	SAME	ALS NEOPRENE FOAM
17α	–	VONAR =3	NOMEX III	R2332NF	POLYIMIDE FOAM
18α	–	VONAR =3	NOMEX III	R2332NF	SILICONE FOAM
19α	–	VONAR =3	NOMEX III	R2332NF	AL S-NEOPRENE FOAM
20o	–	–	–	R2332NF	URETHANE FOAM H45C
21	R2332NF	DURETTE BATT 400-11	PBI 40-9031-2	SAME	AL S-NEOPRENE FOAM

ML SPECIMENS CONTAINED 52.5% KERMEL/47.5% WOOL BLEND WITH NOMEX III SLIP COVER.

* ML SPECIMEN CONTAINED 90% WOOL/10% NYLON BLEND WITH FLAME RETARDED COTTON MUSLIN SLIP COVER.

@ ML SPECIMEN CONTAINED 52.5% KERMEL/47.5% WOOL BLEND WITH FLAME RETARDED COTTON MUSLIN SLIP COVER.

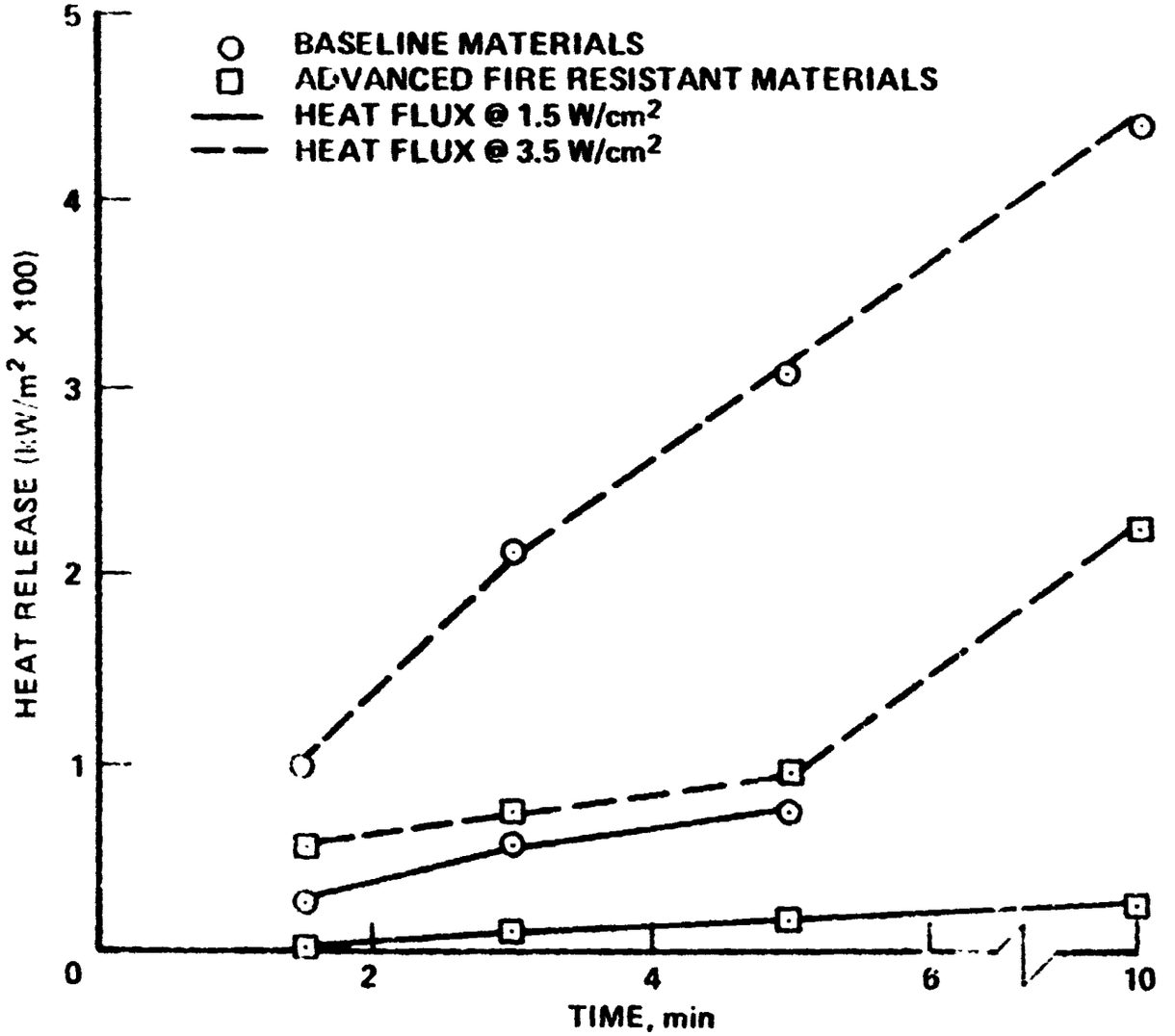
α ML SPECIMEN CONTAINED 52.5% KERMEL/47.5% WOOL BLEND WITH NO SLIP COVER.

o ML SPECIMEN CONTAINED FLAME RETARDED COTTON MUSLIN SLIP COVER.

THERMAL FLUX — HEAT RELEASE

TIME OF EXPOSURE	HEAT FLUX		HEAT FLUX	
	1.5	3.5	1.5	3.5
1.5 MIN	25.7	99	3.7	56.9
3 MIN	57.6	212	10.5	74.1
5 MIN	72.1	319	14.6	93.2
10 MIN	—	438	28.3	220
SPECIMEN NO.	20	10	21	16
DESCRIPTION OF LAYERS				
DECORATIVE	(104)	(104)	(101)	(101)
SLIP COVER	COTTON	COTTON	(214)	(214)
FIRE BLOCK	—	—	(216)	(216)
REINFORCEMENT	—	—	(222)	(214)
CUSHION	(306)	(306)	(310)	(310)

COMPARISON OF HEAT RELEASE FROM ADVANCED AND BASELINE MATERIALS



FIRE SOURCE DETERMINATION

AIRCRAFT SURVEY

AIRLINE TRASH DATA

AIRPLANE: DC-10 DATE: 2-23-78

	BAG 1	BAG 2	BAG 3	BAG 4	BAG 5	BAG 6
AIRCRAFT ORIGIN	CHICAGO	CHICAGO	CHICAGO	LONDON	LONDON	LONDON
SEAT NO./LOCATION	22K AND L/COACH	5K/FIRST CLASS	12D/COACH	UNKNOWN	12B/COACH	28F/COACH
LOCATION RELATIVE TO SEAT	ON FLOOR UNDER AND BEHIND SEAT	ON FLOOR BEHIND SEAT	ON FLOOR UNDER SEAT	UNKNOWN	IN POCKET ON BACK OF SEAT	ON FLOOR IN FRONT OF SEAT
ITEMS COLLECTED	NEWSPAPER – 7 SECTIONS AND ADS	HEADPHONE BAG USED CIGARETTE PACKS NEWSPAPER	2 NEWSPAPERS – ONE WITH SIX SECTIONS – ONE WITH FOUR SECTIONS	2 NEWSPAPERS	2 HEADSET BAGS 1 AIRSICK BAG 1 NAPKIN (COCKTAIL SIZE) 1 AIRLINE MAG	NEWSPAPER – 8 SECTIONS
WEIGHT OF ITEMS	1.44 POUNDS	1.50 POUNDS	2.15 POUNDS	1.52 POUNDS	0.45 POUNDS	1.25 POUNDS

AVERAGE WEIGHT OF ITEMS:
1.385 POUNDS

SUMMARY

- NEWSPAPER WAS THE MOST PREVALENT ITEM ON AIRCRAFT.
- THE MANNER IN WHICH NEWSPAPER WAS FOLDED AND PLACED WILL DETERMINE THE MAGNITUDE AND DURATION OF THE FIRE.
- THE NEWSPAPER IN THE FORM OF A TENT WILL GIVE A REPEATABLE FIRE.
- ONE AND ONE-HALF POUNDS OF NEWSPAPER WILL PROVIDE A MORE SEVERE FIRE THAN 3 POUNDS.