

AD 667718

# NAVAL AIR DEVELOPMENT CENTER

Johnsville, Westminster, Pennsylvania

NADC-AC-6809

9 April 1968

Fleet Evaluation  
Coveralls, Flying, Summer, Fire  
Resistant, Polyamide, Type CS-FRP-1

PHASE REPORT  
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NAVAL AIR DEVELOPMENT CENTER  
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WARMINSTER, PA. 18974

AC  
9 April 1968

From: Commanding Officer, Naval Air Development Center, Johnsville, Pa. 18974

To: Commander, Naval Air Systems Command, Washington D. C.

Subj: Report No. NADC-AC-6809, Fleet Evaluation, Coveralls, Flying, Summer, Fire Resistant, Polyamide, Type CS/FRP-1; letter report concerning

Ref: (a) NAVAIRSYSCOM ltr AIR 5311H/1491:LIW of 19 Jul 1967  
(b) Marine Corps LFDA Quantico ltr 46/3A/HVN-prug 51-64-02 of 25 Oct 1967

- Encl:
- (1) Table I Summary Data of Fleet Evaluation Questionnaires CS/FRP-1
  - (2) Table II Fighter and Attack Aircraft Application Data, Fleet Evaluation Questionnaires, CS/FRP-1
  - (3) Table III Patrol Aircraft Application Data, Fleet Evaluation Questionnaires, CS/FRP-1
  - (4) Table IV Helicopter Application Data, Fleet Evaluation Questionnaires, CS/FRP-1
  - (5) Table V Marine Application Data, Fleet Evaluation Questionnaires, CS/FRP-1
  - (6) Table VI Navy Application Data, Fleet Evaluation Questionnaires, CS/FRP-1

### 1. Introduction

A field evaluation was conducted in accordance with reference (a) on the subject coverall to obtain information regarding the acceptability of first production lots. One thousand questionnaires were distributed to the Fleet and 621 were returned to the Aerospace Crew Equipment Department (ACED) representing a cross section of various activities

### 2. Discussion

The questionnaires associated with the subject evaluation was designed to obtain a Fleet response with regard to laundering, comparison with the cotton coverall it replaces, closures, fit and comfort. Responses were analyzed according to aircraft application, contract number and Navy or Marine use.

### 3. Results

a. Features of the coverall design which were considered favorable by more than 70% of the responding users are:

1. Launderability	-	75% favorable
2. Resistance to soiling	-	94% favorable
3. Color	-	82.5% favorable
4. Durability and tear resistance	-	95% favorable
5. Light weight	-	91% favorable

b. There was dissatisfaction shown with regard to warmth, fit and fabric irritation.

1. Warmth - 42% considered the suit too air permeable for cool environments.
2. Fit - 38% complained of a poorer fit than their regular flight suit.
3. Fabric Irritation - 49.5% of the evaluators complained that the Nomex fabric irritated the skin in a hot environment.
4. Closures - 48.5% complained of closures snagging.

#### 4. Conclusions

a. Warmth - Although 42% considered the suit too air permeable for cool environments, 91% considered the light weight of the suit a definite asset. The Nomex coverall was designed to be as light and cool as possible for warm weather use and is not intended for low temperature environments. The objections to lack of warmth are far outweighed by the acceptability of the light weight feature of the coverall.

b. Fit - Although 38% had a poorer fit than flight suits previously worn, 36% did not have a size which corresponded to their civilian size and an 18% improvement in fit was realized from the first production contract to the third production contract. Poor fit complaints were due to a large extent, to improper size selection since it was formerly practical to select a larger coverall size to allow for shrinkage during laundering. Pattern changes made in the third production contract significantly corrected fit discrepancies. This is further supported by reference (b), a report from the Marines stating that fit problems experienced in early suits have been corrected. Current CS/FRP-1 patterns correct the fit deficiencies indicated in the responses.

c. Fabric Irritation - Fabric irritation is a significant unfavorable feature of first production CS/FRP-1 coveralls. This is attributed to rough fabric surface texture reduced somewhat with laundering and a poor collar patterning which allowed a protruding seam on the inside neck area causing chafing. Since the distribution of the evaluated coveralls, finishing techniques have been improved and implemented to eliminate fabric surface roughness with a high degree of success. All present and future CS/FRP-1 productions will show marked improvement in fabric surface texture and will reflect a pattern change in the collar.

d. Closures - Complaints due to zipper snagging have been attributed to the fact that zipper flaps were sewn down at their end points therefore preventing them from moving out of the way during actuation. This design deficiency was remedied on most recent production lots by eliminating stitches on flap ends. This appears to be a satisfactory solution to the problem as indicated by evaluating activities.

e. Acceptability - The CS/FRP-1 represents a significant improvement over cotton summer flight suits in the area of launderability, resistance to soiling, color, durability and tear resistance and weight. With the implementation of established design changes, eliminating undesirable design characteristics, this summer flight coverall is considered acceptable for general Fleet use.

5. Recommendations - Effort be expended to continue to develop the Nomex flight coverall in the areas of patterning, pocket location and design, and fabric finishing.

6. Project Status - Development of the Nomex coverall is being continued with emphasis on a design which can be tailored to a specific end user application by making minor changes to a basic coverall configuration. The intention is to satisfy the specific requirements of Navy and Marine, fighter, attack, patrol and helicopter pilots and crewmen.

7. This report was prepared by David N. DeSimone and data compiled by Arno'd R. Campanile, Life Support Systems Division, reviewed by Frank A. Catroppa, Supervisory Technologist, Life Support Protective Equipment Branch.



D. A. MANCINELLI  
By direction

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TABLE I

## FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

## SUMMARY DATA

<u>No. Questionnaires Evaluated</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>
	621			
<u>Features Considered</u>				
1. <u>Laundrying</u>	468	353	115	75
2. <u>Comparison with Cottons</u>				
a. <u>Ease of movement</u>	602	459	143	76
b. <u>General comfort</u>	592	317	275	54
c. <u>Soiling</u>	535	505	30	94
d. <u>Ease of donning</u>	590	424	166	72
e. <u>Accessibility of Pockets</u>	567	363	204	64
f. <u>Adequacy of pockets</u>	599	523	76	87
g. <u>Laundrying</u>	546	481	65	88
h. <u>Comfort warm environment</u>	592	295	297	49.8
i. <u>Overall preference flight</u>	585	381	204	65
j. <u>Overall preference on ground</u>	586	322	264	54.9
k. <u>Overall preference short periods</u>	610	392	218	64
l. <u>Overall preference long periods</u>	589	342	247	58
m. <u>Color of suit</u>	570	470	100	82.5
3. <u>Durability and Tear Resistance</u>				
a. <u>Satisfactory</u>	591	563	28	95
b. <u>Better than suit previously used</u>	556	463	93	83
4. <u>Wrist and Ankle Closures</u>				
a. <u>Ease of donning</u>	592	390	202	66
b. <u>Comfort</u>	595	398	197	67
c. <u>Durability</u>	573	515	96	90
5. <u>Tailoring and Fit</u>				
a. <u>Corresponds to civilian size</u>	496	319	177	64
b. <u>General</u>	579	351	228	61

TABLE I Cont'd

## FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

<u>No. Questionnaires Evaluated</u>	<u>621</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>
<u>Features Considered</u>					
c. Compared to other flight suit	606		375	231	62
6. <u>Zippers</u>					
a. Zippers catch	490		238	252	48.5
b. Repair of zipper	327		280	47	86
c. Portion of suit tear or fray	547		437	110	80
7. <u>Warmth of Suit</u>	583		340	243	58
8. <u>Weight of Suit</u>	583		533	50	91
9. <u>Fabric Irritation</u>	588		292	296	49.5
10. <u>Compatibility</u>	542		513	29	94.5

TABLE II

## FLEET EVALUATION QUESTIONNAIRES, GS/FRP-1

## FIGHTER AND ATTACK AIRCRAFT

<u>No. Questionnaires Evaluated</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>
<u>274</u>				
<u>Features Considered</u>				
1. <u>Laundering</u>	213	155	58	74
2. <u>Comparison with Cottons</u>				
a. <u>Ease of movement</u>	264	182	82	69
b. <u>General comfort</u>	265	109	156	41
c. <u>Soiling</u>	261	248	13	95
d. <u>Ease of donning</u>	260	180	80	69.2
e. <u>Accessibility of Pockets</u>	263	174	89	66.2
f. <u>Adequacy of pockets</u>	267	229	38	85.8
g. <u>Laundering</u>	242	208	34	86
h. <u>Comfort warm environment</u>	271	122	149	45
1. <u>Overall preference flight</u>	264	156	108	59
j. <u>Overall preference on ground</u>	268	124	144	46.3
k. <u>Overall preference short periods</u>	269	159	110	59
1. <u>Overall preference long periods</u>	259	124	135	47.9
m. <u>Color of suit</u>	261	215	46	82.4
3. <u>Durability and Tear Resistance</u>				
a. <u>Satisfactory</u>	268	254	14	95
b. <u>Better than suit previously used</u>	243	221	22	91
4. <u>Wrist and Ankle Closures</u>				
a. <u>Ease of donning</u>	263	176	87	67
b. <u>Comfort</u>	265	172	93	65
c. <u>Durability</u>	254	234	20	92
5. <u>Tailoring and Fit</u>				
a. <u>Corresponds to civilian size</u>	265	139	126	52
b. <u>General</u>	262	154	108	59

TABLE II Cont'd

FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

<u>No. Questionnaires Evaluated</u>	<u>274</u>				
<u>Features Considered</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>	
c. Compared to other flight suit	268	153	115	57	
6. <u>Zippers</u>					
a. Zippers catch	266	135	131	51	
b. Repair of zipper	122	96	26	78.6	
c. Portion of suit tear or fray	231	191	40	83	
7. <u>Warmth of Suit</u>	266	143	123	54	
8. <u>Weight of Suit</u>	251	218	33	87	
9. <u>Fabric Irritation</u>	262	110	152	42	
10. <u>Compatibility</u>	254	238	16	94	

TABLE III

## FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

## PATROL AIRCRAFT APPLICATION DATA

<u>No. Questionnaires Evaluated</u>	<u>223</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>
<u>Features Considered</u>					
1. <u>Laundering</u>	156		124	32	79
2. <u>Comparison with Cottons</u>					
a. <u>Ease of movement</u>	223		184	39	82.5
b. <u>General comfort</u>	214		120	94	56
c. <u>Soiling</u>	211		201	10	95.3
d. <u>Ease of donning</u>	215		163	52	75.8
e. <u>Accessibility of Pockets</u>	213		106	107	49.8
f. <u>Adequacy of pockets</u>	217		192	25	88.5
g. <u>Laundering</u>	193		168	25	87
h. <u>Comfort warm environment</u>	214		116	98	54.2
i. <u>Overall preference flight</u>	216		146	70	67.6
j. <u>Overall preference on ground</u>	222		132	90	59.5
k. <u>Overall preference short periods</u>	213		145	68	68
l. <u>Overall preference long periods</u>	214		139	75	65
m. <u>Color of suit</u>	208		164	44	78.9
3. <u>Durability and Tear Resistance</u>					
a. <u>Satisfactory</u>	219		200	19	91
b. <u>Better than suit previously used</u>	206		164	42	80
4. <u>Wrist and Ankle Closures</u>					
a. <u>Ease of donning</u>	213		145	68	68
b. <u>Comfort</u>	213		144	69	68
c. <u>Durability</u>	210		184	26	88
5. <u>Tailoring and Fit</u>					
a. <u>Corresponds to civilian size</u>	215		112	103	52
b. <u>General</u>	209		129	80	62

TABLE III Cont'd

FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

<u>No. Questionnaires Evaluated</u>	<u>223</u>				
<u>Features Considered</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>	
c. Compared to other flight suit	172	110	62	64	
6. <u>Zippers</u>					
a. Zippers catch	218	64	154	29	
b. Repair of zipper	154	130	24	84	
c. Portion of suit tear or fray	205	156	49	76	
7. <u>Warmth of Suit</u>	217	137	80	63	
8. <u>Weight of Suit</u>	206	196	10	95	
9. <u>Fabric Irritation</u>	207	118	89	57	
10. <u>Compatibility</u>	198	189	9	95	

TABLE IV

## FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

## HELICOPTER APPLICATION DATA

<u>No. Questionnaires Evaluated</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>
<u>Features Considered</u>	96			
1. <u>Laundrying</u>	71	50	21	70
2. <u>Comparison with Cottons</u>				
a. <u>Ease of movement</u>	93	80	13	86
b. <u>General comfort</u>	93	59	34	63.4
c. <u>Soiling</u>	91	87	4	95.6
d. <u>Ease of donning</u>	93	72	21	77.4
e. <u>Accessibility of Pockets</u>	93	61	32	65.6
f. <u>Adequacy of pockets</u>	91	81	10	89
g. <u>Laundrying</u>	81	78	3	96.3
h. <u>Comfort warm environment</u>	92	56	36	60.9
i. <u>Overall preference flight</u>	93	72	21	77.4
j. <u>Overall preference on ground</u>	93	59	34	63.4
k. <u>Overall preference short periods</u>	92	70	22	76
l. <u>Overall preference long periods</u>	90	65	25	72.2
m. <u>Color of suit</u>	91	79	12	86.8
3. <u>Durability and Tear Resistance</u>				
a. <u>Satisfactory</u>	92	90	2	98
b. <u>Better than suit previously used</u>	84	71	13	85
4. <u>Wrist and Ankle Closures</u>				
a. <u>Ease of donning</u>	95	57	38	60
b. <u>Comfort</u>	92	61	31	66
c. <u>Durability</u>	90	80	10	89
5. <u>Tailoring and Fit</u>				
a. <u>Corresponds to civilian size</u>	91	51	40	56
b. <u>General</u>	91	62	29	68

TABLE IV Cont'd  
FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

<u>No. Questionnaires Evaluated</u>	<u>96</u>			
<u>Features Considered</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>
c. Compared to other flight suit	94			
6. <u>Zippers</u>		63	31	67
a. Zippers catch	95	41	54	45.5
b. Repair of zipper	56	45	11	80
c. Portion of suit tear or fray	84	69	15	82
7. <u>Warmth of Suit</u>	96	54	42	56
8. <u>Weight of Suit</u>	90	83	7	92
9. <u>Fabric Irritation</u>	90	41	49	45.5
10. <u>Compatibility</u>	79	73	6	92

TABLE V

## FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

## MARINE APPLICATION DATA

Features Considered	Total Number of Responses	Number Favorable	Number Not Favorable	Percent Favorable
	135			
<u>1. Laundering</u>	104	69	34	67
<u>2. Comparison with Cottons</u>				
a. Ease of movement	123	94	29	76.4
b. General comfort	128	70	58	55
c. Soiling	123	120	3	97.5
d. Ease of donning	127	88	39	69
e. Accessibility of Pockets	100	96	4	96
f. Adequacy of pockets	126	106	20	84
g. Laundering	120	118	2	98.3
h. Comfort warm environment	125	61	64	48.8
i. Overall preference flight	125	90	35	72
j. Overall preference on ground	127	70	57	55
k. Overall preference short periods	129	87	42	67.4
l. Overall preference long periods	120	68	52	56.7
m. Color of suit	124	97	27	78.2
<u>3. Durability and Tear Resistance</u>				
a. Satisfactory	123	119	4	97
b. Better than suit previously used	116	94	22	81
<u>4. Wrist and Ankle Closures</u>				
a. Ease of donning	124	77	47	62
b. Comfort	130	94	36	72
c. Durability	124	112	12	90
<u>5. Tailoring and Fit</u>				
a. Corresponds to civilian size	123	73	50	59
b. General	121	81	40	67

TABLE V Cont'd

FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

<u>No. Questionnaires Evaluated</u>	<u>135</u>				
<u>Features Considered</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>	
c. Compared to other flight suit	132	86	46	65	
6. <u>Zippers</u>					
a. Zippers catch	125	52	73	42	
b. Repair of zipper	67	52	15	78	
c. Portion of suit tear or fray	112	96	16	77	
7. <u>Warmth of Suit</u>	121	74	47	61	
8. <u>Weight of Suit</u>	126	120	6	95	
9. <u>Fabric Irritation</u>	122	62	60	51	
10. <u>Compatibility</u>	114	113	1	99	

TABLE VI

## FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

## NAVY APPLICATION DATA

<u>No. Questionnaires Evaluated</u>	<u>486</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>
<u>Features Considered</u>					
1. <u>Laundrying</u>	365	284	81	79	
2. <u>Comparison with Cottons</u>					
a. <u>Ease of movement</u>	479	365	114	76	
b. <u>General comfort</u>	464	247	217	53.2	
c. <u>Soiling</u>	412	375	27	91	
d. <u>Ease of donning</u>	463	336	127	72.5	
e. <u>Accessibility of Pockets</u>	467	267	200	57	
f. <u>Adequacy of pockets</u>	473	417	56	88	
g. <u>Laundrying</u>	426	363	63	85	
h. <u>Comfort warm environment</u>	467	234	233	50.1	
i. <u>Overall preference flight</u>	460	291	169	63.2	
j. <u>Overall preference on ground</u>	459	252	207	54.9	
k. <u>Overall preference short periods</u>	481	305	176	63.4	
l. <u>Overall preference long periods</u>	469	274	195	58.4	
m. <u>Color of suit</u>	446	373	73	83.6	
3. <u>Durability and Tear Resistance</u>					
a. <u>Satisfactory</u>	468	444	24	95	
b. <u>Better than suit previously used</u>	440	369	71	84	
4. <u>Wrist and Ankle Closures</u>					
a. <u>Ease of donning</u>	468	313	155	67	
b. <u>Comfort</u>	465	304	161	65	
c. <u>Durability</u>	449	403	46	90	
5. <u>Tailoring and Fit</u>					
a. <u>Corresponds to civilian size</u>	373	246	127	66	
b. <u>General</u>	458	270	188	59	

TABLE VI Cont'd

FLEET EVALUATION QUESTIONNAIRES, CS/FRP-1

<u>No. Questionnaires Evaluated</u>	<u>486</u>				
<u>Features Considered</u>	<u>Total Number of Responses</u>	<u>Number Favorable</u>	<u>Number Not Favorable</u>	<u>Percent Favorable</u>	
c. Compared to other flight suit	474	289	185	61	
6. Zippers					
a. Zippers catch	365	186	179	51	
b. Repair of zipper	250	228	32	88	
c. Portion of suit tear or fray	435	341	94	78	
7. Warmth of Suit	462	266	196	58	
8. Weight of Suit	457	413	44	90	
9. Fabric Irritation	466	230	236	49	
10. Compatibility	428	400	28	93.5	

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Security Classification

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5. AUTHOR(S) (First name, middle initial, last name) David N. DeSimone		
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10. DISTRIBUTION STATEMENT Distribution of this document is unlimited.		
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13. ABSTRACT  A field evaluation was conducted in accordance with reference (a) on the subject coverall to obtain information regarding the acceptability of first production lots. One thousand questionnaires were distributed to the Fleet and 621 were returned to the Aerospace Crew Equipment Department representing a cross section of various activities. Coverall design was found acceptable for Fleet use.		

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14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
	1. Fleet Evaluation 2. Coveralls, Flying, Summer, Fire Resistant, Polyamide, Type CS/FRP-1					

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