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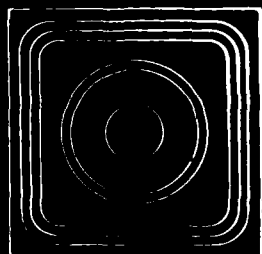
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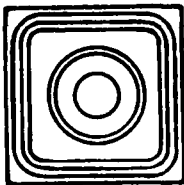
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NONELECTRONIC PARTS RELIABILITY DATA

Prepared by:

Robert G. Arno
IIT Research Institute

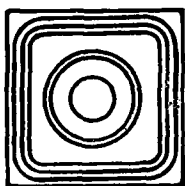
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Reliability Analysis Center
Rome Air Development Center (RBRAC)
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Nonelectronic Parts Failure Modes and Mechanisms Failure Rates Electromechanical Component Reliability Information Mechanical Parts		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report, organized in four major sections, presents reliability information based on field operation, dormant state and test data for more than 250 major nonelectronic part types. The four sections are Generic Data, Detailed Data, Application Data, and Failure Modes and Mechanisms. Each device type contains reliability information in relation to the specific operational environments.		

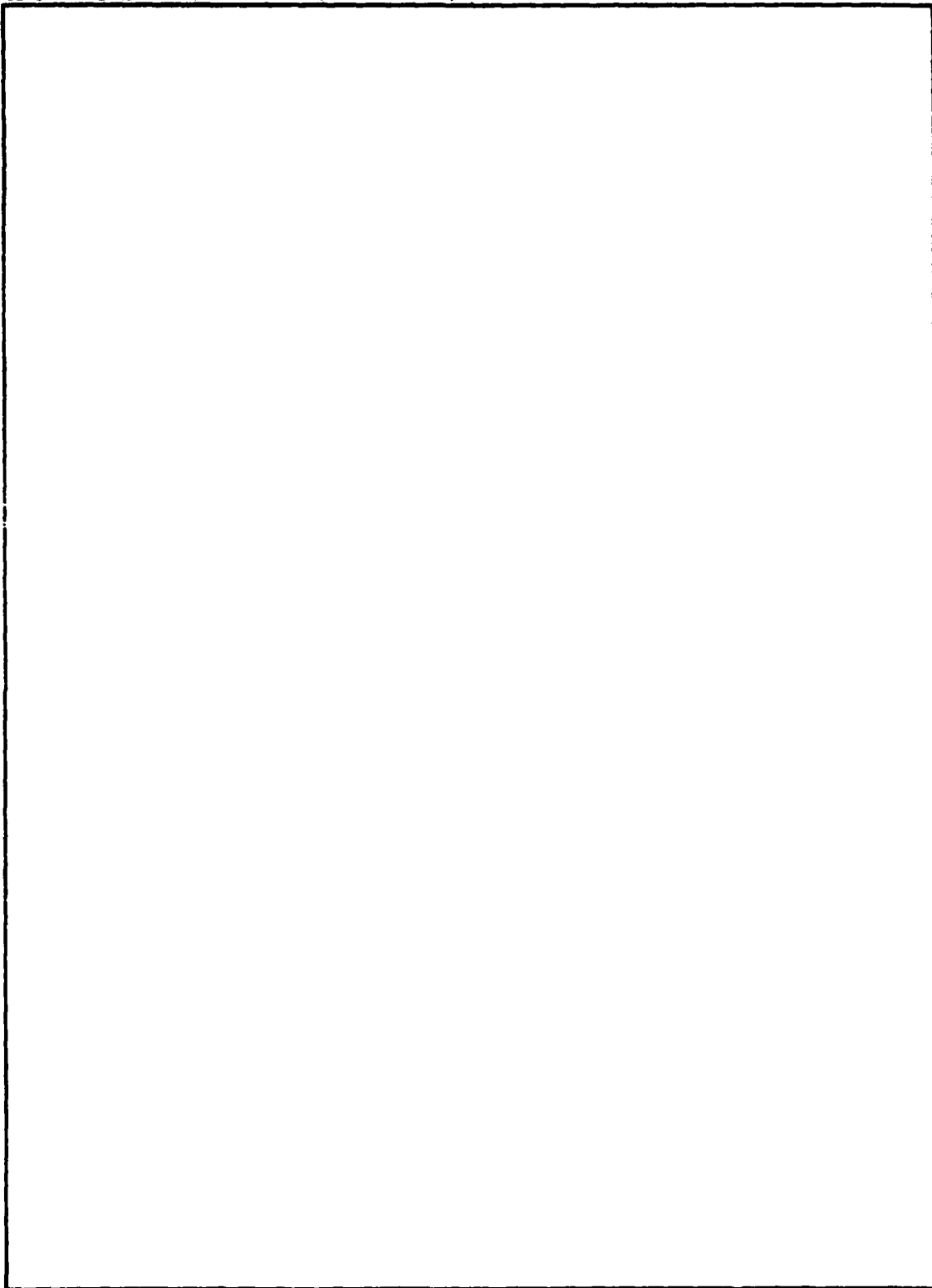
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PREFACE

This is the second edition of a series of data publications dealing with nonelectronic reliability at the part level. NPRD-2 updates NPRD-1 by expanding the scope and quality of data.

The data presented in these reliability publications are intended to compliment such documents as MIL-HDBK-217 and MIL-STD-883. The user is cautioned, however, that the data contained herein may not be used in lieu of contractually cited references. It should also be noted that the data contained in this document is failure data, not part replacement data. Only verified failures were used in the calculations of the failure rates.

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INTRODUCTION

This nonelectronic reliability data publication provides failure rate and failure mode information for mechanical, electromechanical, electrical, pneumatic, hydraulic and rotating parts. The data utilized in the development of this publication were collected by the RAC and represent equipment level experience under field conditions in military, industrial and commercial applications.

It has been necessary to accept the assumption that the failures of nonelectronic parts follow the exponential distribution; that is, such parts display a constant failure rate. This assumption is necessary due to the virtual absence of data containing individual times or cycles to failure.

Section 1 of this publication provides summarized generic part level failure rates. Section 2 consists of detailed entries by part type and environmental application in unsummarized form. In Section 3, failure rates for parts unique to or frequently used in computer peripherals, point of sale equipment, and test instruments are tabulated. Section 4 presents the distribution of failure modes for a number of major nonelectronic part families.

NONELECTRONIC PARTS RELIABILITY DATA

SECTION 1

NONELECTRONIC GENERIC FAILURE RATES

Section 1

DEFINITIONS OF TERMS

This section presents summaries of field reliability experience for nonelectronic parts. The summaries are presented in alphabetical order by major family classes and alphabetically by type within each family class.

A careful reading of the description of the presentation format and entry codes employed will aid the user of this publication. The circled numbers shown in the tabulation form below are referenced to the explanatory text which follows.

PART CLASS: (1)

TYPE: (2)

ENVIRONMENT		APPLICATION MIL. COML.		FAILURE RATE/10 ⁶ HOURS		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (10 ⁶)		
				λ	90% UPPER SINGLE-SIDED CONFIDENCE				90% CONFIDENCE INTERVAL	
									LOWER	UPPER
(3)	(4)	(5)	(6)	(7)		(8)	(9)	(10)		

(1) PART CLASS

A major family of parts having or providing the same function.

(2) TYPE:

The identification of the part type.

(3) ENVIRONMENT:

The coded entries are as follows:

DOR - Dormant

The state wherein a component or equipment is connected to a system in the normal operational configuration and experiences below normal and/or periodic operational stresses and environmental stresses. The system may be in a dormant state for prolonged periods (up to five years or more) before being used in a mission.

DEFINITION OF TERMS (Cont'd)

SAT - Satellite	Earth orbital, approaches benign conditions without access for maintenance. Vehicle neither under powered flight nor in atmosphere re-entry.
GRF - Ground Fixed	Conditions less than ideal to include installation in permanent racks with adequate cooling air, maintenance by military personnel and possible installation in unheated buildings.
GRM - Ground Mobile	Conditions more severe than GRF, mostly for vibration and shock. Cooling air supply may also be more limited, and maintenance less uniform.
A - Airborne	The most generalized aircraft conditions.
AI - Airborne Inhabited	General conditions in inhabited areas without environmental extremes.
AIT - Airborne Inhabited Transport	Conditions in inhabited areas of subsonic aircraft such as transport, cargo, heavy bomber, and patrol.
AIF - Airborne Inhabited Fighter	The conditions to be found in the cockpit area of fighters and interceptors.

DEFINITIONS OF TERMS (Cont'd)

AU - Airborne Uninhabited	General conditions typical of such areas as cargo storage areas, wing and tail installations where extreme pressure, temperature and vibration cycling exist; also, may be aggravated by contamination from oil, hydraulic fluid and engine exhaust.
AUT - Airborne Uninhabited Transport	Conditions in uninhabited areas of subsonic aircraft such as transport, cargo, heavy bomber, and patrol.
AUF - Airborne Uninhabited Fighter	Conditions in uninhabited areas of fighters and interceptors.
HEL - Helicopter	Conditions most severe for vibration, temperature and humidity.
SHS - Ship Sheltered	Surface conditions similar to GRF but subject to occasional high shock and vibration.
SHU - Ship Unsheltered	Normal surface shipboard conditions but with repetitive high levels of shock and vibration.
SUB - Submarine	Conditions normal to operation aboard a submerged vessel. Temperature and humidity controlled.

DEFINITIONS OF TERMS (Cont'd)

MIS - Missile Launch

Severe conditions of noise, vibration and other environments related to missile launch, and space vehicle boost into orbit, vehicle re-entry and landing by parachute. Conditions may also apply to installation near main rocket engines during launch operations.

④ APPLICATION:

MIL. (Military)

Data resulting from a military or satellite application.

COML. (Commercial)

Data resulting from a commercial or industrial application.

N/A

Not applicable. The nature of the hardware application is unknown.

⑤ $\hat{\lambda}$

The maximum likelihood estimator when the exponential distribution is assumed.

⑥ 60% UPPER SINGLE-SIDED
CONFIDENCE

The 60% upper single-sided confidence limit estimate of the failure rate, computed from the Chi-square distribution, is provided for those entries for which zero failures have been recorded.

DEFINITION OF TERMS (Cont'd)

- ⑦ 60% CONFIDENCE INTERVAL,
LOWER AND UPPER: The lower and upper limits of the 60% confidence interval about $\hat{\lambda}$ computed from the Chi-square distribution.
- ⑧ NUMBER OF RECORDS: The number of records merged to provide the failure rate information. The merged records represent only those accepted by a test statistic based on the F-distribution at the 5% level.
- ⑨ NUMBER FAILED: The total number of failures observed in the merged records.
- ⑩ OPERATING HOURS ($\times 10^6$): The total hours at the part level. Derived by multiplying the part population by the equipment hours of operation observed during the period covered by each record. An asterisk (*) in the $\hat{\lambda}$ column indicates that, for this entry, the failure rate information is given in terms of per 10^6 cycles and the total operating hours in the last column should be read as cycles $\times 10^6$.

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GENERIC FAILURE RATE TABLES

PART CLASS: ACCELEROMETER

TYPE: ANGULAR

ENVIRONMENT	APPLICATION MIL. COML.	FAILURE RATE/10 ⁶ HOURS				
		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
				LOWER	UPPER	
DOR	X	---	0.177	---	---	3
						0
						5.182

PART CLASS: ACCELEROMETER

TYPE: GENERAL

ENVIRONMENT	APPLICATION		FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER	UPPER				
DOR	X		0.419	---	0.389	0.452	6	138	329.240	
SAT	X		---	8.179	---	---	2	0	0.112	
GRM	X		35.078	---	33.373	36.883	3	303	8.638	
AI	X		153.749	---	146.965	160.901	1	367	2.387	
AI		X	10.796	---	7.535	15.408	2	8	0.741	

PART CLASS: ACCELEROMETER

TYPE: LINEAR

ENVIRONMENT	APPLICATION MIL. COML.	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS			
				LOWER	UPPER				
DOR	X	---	0.324	---	---	4	0	2.826	
AI	X	525.641	---	476.385	580.671	1	82	0.156	

PART CLASS: ACCELEROMETER

TYPE: PENDULUM

ENVIRONMENT	APPLICATION MIL. COML.	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
		$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
				LOWER	UPPER				
DOR	X	1.923	---	1.449	2.554		2	12	6.239

PART CLASS: ACCUMULATOR

TYPE: GENERAL

ENVIRONMENT	APPLICATION MIL. COML.	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
		$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
				LOWER	UPPER				
DOR	X	0.324	---	0.276	0.381		5	33	102.003
SAT	X	---	1.693	---	---		1	0	0.541
GRM	X	29.851	---	12.143	64.524		1	2	0.067
AU	X	0.229	---	0.193	0.272		1	30	131.000
AU	X	193.097	---	181.738	205.280		3	207	1.072
HEL	X	500.000	---	338.580	733.614		1	7	0.014

PART CLASS: ACCUMULATOR

TYPE: HYDRAULIC

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR	X		0.531	---	0.513	0.550	6	605	1,138.442
SAT	X		1.504	---	1.352	1.674	1	71	47.220
GRM	X		55.182	---	53.396	57.038	2	681	12.341
GRM		X	13.739	---	12.638	14.949	1	112	8.152
AU	X		156.365	---	152.606	160.234	2	1232	7.879
HEL	X		80.357	---	70.171	92.180	1	45	0.560

PART CLASS: ACTUATOR

TYPE: EXPLOSIVE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL					
	MIL.	COML.			LOWER	UPPER				
DOR		X	0.063	---	0.048	0.082	1	13	207.100	
GRF	X		218.765	---	156.468	305.193	1	9	0.041	

PART CLASS: ACTUATOR

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
					LOWER						
DOR	X		---	0.434	---		---		1	0	2.110
AUT		X	101.429	---	98.806		104.134		1	1065	10.500

PART CLASS: ACTUATOR

TYPE: HYDRAULIC

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		0.057	0.880				
					LOWER	UPPER						
DOR	X		0.290	---					2	1	3.454	

PART CLASS: ACTUATOR

TYPE: LINEAR

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL							
					LOWER	UPPER						
DOR	N/A	N/A	0.168	---	0.142	0.200	12	29	172.234			
GRF	X		14.398	---	13.212	15.705	9	106	7.362			
GRM	X		50.459	---	37.464	67.948	1	11	0.218			
A	X		174.767	---	170.328	179.342	7	1104	6.317			
AUT		X	69.801	---	68.195	71.452	5	1345	19.269			
AUF	X		48.132	---	43.446	53.389	1	76	1.579			
HEL	X		370.370	---	270.321	506.931	2	10	0.027			
HEL		X	159.459	---	147.017	173.109	4	118	0.740			
SHS	X		10.707	---	6.622	17.014	1	5	0.467			

PART CLASS: ACTUATOR

TYPE: ROTARY

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER					
					LOWER	UPPER						
A	X		405.405	---	382.536	429.865	1	225	0.555			
AUT		X	87.935	---	81.374	95.103	1	129	1.467			
SUB	X		---	0.484	---	---	1	0	1.893			

PART CLASS: BATTERY

TYPE: LEAD ACID

ENVIRONMENT	APPLICATION		λ	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)	
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	60% UPPER SINGLE-SIDED CONFIDENCE				60% CONFIDENCE INTERVAL
					LOWER	UPPER							
GRF		X	0.440	---		0.298	0.645			2	7	15.917	

PART CLASS: BATTERY

TYPE: MERCURY

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER					
GRF		X	0.742	---	0.559	0.986	4	12	16.164	

PART CLASS: BATTERY

TYPE: NICKEL CADMIUM

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
SAT GRF	X	X	0.047/CELL	---	0.027	0.078	2	4	85.862	
			0.251/CELL	---	0.235	0.268	9	171	681.593	

PART CLASS: BATTERY

TYPE: NON-RECHARGEABLE

ENVIRONMENT	APPLICATION	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
		MIL.	COML.	$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
						LOWER	UPPER			
GRM	X			333.333	---	66.047	1013.579	1	1	0.003

PART CLASS: BATTERY

TYPE: RECHARGEABLE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED ⁽¹⁾	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR	X		0.016	---	0.013	0.022	3	12	732.564
GRF	X		1.498	---	1.046	2.138	1	8	5.339
GRM	X		15.748	---	6.406	34.040	2	2	0.127
A	X		348.852	---	342.921	355.955	3	2810	8.055
HEL	X		676.768	---	636.364	720.148	2	201	0.297

PART CLASS: BEARING

TYPE: BALL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		0.010	---	0.007	0.014	3	9	903.040	
SAT	X		---	0.688	---	---	2	0	1.332	
GRF	X		1.148	---	1.001	1.319	8	44	38.320	
GRF		X	13.975	---	10.356	19.410	1	9	0.644	
GRM	X		0.094	---	0.054	0.159	1	4	42.554	
A	X		5.133	---	4.787	5.507	2	158	30.784	
A		X	1.372	---	0.272	4.171	1	1	0.729	
AI	X		4.829	---	3.799	6.148	1	16	3.313	
HEL	X		13.398	---	10.963	16.408	2	22	1.642	
SHS	X		---	0.053	---	---	2	0	17.156	
SUB	X		4.728	---	1.923	10.220	1	2	0.423	

PART CLASS: BEARING

TYPE: BUSHING

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER					
					LOWER							
GRF		X	---	0.046	---	---	7	0	19.922			
A	X		---	0.609	---	---	1	0	1.503			
A		X	---	1.020	---	---	1	0	0.898			
HEL	X		21.146	---	20.148	22.202	2	321	15.180			

PART CLASS: BEARING

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF		X	4.068	---	3.200	5.180	2	16	3.933	
GRF	X		1.378	---	1.084	1.754	1	16	11.614	
GRM		X	21.921	---	18.721	25.719	1	34	1.551	
A	X		8.260	---	7.828	8.720	1	261	31.598	
AUT		X	11.468	---	7.093	18.224	1	5	0.436	
AUF	X		3.101	---	1.261	6.702	1	2	0.645	
HEL	X		12.591	---	11.735	13.520	1	155	12.310	

PART CLASS: BEARING

TYPE: NEEDLE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER	UPPER				
A		X	---	2.718	---	---	---	1	0	0.337

PART CLASS: BEARING

TYPE: ROLLER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		0.280	---	0.195	0.400	1	8	28.562	
GRM		X	207.328	---	195.811	219.633	1	232	1.119	
A	X		0.863	---	0.641	1.162	1	11	12.745	
A		X	---	0.628	---	---	1	0	1.459	
AU	X		---	0.037	---	---	1	0	24.570	
SHS	X		1.206	---	0.693	2.039	1	4	3.317	
HEL	X		24.000	---	15.634	36.457	1	6	0.250	

PART CLASS: BEARING

TYPE: SPHERICAL

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRM	X		0.206	---	0.169	0.252	1	22	106.731
A	X		8.260	---	7.828	8.720	1	261	31.598
AUT		X	9.000	---	7.524	10.787	1	27	3.000
HEL	X		53.220	---	49.623	57.119	1	157	2.950

PART CLASS: BELLOWS

TYPE: DIAPHRAGM BURST

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		LOWER	UPPER				
DOR	X		---	1.384	---	---	---		1	0	0.662	

PART CLASS: BELLOWS

TYPE: EXPLOSIVE

FAILURE RATE / 10^6 HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.			LOWER	UPPER			
DOR	X		---	0.014	---	---	1	0	65.600

PART CLASS: BELLOWS

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10^6 HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER					
					LOWER	UPPER						
DOR GRF	X		---	0.068	---	---	1	0	13.520			
	X		---	65.429	---	---	1	0	0.014			

PART CLASS: BRAKE

TYPE: GENERAL

ENVIRONMENT	APPLICATION		FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL						
					LOWER	UPPER					
GRF	X		4.274	---	0.847	12.995	1	1	0.234		
A	X		766.250	---	760.349	772.207	1	11,965	15.615		
AU	X		213.143	---	209.249	217.123	1	2,131	9.998		
AUT		X	11.570	---	7.835	16.976	3	7	0.605		
HEL	X		100.000	---	94.333	106.062	1	223	2.230		

PART CLASS: BRAKE

TYPE: MAGNETIC

ENVIRONMENT	APPLICATION		FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
					LOWER	UPPER					
GRF HEL	X		11.976	---	6.877	20.245	1	4	0.334		
	X		241.540	---	227.332	256.780	3	207	0.857		

PART CLASS: BRUSH

TYPE: ELECTRIC

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
A SHS	X		4.749	---	4.461	5.058	1	195	41.062	
	X		---	0.152	---	---	1	0	6.030	

PART CLASS: CIRCUIT BOARD

TYPE: PLATED THROUGH HOLES

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (10 ⁶)
	MIL.	COMPL.		LOWER	UPPER					
DOR	X		---	0.000251	---	---	1	0	3643.900	
DOR		X	---	0.000112	---	---	1	0	8183.538	
SAT	X		---	0.000278	---	---	1	0	3298.700	
GRM		X	0.000219	---	0.000049	0.000655	1	1	4577.251	
AIT	X		0.000110	---	0.000045	0.000233	4	2	18444.416	
AIF	X		0.000702	---	0.000474	0.001030	4	7	9974.127	

PART CLASS: CIRCUIT BOARD

TYPE: PRINTED CIRCUIT BOARD, SINGLE LAYER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		0.826	---	0.184	2.479	1	1	1.210	
GRF	X	X	0.163	---	0.036	0.490	10	1	6.119	
GRF			---	0.017	---	---	1	0	54.700	
GRM	X	X	0.036	---	0.007	0.110	9	1	27.420	
A	X		0.004	---	0.001	0.012	1	1	249.000	
AIT		X	1.849	---	0.412	5.545	14	1	0.541	
AIF	X		5.091	---	1.138	15.306	22	1	0.196	
SHS	X		1.682	---	1.203	2.336	1	9	5.350	

PART CLASS: CIRCUIT BOARD

TYPE: PRINTED CIRCUIT BOARD, MULTILAYER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (10 ⁶)
	MIL.	COML.			60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
DOR	X		0.083	---	0.017	0.254	134	1	11.985
GRM	X		0.131	---	0.100	0.181	213	13	99.608

PART CLASS: CIRCUIT BOARD

TYPE: TERMINAL

FAILURE RATE / 10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
A	X		4.946	---	4.612	5.307	1	158	31.948
A		X	---	32.714	---	---	1	0	0.028
AIF	X		---	0.335	---	---	2	0	2.730

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: FUSE

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR	X		---	0.423	---	---	2	0	2.168
SAT	X		---	0.238	---	---	1	0	3.850
GRF	X		0.136	---	0.122	0.151	1	72	529.168
AIF	X		9.980	---	2.226	29.994	1	1	0.100
HEL		X	200.000	---	114.852	338.090	1	4	0.020
SHS	X		0.124	---	0.080	0.188	1	6	48.577

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: FUSE HOLDER

ENVIRONMENT	APPLICATION MIL. COML.	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
				LOWER						
GRM	X	0.016	---	0.007	0.035		2	2	124.181	
AIF	X	---	9.142	---	---	---	1	0	0.100	
SHS	X	---	0.021	---	---	---	1	0	44.480	

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
SAT	X		44.758	---	25.691	74.969	2	4	8.937	
GRF	X		0.683	---	0.608	0.767	19	61	89.359	
GRM	X		0.748	---	0.631	0.887	2	30	40.125	
A	X		1.967	---	1.858	2.082	1	236	119.998	
A		X	---	10.905	---	---	1	0	0.084	
HEL		X	28.571	---	11.622	61.759	1	2	0.070	
SHS	X		0.268	---	0.053	0.814	2	1	3.737	
SUB	X		41.565	---	37.285	46.398	2	68	1.636	

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: MOLDED CASE CIRCUIT BREAKER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		1.107	---	0.932	1.318	14	29	26.186	

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: POWER SWITCH, CIRCUIT BREAKER

ENVIRONMENT	APPLICATION		60% UPPER SINGLE-SIDED CONFIDENCE	FAILURE RATE/10 ⁶ HOURS		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% CONFIDENCE INTERVAL LOWER	UPPER			
GRF	X		2.879	1.876	4.373	3	6	2.083

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: SPARK GAP, SURGE PROTECTION

ENVIRONMENT	APPLICATION		60% UPPER SINGLE-SIDED CONFIDENCE	FAILURE RATE/10 ⁶ HOURS		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% CONFIDENCE INTERVAL LOWER	UPPER			
DOR	X		0.012	0.002	0.036	2	1	84.790

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: UNDERVOLTAGE

ENVIRONMENT	APPLICATION		60% UPPER SINGLE-SIDED CONFIDENCE	FAILURE RATE/10 ⁶ HOURS		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% CONFIDENCE INTERVAL LOWER	UPPER			
GRF	X		1.870	1.305	2.669	2	8	4.278

PART CLASS: COMPRESSOR

TYPE: AIR

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRM	X		5.959	---	4.793	7.424	1	19	3.188	
SHS	X		720.694	---	633.177	821.659	1	49	0.067	

PART CLASS: COMPRESSOR

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		1992.793	3.742	1942.226	---	1	0	0.244	
AU	X			---		2044.922	1	1106	0.555	

PART CLASS: CONNECTION

TYPE: GENERAL SOLDER

ENVIRONMENT	APPLICATION MIL. COMPL.	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER	60% LOWER CONFIDENCE	60% UPPER CONFIDENCE			
DOR	X	---	---	---	---	---	1	0	6101.826
GRF	X	0.000644	0.000497	0.000835	---	---	1	14	21740.000

PART CLASS: CONNECTION

TYPE: HAND LAP, SOLDER

ENVIRONMENT	APPLICATION MIL. COMPL.	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER	60% LOWER CONFIDENCE	60% UPPER CONFIDENCE			
DOR	X	---	---	---	---	---	1	10	52594.180
SAT	X	0.000150	0.000139	0.000259	---	---	1	0	39610.000

PART CLASS: CONNECTION

TYPE: WAVE, SOLDER

ENVIRONMENT	APPLICATION MIL. COMPL.	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER	60% LOWER CONFIDENCE	60% UPPER CONFIDENCE			
SHS	X	0.000069	0.0000397	0.00012	---	---	1	4	57835.239

PART CLASS: CONNECTION

TYPE: WIRE WRAP

ENVIRONMENT	APPLICATION MIL. COMPL.	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER	60% LOWER CONFIDENCE	60% UPPER CONFIDENCE			
GRF	X	0.000355	0.00021	0.000536	---	---	1	1	16299.8823

PART CLASS: CONNECTOR

TYPE: CIRCULAR

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS									
	APPLICATION		$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)	
	MIL.	COML.			LOWER	UPPER				
DOR	X		---	0.026	---	---	1	0	34.627	
SAT	X		---	0.016	---	---	10	0	57.509	
GRF	X		0.366	---	0.338	0.395	31	130	355.656	
GRM	X		---	16.357	---	---	5	0	0.056	
A	X		0.839	---	0.798	0.882	2	308	367.203	
AI	X		---	3.664	---	---	15	0	0.250	
AU	X		1.248	---	1.181	1.303	3	257	205.916	
AUF	X		---	0.920	---	---	5	0	0.996	
SHS	X		0.071	---	0.055	0.092	81	14	197.465	
SUB	X		---	1.196	---	---	59	0	0.766	

PART CLASS: CONNECTOR

TYPE: COAXIAL

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS									
	APPLICATION		$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)	
	MIL.	COML.			LOWER	UPPER				
SAT	X		0.023	---	0.005	0.070	12	1	43.262	
GRF	X		0.187	---	0.164	0.215	31	45	240.318	
GRF		X	---	0.019	---	---	5	0	48.700	
A	N/A	N/A	0.672	---	0.610	0.740	5	86	128.000	
HEL		X	10.000	---	1.981	30.407	1	1	0.100	
SHS	X		0.017	---	0.003	0.053	6	1	57.253	

PART CLASS: CONNECTOR

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
	MIL.	COML.			LOWER	UPPER				
DOR	X		0.001	---	0.001	0.002	10	17	11,624.494	
SAT	X		---	0.023	---	---	1	0	40.000	
GRF	X		0.036	---	0.024	0.053	14	7	195.446	
GRF		X	0.689	---	0.154	2.067	1	1	1.451	
GRM	X		---	6.596	---	---	3	0	0.139	
GRM		X	---	0.271	---	---	1	0	3.380	
A		X	0.351	---	0.334	0.369	1	305	868.805	
AI	X		0.130	---	0.026	0.394	42	1	7.717	
AI		X	---	3.915	---	---	15	0	0.234	
AUT		X	---	0.387	---	---	5	0	2.368	
HEL	X		10.270	---	8.261	12.794	1	19	1.850	
SUB	X		0.051	---	0.041	0.063	64	20	391.136	

PART CLASS: CONNECTOR

TYPE: PHONE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
SHS	X		---	1.990	---	---	1	0	0.460	

PART CLASS: CONNECTOR

TYPE: PIN

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% LOWER			
	MIL.	COML.			UPPER					
DOR	X		---	0.0003200	---	---	---	1	0	2798.310
SAT	X		---	0.0004200	---	---	---	2	0	2208.930
GRF	X		---	0.0010000	---	---	---	1	0	1514.246
GRM	X		0.011	---	0.007	0.017	---	1	6	529.200
AIT	X		---	0.0000904	---	---	---	1	0	10130.000

PART CLASS: CONNECTOR

TYPE: POWER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		---	0.136	---	---	1	0	6.740	
AIF	X		3.194	---	1.299	6.903	4	2	0.626	

PART CLASS: CONNECTOR

TYPE: PRINTED CIRCUIT BOARD

ENVIRONMENT	APPLICATION		λ	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		---	0.065	---	---	1	0	14.140	
SAT	X		---	0.044	---	---	2	0	20.797	
GRF	X		---	0.031	---	---	12	0	3.044	
GRM	X		---	0.025	---	---	2	0	36.745	
AI	X		0.171	---	0.308	0.512	2	1	5.860	
AIF	X		---	0.026	---	---	19	0	34.890	
SHS	X		0.011	---	0.005	0.024	2	2	176.678	
SUB	X		---	12.053	---	---	4	0	0.076	

PART CLASS: CONNECTOR

TYPE: RADIO FREQUENCY

ENVIRONMENT	APPLICATION		λ	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER	UPPER				
GRF	X		0.062	---	0.052	0.074	1	27	434.534	

PART CLASS: CONNECTOR

TYPE: RECTANGULAR

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
SAT	X		---	0.402	---	---	3	0	2.279
GRF	X		0.097	---	0.060	0.155	12	5	51.315
GRF		X	---	0.007	---	---	1	0	140.018
A	X		1.087	---	0.988	1.200	5	85	78.128
A		X	1.273	---	1.156	1.404	1	85	66.762
AI	X		---	0.554	---	---	19	0	1.653
SUB	X		---	3.084	---	---	16	0	0.297

PART CLASS: CONNECTOR

TYPE: TEST JACK

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		0.003	---	0.002	0.004	6	14	4515.305	
AIF	X		---	0.119	---	---	1	0	7.715	
SHS	X		0.011	---	0.008	0.015	1	9	8444.861	

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: AIR PRESSURE GAUGE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER					
GRF	X		2.611	---	2.251	3.035	4	38	14.551	
GRM	X		1.020	---	0.796	1.311	2	15	14.699	
AI	X		35.185	---	28.300	43.830	1	19	0.540	

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: ALTIMETER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS			
	MIL.	COML.			LOWER	UPPER				
AI HEL	N/A	N/A	130.506	---	121.768	139.967	4	160	1.226	
	X		269.608	---	254.226	286.071	3	220	0.816	

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: AMMETER

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRM	X		0.336	---	0.298	0.450	1	21	57.408
GRM		X	26.018	---	21.394	31.708	1	23	0.884
SHS	X		7.491	---	1.484	22.777	2	1	0.133
SUB	X		97.096	---	93.220	101.162	1	448	4.614

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: COMPASS

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
AIT HEL		X	36.090	---	29.812	43.782	3	24	0.665	
	X		252.941	---	220.137	291.147	1	43	0.170	

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: INDICATOR

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
SAT	X		---	0.904	---	---	1	0	1.013	
GRF	X		3.907	---	3.585	4.262	4	106	27.130	
GRM		X	70.413	---	64.696	76.709	2	109	1.548	
AI	X		165.406	---	163.744	167.087	1	7039	42.556	
AIT		X	163.747	---	160.608	166.960	8	1935	11.817	
HEL	X		166.956	---	162.167	171.912	18	866	5.187	

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: MAGNETIC SENSING

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER	UPPER				
SAT	X		---	1.825	---	---	2	0	0.502	
AIT		X	246.429	---	221.241	274.848	1	69	0.280	

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: RATE OF FLOW INSTRUMENT

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		8.363	---	7.209	9.720	4	38	4.543	

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: TACHOMETER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRM	X		10.682	---	9.675	11.808	1	81	7.583	
AI	N/A	N/A	23.632	---	18.991	29.396	2	19	0.804	
HEL	X		37.500	---	26.821	52.315	2	9	0.240	
SUB	X		2.298	---	1.319	3.884	1	4	1.741	

PART CLASS: EMERGENCY LIGHT

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		---	LOWER	UPPER				
GRF	X		1.966		---	1.601	2.421	2	21	10.678

PART CLASS: FAN

TYPE: AXIAL

ENVIRONMENT	APPLICATION		FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.	$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
					LOWER	UPPER					
DOR	X		---	0.126	---	---	2	0	7.260		
GRF	X		---	0.510	---	---	4	0	1.796		
GRF		X	1.854	---	1.353	2.538	2	10	5.393		
GRM	X		9.615	---	4.908	17.812	3	3	0.312		
A	X		211.557	---	199.376	224.604	1	216	1.021		
A		X	5.510	---	2.241	11.909	2	2	0.363		
AIT		X	---	57.250	---	---	1	0	0.016		
AU	X		1296.089	---	1224.091	1373.015	3	232	0.179		
HEL	X		100.000	---	19.814	304.074	1	1	0.010		
SHS	X		10.926	---	8.788	13.610	1	19	1.739		
SUB	X		1.552	---	1.248	1.946	1	18	11.600		

PART CLASS: FAN

TYPE: CENTRIFUGAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
					LOWER	UPPER			
DOR	X		---	1.692	---	---	2	0	0.541
GRF	X		---	0.357	---	---	5	0	2.568
GRM	X		1.220	---	0.960	1.553	2	16	13.114
A	X		89.200	---	85.552	93.031	1	427	4.787
A		X	21.739	---	12.484	36.749	1	4	0.184
SUB	X		8.427	---	4.301	15.610	1	3	0.356

PART CLASS: FAN

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		---	0.416	---	---	2	0	2.200	
GRF	X		2.518	---	2.289	2.773	6	87	34.557	
GRF		X	2.795	---	2.217	3.530	4	17	6.082	
GRM	X		6.253	---	5.604	6.986	1	67	10.715	
A	X		36.895	---	36.072	37.741	1	1428	38.704	
AU	X		74.627	---	46.157	118.592	1	5	0.067	
AIT		X	71.634	---	69.208	74.160	2	622	8.683	
AIF	X		---	5.234	---	---	1	0	0.175	
HEL	X		9.091	---	6.938	11.922	1	13	1.430	
SHS	X		13.761	---	12.659	14.973	2	112	8.138	
SUB	X		0.456	---	0.282	0.725	2	5	10.953	

PART CLASS: FILTER

TYPE: FLUID

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		---	0.922	---	---	1	0	0.993	
GRF	X		2.997	---	2.566	3.507	3	35	11.679	
GRM	X		2.977	---	2.560	3.467	3	37	12.430	
GRM		X	64.236	---	57.898	71.359	2	74	1.152	
AU	X		22.954	---	20.997	25.118	7	99	4.313	
AUT		X	66.496	---	60.967	72.598	3	104	1.564	
AUF	X		8.547	---	1.694	25.989	1	1	0.117	
HEL	X		49.519	---	42.495	57.813	4	36	0.727	

PART CLASS: FILTER

TYPE: GAS

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		1.201	---	0.813	1.763	1	7	5.827	
GRM	X		2.746	---	2.120	3.562	1	14	5.098	
AUT		X	2.193	---	0.435	6.668	1	1	0.456	
HEL	X		25.974	---	10.566	56.144	2	2	0.077	

PART CLASS: FILTER

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		---	0.035	---	---	2	0	25.867	
SAT	X		---	0.206	---	---	1	0	4.450	
GRM		X	66.185	---	58.602	74.865	2	55	0.831	
AU		X	---	0.954	---	---	1	0	0.960	
AUT		X	54.490	---	49.000	60.673	1	71	1.303	
HEL	X		1.265	---	1.024	1.566	1	20	15.810	

PART CLASS: GASKET AND SEAL

TYPE: GASKET, SHIELDING, RFI

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS			NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	UPPER			
GRF	X		0.356	---	0.145	0.769	1	2	5.619

PART CLASS: GASKET AND SEAL

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
	MIL.	COML.			LOWER	UPPER						
DOR	X		---	0.004	---	---	---	3	0	221.680		
GRF	X		1.338	---	1.052	1.704	---	3	16	11.959		
GRM		X	1.148	---	1.050	1.256	---	4	99	86.248		
A	X		65.788	---	65.251	66.330	---	3	10,647	161.838		
A		X	1.486	---	0.294	4.518	---	1	1	0.673		
AUT		X	122.271	---	113.516	131.803	---	1	140	1.145		
HEL	X		31.594	---	30.046	32.967	---	3	301	9.527		
SHS	X		3.767	---	2.797	5.073	---	1	11	2.920		

PART CLASS: GASKET AND SEAL

TYPE: O-RING

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER					
					LOWER							
DOR	X		---	0.078	---	---	---	---	1	0	11.699	
GRM	X		0.530	---	---	0.304	0.895	---	1	4	7.552	
A	X		2.387	---	---	2.081	2.743	---	1	44	18.431	
SHS	X		0.454	---	---	0.232	0.836	---	3	3	6.602	

PART CLASS: GASKET AND SEAL

TYPE: PACKING

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL		60% CONFIDENCE INTERVAL				
	MIL.	COML.				LOWER	UPPER	UPPER				
DOR	X		---	0.002	---	---	---		1	0	581.360	
GRF	X		3.531	---	2.525	4.926		1	1	9	2.549	
GRM	X		0.274	---	0.111	0.591		1	1	2	7.310	
A	X		1.512	---	1.199	1.910		1	1	17	11.244	
HEL	X		5.063	---	4.866	5.270		1	1	471	93.020	

PART CLASS: GENERATOR

TYPE: AC

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR SHS	X		0.806	---	0.598	1.082	2	11	13.641
	X		0.023	---	0.016	0.033	1	8	341.000

PART CLASS: GENERATOR

TYPE: DC

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER		LOWER	UPPER			
GRM AU HEL	X		36.784	---		34.482	39.264	2	183	4.975		
	X		489.649	---		471.915	508.162	2	544	1.111		
	X		205.882	---		139.415	302.076	1	7	0.034		

PART CLASS: GENERATOR

TYPE: DIESEL ENGINE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)	
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		LOWER				UPPER
					MIL.	COMPL.					
DOR	X		1.292	---		0.875	1.895	1	7	5.418	

PART CLASS: GENERATOR

TYPE: GAS ENGINE

ENVIRONMENT	APPLICATION		Λ	FAILURE RATE/10 ⁶ HOURS			NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COHL.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	UPPER			
DOR	X		2.702	---	1.099	5.840	2	2	0.740

PART CLASS: GENERATOR

TYPE: GENERAL

ENVIRONMENT	APPLICATION		Λ	FAILURE RATE/10 ⁶ HOURS			NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COHL.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	UPPER			
DOR	X		---	4.925	---	---	1	0	0.186
AU	X		113.353	---	105.532	122.073	4	309	2.726
HEL	X		12.821	---	7.930	20.374	1	5	0.390

PART CLASS: GENERATOR

TYPE: HOT GAS

ENVIRONMENT	APPLICATION		Λ	FAILURE RATE/10 ⁶ HOURS			NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COHL.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	UPPER			
DOR	X		---	0.781	---	---	1	0	1.173

PART CLASS: GENERATOR

TYPE: MOTOR/GENERATOR

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR	X		---	0.210	---	---	3	0	4.353
GRF	X		27.778	---	15.952	46.957	1	4	0.144
GRM	X		166.667	---	67.797	360.259	1	2	0.012
AUF	X		---	2.610	---	---	1	0	0.351

PART CLASS: GENERATOR

TYPE: TURBINE/GENERATOR

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR	X		38.052	---	19.422	70.488	1	3	0.078
GRF	X		626.217	---	597.420	656.639	1	338	0.539
GRF		X	11.925	---	10.462	13.616	1	48	4.025
SHS	X		14.409	---	11.661	17.840	1	20	1.388

PART CLASS: GYROSCOPE

TYPE: DIRECTIONAL

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
AI HEL	X		513.917	---	507.464	520.469	6	4505	8.766
	X		300.000	---	264.296	341.075	3	51	0.170

PART CLASS: GYROSCOPE

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL,	COML,		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL							
					LOWER	UPPER						
DOR SAT	X		0.247	---	0.229	0.267	1	128	518.000			
	X		3.503	---	1.425	7.571	3	2	0.571			

PART CLASS: GYROSCOPE

TYPE: RATE INTEGRATING

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER					
	MIL.	COML.			LOWER	UPPER						
DOR	X		0.409	---	0.368	0.454	15	73	178.654			
SAT	X		---	5.295	---	---	1	0	0.173			
GRM	X		31.051	---	29.530	32.664	4	298	9.597			
AI	X		352.023	---	347.857	356.248	7	5073	14.411			
AI		X	4.167	---	1.695	9.006	2	2	0.480			
AIF	X		288.156	---	272.286	305.103	1	236	0.819			
HEL	X		75.000	---	53.643	104.630	1	9	0.120			
SUB	X		70.919	---	68.468	73.474	1	597	8 '18			
MIS	X		541.667	---	451.157	651.686	1	26	C '18			

PART CLASS: HEATER

TYPE: ELECTRIC, GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL		UPPER					
					LOWER							
SAT	X		0.450	---	0.089		1.369	3	1	2.221		
GRF	X		2.286	---	1.313		3.864	3	4	1.750		
GRM	X		---	4.468	---		---	1	0	0.205		
A		X	---	1.454	---		---	1	0	0.630		
AIT		X	17.738	---	15.352		20.532	3	40	2.255		
HEL	X		50.000	---	25.520		92.621	1	3	0.060		
SUB	X		7.595	---	3.876		14.069	1	3	0.395		

PART CLASS: HEATER

TYPE: ELECTRIC, SPACE

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS								
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRF	X		1.157	---	0.883	1.517	4	13	11.239

PART CLASS: HEATER

TYPE: GENERAL

ENVIRONMENT	APPLICATION		λ	FAILURE RATE/ 10^6 HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
					LOWER						
DOR	X		---	0.268	---			---	3	0	3.416

PART CLASS: HEAT EXCHANGER

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER? SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		0.904	---	0.461	1.675	1	3	3.318	
GRM	X		3.876	---	2.525	5.888	1	6	1.548	
A	X		1.116	---	1.074	1.160	1	505	452.369	
AU	X		2.899	---	2.152	3.903	2	11	3.795	
AUT		X	5.344	---	3.618	7.840	1	7	1.310	
AUF	X		21.898	---	17.058	28.029	3	15	0.685	
SHS	X		---	1.667	---	---	1	0	0.549	
SUB	X		---	4.447	---	---	1	0	0.206	

PART CLASS: HOSE

TYPE: FITTINGS, GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL							
	MIL.	COML.				LOWER	UPPER					
DOR	X		0.461	---	0.265	0.780	2	4	8.674			
GRM	X		13.035	---	8.827	19.126	2	7	0.537			
A	X		19.048	---	10.938	32.199	2	4	0.210			
AU	X		1118.928	---	1082.369	1156.945	1	668	0.597			
HEL	X		3.898	---	3.311	4.597	2	32	8.210			

PART CLASS: HOSE

TYPE: HYDRAULIC

ENVIRONMENT	APPLICATION MIL. COHL.		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER					
DOR	X		1.613	---	1.092	1.613	2	7	4.339	
GRF	X		---	1.105	---	---	1	0	0.829	
GRM	X		0.240	---	0.189	0.305	2	16	66.766	
A	X		115.830	---	97.821	137.433	1	30	0.259	
HEL	X		32.941	---	30.789	35.267	1	168	5.100	

PART CLASS: LAMP

TYPE: INCANDESCENT

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		---	0.006	---	---	---	1	0	141.538
GRF		X	0.906	---	0.590	1.376	---	2	6	6.623
GRM	X		10.171	---	4.137	21.985	---	1	2	0.196
GRM		X	---	0.054	---	---	---	2	0	16.900
SHS	X		18.624	---	18.029	19.241	---	1	700	37.586

PART CLASS: LAMP

TYPE: LED

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
	MIL.	COML.			LOWER	UPPER	
GRF		X	0.276	---	0.264	0.289	16
GRF	X		---	0.480	---	---	1
							363
							0
							1312.882
							1.910

PART CLASS: LAMP

TYPE: NEON

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
	MIL.	COML.			LOWER	UPPER	
SHS	X		0.489	---	0.407	0.588	1
							26
							53.215

PART CLASS: MANIFOLD

TYPE: GENERAL

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
	MIL.	COML.			LOWER	UPPER	
DOR	X		0.613	---	0.249	1.325	3
GRM	X		7.390	---	7.047	7.753	2
A	X		27.568	---	26.469	28.721	1
AU	X		152.318	---	140.278	165.541	1
AUT		X	31.682	---	28.052	35.837	1
HEL	X		75.194	---	68.719	82.364	1
							2
							332
							449
							115
							55
							97
							3.263
							44.924
							16.287
							0.755
							1.736
							1.290

PART CLASS: MECHANICAL DEVICE

TYPE: CLUTCH

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
	MIL.	COML.			LOWER	UPPER				
GRF SHS		X	0.594 ---	---	0.571 ---	0.619 ---	1 1	478 0	804.347 0.536	
	X			1.708						

PART CLASS: MECHANICAL DEVICE

TYPE: COUPLING

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		5.341	---	3.067	9.028	1	4	0.748	

PART CLASS: MECHANICAL DEVICE

TYPE: GEAR

ENVIRONMENT	APPLICATION		FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL						
	MIL.	COML.			LOWER	UPPER					
GRF	X		---	0.175	---	---	---	4	0	5.230	
GRF		X	0.169	---	0.129	0.218		1	14	83.067	
SHS	X		0.073	---	0.016	0.170		2	1	13.641	

PART CLASS: MECHANICAL DEVICE

TYPE: GEAR ASSEMBLY

ENVIRONMENT	APPLICATION		λ	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)	
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		40.515				65.578
					LOWER	UPPER					
SHS	X	COML.	51.503	---				3	16	0.310	

PART CLASS: MECHANICAL DEVICE

TYPE: GEAR SHAFT

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
SUB	X		6.730	---	1.333	20.464	1	1	0.148

PART CLASS: MECHANICAL DEVICE

TYPE: JOY STICK ASSEMBLY

ENVIRONMENT	APPLICATION MIL, COML.		FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER					
SHS	X		14.482	---	5.967		31.064	2	2	0.138

PART CLASS: MECHANICAL DEVICE

TYPE: MECHANISM, POWER TRANSMITTAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
	MIL.	COML.			LOWER	UPPER				
DOR	X		0.112	---	0.022	0.341	2	1	8.929	
SAT	X		---	6.836	---	---	2	0	0.134	
GRF	X		1.670	---	1.379	2.024	7	24	14.370	
GRF		X	54.054	---	42.480	68.709	2	16	0.296	
GRM	X		11.528	---	10.927	12.168	2	263	22.814	
GRM		X	41.622	---	39.374	43.864	4	272	6.535	
AU	X		10.987	---	10.842	11.135	9	4057	369.258	
AUT		X	9.256	---	8.653	9.908	9	169	18.258	
AUF	X		1.960	---	1.125	3.313	1	4	2.041	
HEL	X		986.655	---	961.652	1012.428	8	1109	1.124	
SHS	X		1.776	---	0.352	5.401	1	1	0.563	

PART CLASS: MECHANICAL DEVICE

TYPE: SPEED DRIVE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	60% UPPER SINGLE-SIDED CONFIDENCE			
	MIL.	COML.			LOWER	UPPER						
AUT		X	131.108	---	120.511	142.772	2	110	0.839			

PART CLASS: MECHANICAL DEVICE

TYPE: SPRING

ENVIRONMENT	APPLICATION MIL, COML.	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% UPPER SINGLE-SIDED CONFIDENCE			
				LOWER	UPPER				
GRF	X	---	5.551	---	---	1	0	0.165	
AIF	X	---	1.406	---	---	2	0	0.651	

PART CLASS: MISCELLANEOUS

TYPE: COIL, COOLING-CHILLED WATER

ENVIRONMENT	APPLICATION MIL, COML.	λ	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% UPPER SINGLE-SIDED CONFIDENCE			
				LOWER	UPPER				
GRF	X	1.005	---	0.621	1.597	2	5	4,976	

PART CLASS: MISCELLANEOUS

TYPE: ENGINE

ENVIRONMENT	APPLICATION MIL, COML.		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% UPPER SINGLE-SIDED CONFIDENCE				
					LOWER	UPPER					
DOR	X		0.898	---	0.608	1.318	1	7	7.792		
GRF		X	577.397	---	563.952	591.222	1	1313	2.274		

PART CLASS: MISCELLANEOUS

TYPE: RF CABLE ASSEMBLY

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER					
GRF	X		---	0.545	---		---	1	0	1.681

PART CLASS: MISCELLANEOUS

TYPE: SAFE AND ARM DEVICE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER					
DOR	X		0.482	---	0.414	0.563	5	36	74.706	

PART CLASS: MOTOR

TYPE: FRACTIONAL H.P.

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		LOWER	UPPER				
	MIL.	COML.										
GRF	X		3.307	---	2.660	4.120		2	19	5.744		
GRF		X	1.498	---	1.396	1.609		1	154	102.788		
GRM	X		7.552	---	7.080	8.059		1	184	24.366		
AI	X		4.829	---	3.799	6.148		1	16	3.313		

PART CLASS: MOTOR

TYPE: FULL H.P.

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
	MIL.	COHL.			LOWER						
DOR	X		0.499	---	0.099	1.517		1	1	2.004	
GRF	X		0.913	---	0.773	1.080		12	31	33.967	
GRM	X		4.238	---	3.468	5.191		2	22	5.190	

PART CLASS: MOTOR

TYPE: GENERAL, A.C.

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER	LOWER				
	MIL.	COHL.										
GRF	X		1.235	---	0.883	1.723			2	9	7.288	
SHS	X		10.243	---	8.882	11.833			6	41	4.000	
SUB	X		2.247	---	0.914	4.820			2	2	0.890	

PART CLASS: MOTOR

TYPE: GENERAL, D.C.

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
	MIL.	COML.			LOWER						
SAT	X		0.871	---	0.354	1.884	2	2	2.295		
GRM	X		9.132	---	6.665	12.500	1	10	1.095		
AU	X		187.387	---	171.807	204.581	1	104	0.555		
AUT		X	157.209	---	152.103	162.518	2	676	4.300		
HEL	X		190.909	---	155.387	235.027	1	21	0.110		
SUB	X		31.384	---	25.679	38.434	2	22	0.701		

PART CLASS: MOTOR

TYPE: INDUCTION

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER					
GRF	X		---	14.774	---		---	1	0	0.062

PART CLASS: MOTOR

TYPE: PM

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS									
	APPLICATION		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)	
	MIL.	COML.			LOWER	UPPER				
GRF	X		---	4.202	---	---	1	0	0.218	

PART CLASS: MOTOR

TYPE: SENSOR

ENVIRONMENT	APPLICATION		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRM	X		0.792	---	0.322	1.713	1	2	2.524
A		X	8.152	---	4.161	15.101	1	3	0.368
SHS	X		---	0.389	---	---	1	0	2.357
SUB	X		10.487	---	10.112	10.879	1	557	53.114

PART CLASS: MOTOR

TYPE: SOLENOID

ENVIRONMENT	APPLICATION		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR	X		---	2.379	---	---	1	0	0.385
SAT	X		*	0.034	---	---	1	0	26.975

PART CLASS: MOTOR

TYPE: STEP

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		λ	60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL	
	MIL.	COML.		LOWER	UPPER	LOWER	UPPER
GRF		X	1.378	---		0.568	2.956
						1	2
							1.451

PART CLASS: MOTOR

TYPE: TORQUE

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		λ	60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL	
	MIL.	COML.		LOWER	UPPER	LOWER	UPPER
DOR	X		---	0.220	---	---	---
GRM	X		---	4.183	---	---	---
SUB	X		---	0.425	---	---	---
						1	0
						1	0
						1	0
							4.158
							0.219
							2.153

PART CLASS: PUMP

TYPE: BOILER FEED

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		λ	60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL	
	MIL.	COML.		LOWER	UPPER	LOWER	UPPER
GRF	X		0.422	---		0.381	0.467
						1	78
							185.000

PART CLASS: PUMP

TYPE: CENTRIFUGAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		12.013	---	10.176	14.211	5	31	2.580	
GRF		X	5.777	---	4.500	7.408	3	15	2.596	
SHS	X		298.122	---	282.298	314.980	1	254	0.852	

PART CLASS: PUMP

TYPE: COOLANT

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
A	X		657.251	---	648.831	665.803	1	4328	6.585	
AUT		X	154.545	---	122.563	195.215	1	17	0.110	

PART CLASS: PUMP

TYPE: ELECTRIC MOTOR DRIVEN

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
	MIL,	COHL.			LOWER	UPPER				
A		X	6.889	---	5.576	8.530	4	20	2.903	
AIT		X	387.352	---	354.168	424.080	1	98	0.253	
AU	X		354.817	---	341.710	368.516	3	523	1.474	
AUT		X	10.000	---	1.981	30.407	1	1	0.100	
HEL	X		20.000	---	3.963	60.815	1	1	0.050	

PART CLASS: PUMP

TYPE: ENGINE DRIVEN

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS									
	APPLICATION MIL. COMH.		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)	
					LOWER	UPPER				
A		X	18.519	---	9.452	34.304	1	3	0.162	
AIT		X	443.137	---	418.195	469.810	1	226	0.510	
AUT		X	231.343	---	195.964	273.660	1	31	0.134	
HEL	X		86.667	---	72.185	104.270	1	26	0.300	

PART CLASS: PUMP

TYPE: FIXED DISPLACEMENT

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		λ	50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER.	UPPER			
DOR GRF	X		0.250	---	0.232	0.270	6	135	540.000
	X		1.464	---	0.290	4.452	1	1	0.683

PART CLASS: PUMP

TYPE: FUEL

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	CONL.			LOWER	UPPER			
DOR	X		---	0.057	---	---	3	0	16.140
GRF	X		176.471	---	149.034	209.383	1	30	0.170
GRM	X		6.683	---	5.879	7.608	2	50	7.482
GRM		X	181.001	---	168.088	195.057	1	141	0.779
A	X		71.879	---	70.166	73.642	3	1253	17.432
AU	X		37.539	---	33.783	41.766	1	72	1.918
AUT		X	10.471	---	9.555	11.487	7	94	8.977
AUF	X		130.342	---	116.167	146.457	3	61	0.468
HEL	X		334.821	---	302.005	371.668	1	75	0.224

PART CLASS: PUMP

TYPE: GEROTER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER					
	M/L	CONL.			LOWER	UPPER						
A	X		18.286	---	14.384	23.283	2	16	0.875			
AUF	X		30.525	---	25.323	36.873	1	25	0.819			

PART CLASS: PUMP

TYPE: HYDRAULIC

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
	MIL.	COML.			LOWER	UPPER				
DOR	X		0.178	---	0.155	0.204	15	43	242.136	
GRF	X		1.675	---	1.036	2.662	1	5	2.985	
GRM	X		42.437	---	41.241	43.675	4	897	21.137	
A	X		573.711	---	565.297	582.275	1	3304	5.759	
AIT		X	6.289	---	5.295	7.486	4	29	4.611	
AUF	X		799.145	---	749.673	852.400	1	187	0.234	
HEL	X		395.022	---	377.544	413.448	4	365	0.924	

PART CLASS: PUMP

TYPE: HYDRAULIC MOTOR DRIVEN

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS									
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)	
					MIL.	COML.				LOWER
GRF		X	4.219	---	3.452	5.166	4	2	5.215	
AUF	X		16.949	---	3.358	51.538	1	1	0.059	
SUB	X		34.330	---	29.080	40.610	2	31	0.903	

PART CLASS: PUMP

TYPE: IMPELLER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		---			
					LOWER	UPPER				
GRF	X		---	1.741	---	---	1	0	0.526	

PART CLASS: PUMP

TYPE: OIL

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRM		X	28.241	---	23.108	34.586	1	22	0.779
A	X		59.459	---	50.648	69.941	1	33	0.555
AIT		X	11.687	---	9.610	14.243	1	23	1.968
HEL	X		45.455	---	26.103	76.839	2	4	0.088
SHS	X		78.975	---	71.183	87.732	1	74	0.937

PART CLASS: PUMP

TYPE: TURBINE DRIVEN

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS			
	MIL.	COML.			LOWER	UPPER				
AU	X		78.189	---	69.391	88.236	1	57	0.729	
GRM		X	0.342	---	0.325	0.361	1	265	774.000	
AUT		X	66.667	---	53.262	83.601	1	18	0.270	

PART CLASS: PUMP

TYPE: VACUUM

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRF		X	27.027	---	5.355	82.182	3	1	0.037
A	X		15.464	---	7.893	28.646	1	3	0.194

PART CLASS: PUMP

TYPE: VARIABLE DISPLACEMENT

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		0.200	---	0.162	0.248	2	20	100.000	

PART CLASS: PUMP

TYPE: WATER

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
	MIL.	COML.			LOWER	UPPER	
GRM AUT		X	0.342	---	0.325	0.361	1
		X	66.667	---	53.262	83.601	1
							NUMBER FAILED
							265 18
							OPERATING HOURS (X 10 ⁶)
							774.000 0.270

PART CLASS: REGULATOR

TYPE: FUEL

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
	MIL.	COML.			LOWER	UPPER	
AU HEL	X		178.807	---	174.107	183.657	1
	X		136.213	---	118.118	157.363	2
							NUMBER FAILED
							1031 41
							OPERATING HOURS (X 10 ⁶)
							5.766 0.301

PART CLASS: REGULATOR

TYPE: GENERAL

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
	MIL.	COML.			LOWER	UPPER	
A	N/A	N/A	4.072	---	2.908	5.656	3
							NUMBER FAILED
							9
							OPERATING HOURS (X 10 ⁶)
							2.210

PART CLASS: REGULATOR

TYPE: OXYGEN DEMAND

ENVIRONMENT	APPLICATION MIL. COHL.	FAILURE RATE/10 ⁶ HOURS				
		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
				LOWER	UPPER	
A	X	736.274	---	714.541	758.788	1
						818
						1.111

PART CLASS: REGULATOR

TYPE: PRESSURE

ENVIRONMENT	APPLICATION MIL. COHL.	FAILURE RATE/10 ⁶ HOURS				
		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
				LOWER	UPPER	
DOR	X	---	0.906	---	---	2
SAT	X	2.857	---	0.566	8.688	2
GRF	X	2.435	---	2.145	2.768	13
GRM	X	2.525	---	1.811	2.805	3
A	N/A	83.117	---	81.714	84.549	23
HEL	X	55.319	---	46.076	66.555	1
						0
						1
						51
						19
						2495
						26
						1.011
						0.350
						20.946
						8.437
						30.018
						0.470

PART CLASS: REGULATOR

TYPE: TENSION

ENVIRONMENT	APPLICATION MIL. COHL.	FAILURE RATE/10 ⁶ HOURS				
		λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
				LOWER	UPPER	
A	X	5.221	---	4.381	6.235	1
						28
						5.363

PART CLASS: REGULATOR

TYPE: THERMOSTAT

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL						
	MIL.	COML.				LOWER	UPPER					
SAT	X		3.484	---		0.690	10.595		1	1	0.287	
GRF	X		4.858	---		4.369	5.410		5	71	14.613	
GRF		X	17.386	---		14.535	20.838		1	27	1.553	
A	X		233.746	---		230.308	237.245		1	3286	14.058	
AIT		X	22.562	---		21.248	23.971		3	211	9.352	

PART CLASS: REGULATOR

TYPE: VOLTAGE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER	UPPER				
GRF	X		2.998	---	2.188	4.103	1	10	3.336	

PART CLASS: RELAY

TYPE: ARMATURE

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRF	X		0.375	---	0.326	0.432	17	43	114.702
GRF		X	0.015	---	0.003	0.044	2	1	68.807
GRM	X		1.229	---	0.243	3.736	1	1	0.814
GRM		X	---	0.271	---	---	1	0	3.380
AIT	X		0.054	---	0.044	0.066	2	21	392.000
SHS	X		0.915	---	0.843	0.995	2	116	126.716
SUB	X		1.030	---	1.020	1.041	1	6953	6750.051

PART CLASS: RELAY

TYPE: COAXIAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		---				
					LOWER	UPPER					
GRF	X		---	3.923	---	---	---	1	0	0.233	

PART CLASS: RELAY

TYPE: CRYSTAL CAN

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		---	0.021	---	---	1	0	43.469	
GRF	X		0.156	---	0.105	0.228	2	7	44.954	
GRF		X	0.082	---	0.068	0.100	11	23	279.663	
AIT	X		7.407	---	6.256	8.789	2	30	4.050	
SHS	X		---	0.920	---	---	1	0	0.996	

PART CLASS: RELAY

TYPE: CURRENT SENSITIVE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		---			
	MIL.	COML.			LOWER	UPPER				
GRF		X	---	1.285	---	---	1	0	0.713	

PART CLASS: RELAY

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		LOWER	UPPER				
DOR	X		0.024	---	0.019	0.030	10	19	799.900			
SAT	X		0.013	---	0.007	0.024	9	3	231.331			
GRF	X		0.189	---	0.158	0.227	13	27	142.656			
GRF		X	1.909	---	1.847	1.974	15	670	350.882			
GRM	X		---	1.165	---	---	6	0	0.786			
AIT		X	4.106	---	3.724	4.533	9	83	20.212			
AIF	X		---	12.189	---	---	1	0	0.075			
HEL	X		30.986	---	27.014	35.604	1	44	1.420			
SHS	X		0.932	---	0.825	1.054	9	55	59.003			
SUB	X		0.353	---	0.341	0.366	5	632	1788.524			

PART CLASS: RELAY

TYPE: HIGH VOLTAGE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		---	0.545	---		1	0	1.681	
GRF		X	0.551	---	0.109	1.674	3	1	1.816	

PART CLASS: RELAY

TYPE: LATCHING

ENVIRONMENT	APPLICATION		λ	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		0.081	---	0.016	0.247	1	1	12.333	
SAT	X		---	0.066	---	---	7	0	13.897	
GRF	X		0.027	---	0.017	0.041	6	6	225.862	
GRF		X	0.182	---	0.074	0.393	4	2	11.000	
AIT	X		0.043	---	0.008	0.130	1	1	23.400	
AIF	X		---	7.328	---	---	3	0	0.125	
SUB	X		0.342	---	0.330	0.354	1	601	1759.452	

PART CLASS: RELAY

TYPE: MOTOR DRIVEN

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		15.048			
	MIL.	COML.			LOWER	UPPER				
GRF		X	22.222	---		32.605	1	7	0.315	

PART CLASS: RELAY

TYPE: POWER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% UPPER SINGLE-SIDED CONFIDENCE				
	MIL.	COML.			LOWER	UPPER					
GRF	X		1.013	---	0.686	1.486	1	7	6.912		
GRF		X	1.930	---	1.505	2.480	6	15	7.770		
GRM	X		7.009	---	4.566	10.647	2	6	0.856		
A	X		9.502	---	8.360	10.818	1	50	5.262		
SHS	X		0.198	---	0.101	0.367	4	3	15.139		

PART CLASS: RELAY

TYPE: REED

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
	MIL.	COML.			LOWER	UPPER					
GRF	X		0.194	---	0.152	0.246	4	16	82.675		
GRF		X	0.873	---	0.698	1.095	2	18	20.609		
SUB		X	1.436	---	1.289	1.602	6	69	48.042		
SUB	X		---	0.733	---	---	1	0	1.250		

PART CLASS: RELAY

TYPE: THERMAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER	UPPER				
DOR	X		---	2.000	---	---	---	1	0	0.458
GRF	X		13.089	---	8.096	20.800	---	1	5	0.382
GRF		X	0.435	---	0.177	0.941	---	1	2	4.596
AIT	X		25.641	---	5.081	77.968	---	1	1	0.039
SHS	X		0.746	---	0.304	1.613	---	1	2	2.680
SUB	X		10.667	---	7.445	15.223	---	1	8	0.750

PART CLASS: RELAY

TYPE: TIME DELAY

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER	UPPER				
GRF	X		1.567	---	1.164	2.110	4	11	7.019	
GRF		X	---	1.908	---	---	1	0	0.480	
GRM	X		4.246	---	1.727	9.179	1	2	0.471	
AIT	X		26.620	---	21.889	32.442	1	23	0.864	
SHS	X		1.014	---	0.862	1.196	2	3	4.950	
MIS	X		---	1.953	---	---	1	0	0.469	

PART CLASS: ROTARY JOINT

TYPE: MICROWAVE

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRF A	X	X	--- 393.162	0.401 ---	--- 343.875	--- 450.280	1 1	0 46	2.282 0.117

PART CLASS: SENSOR

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL						
	MIL.	COML.				LOWER	UPPER					
DOR	X		0.545	---		0.398	0.746	1	10	18.340		
GRF	X		2.980	---		2.545	3.496	9	34	11.409		
GRF		X	60.606	---		24.654	131.003	1	2	0.033		
A	X		88.980	---		82.367	96.203	2	130	1.461		
AIT		X	89.252	---		83.786	95.133	2	191	2.140		
AU	X		672.367	---		651.597	693.921	1	747	1.111		
AUT		X	50.575	---		44.091	58.113	1	44	0.870		
HEL	X		76.613	---		66.039	89.047	5	38	0.496		

PART CLASS: SHOCK ABSORBER

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		---	0.552	---	---	1	0	1.658	
GRM	X		---	1.141	---	---	1	0	0.803	
HEL	X		17.460	---	14.287	21.383	1	22	1.260	

PART CLASS: SHOCK ABSORBER

TYPE: GENERAL, MOUNT

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER					
					LOWER							
GRF	X		0.806	---	0.328	1.742	1	2	2.482			
A	X		6.309	---	3.623	10.665	1	4	0.634			
AUF	X		6.826	---	2.777	14.755	2	2	0.293			
HEL	X		131.579	---	102.581	169.017	1	15	0.114			

PART CLASS: SHOCK ABSORBER

TYPE: ISOLATOR

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER					
GRF	X		1.206	---	0.239	3.666	1	1	0.829	

PART CLASS SLIP RING ASSEMBLY

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		---	0.110	---	---	2	0	8.316	
SAT	X		---	2.245	---	---	2	0	0.408	
GRF	X		---	2.096	---	---	1	0	0.437	
GRM	X		49.879	---	45.712	54.480	1	103	2.065	
A	X		---	0.174	---	---	2	0	5.261	
SHS	X		---	0.148	---	---	1	0	6.168	
SUB	X		39.918	---	34.480	46.299	1	39	0.977	

PART CLASS: SOCKET

TYPE: DUAL-IN-LINE (PER PIN)

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRF SHS		X	0.00056 ---	---	0.00012	0.0017	1	1	1801.200
	X			0.005	---	---	1	0	200.500

PART CLASS: SOCKET

TYPE: HIGH POWER TUBE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL				
	MIL.	COML.				LOWER	UPPER			
GRF	X		---	0.477	---	---	---	1	0	1.921

PART CLASS: SOCKET

TYPE: LAMP

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		---	0.007	---	---	1	0	124.942	
SHS	X		---	0.012	---	---	1	0	76.218	

PART CLASS: SOCKET

TYPE: RELAY

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
					LOWER	UPPER					
SHS	X		---	0.144	---	---	---	1	0	6.343	

PART CLASS: SOLENOID

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COMPL.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		----	0.300	----	----	1	0	3.057	
SAT	X		0.715	---	0.142	2.174	2	1	1.399	
A	X		65.637	---	63.372	67.997	3	599	9.126	
AIT		X	18.031	---	13.761	23.646	1	13	0.721	
SUB	X		---	25.641	16.703	38.950	1	6	0.234	

PART CLASS: SPRINKLER HEAD

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/ 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COMPL.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		0.619	---	0.530	0.724	3	35	56.573	

PART CLASS: SWITCH

TYPE: CENTRIFUGAL

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER.	UPPER			
GRF	X		1.808	---	1.178	2.747	2	6	3.317
AIT		X	30.769	---	12.516	66.509	1	2	0.065
AU	X		353.204	---	333.793	373.930	1	237	0.671
HEL	X		73.759	---	60.205	90.108	1	22	0.299

PART CLASS: SWITCH

TYPE: COAXIAL

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRF	X		0.285	---	0.164	0.482	3	4	14.031
GRF		X	0.431	---	0.175	0.931	2	2	4.645
AIF	X		---	18.283	---	---	1	0	0.050
SUB	X		1.971	---	0.439	5.917	1	1	0.507

PART CLASS: SWITCH

TYPE: Dual-In-Line (DIP)

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		---	1.807	---	---	2	0	0.507	

PART CLASS: SWITCH

TYPE: FLOW

ENVIRONMENT	APPLICATION MIL. COML.	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS			
				LOWER	UPPER				
GRF	X	4.492	---	4.023	5.024	5	66	14.691	
SHS	X	---	1.839	---	---	1	0	0.498	
SUB	X	2.542	---	1.721	3.718	1	7	2.754	

PART CLASS: SWITCH

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		---	0.020	---	---	5	0	44.949	
SAT	X		0.508	---	0.292	0.858	2	4	7.880	
GRF	X		1.986	---	1.633	2.420	9	23	11.581	
GRF		X	0.129	---	0.025	0.391	4	1	7.778	
AI		X	0.506	---	0.206	1.094	1	2	3.952	
AIT		X	107.295	---	104.541	110.135	2	1081	10.075	
AIF	X		11.976	---	6.113	21.992	1	3	0.251	
HEL	X		178.097	---	169.706	186.975	1	322	1.808	
SHS	X		---	0.173	---	---	6	0	5.297	
SUB	X		0.506	---	0.206	1.094	1	2	3.952	

PART CLASS: SWITCH

TYPE: HUMIDITY

ENVIRONMENT		APPLICATION MIL. COML.		FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
						LOWER	UPPER			
GRF		X		16.775	---	9.633	28,358	1	4	0.238

PART CLASS: SWITCH

TYPE: INERTIAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER			
DOR	X		0.066	---	0.047	0.092	1	9	137.100

PART CLASS: SWITCH

TYPE: KEY

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER			
GRF		X	2.317	---	1.508	3.514	1	6	2.589

PART CLASS: SWITCH

TYPE: LIQUID LEVEL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER			
GRF	X		5.277	---	3.029	8.839	2	4	0.758
AU	X		285.714	---	116.224	617.586	1	2	0.007
AUT		X	---	18.320	---	---	1	0	0.050
HEL	X		46.512	---	18.920	100.537	1	2	0.043

PART CLASS: SWITCH

TYPE: PENDANT-HOIST

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER					
GRF	X		6.155	---	3.142		11.402	1	3	0.487

PART CLASS: SWITCH

TYPE: PRESSURE

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS							OPERATING HOURS (x 10 ⁶)	
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS		
	MIL.	COML.			LOWER.	UPPER			
DOR	X		0.083	---	0.048	0.140	2	4	48.300
GRF	X		0.976	---	0.852	1.120	11	45	46.095
GRM	X		6.934	---	6.500	7.402	5	183	26.390
A	N/A	N/A	39.030	---	37.718	40.396	5	631	16.167
HEL	X		95.028	---	86.334	104.716	2	86	0.905
SHS	X		22.556	---	18.021	28.286	1	18	0.798
SUB	X		6.525	---	3.747	11.031	1	4	0.613

PART CLASS: SWITCH

TYPE: PUSH BUTTON

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER UPPER			
DOR	X		---	1.519	---	1	0	0.603
GRF	X		0.144	---	0.101	28	8	55.533
GRF		X	27.155	---	26.694	3	21102	777.089
GRM	N/A	N/A	---	0.226	---	5	0	4.053
A	N/A	N/A	7.353	---	6.738	7	103	14.009
HEL	X		---	0.712	---	1	0	1.286
SHS	X		0.448	---	0.398	2	57	127.097
SUB	X		0.078	---	0.053	3	7	90.228

PART CLASS: SWITCH

TYPE: REED

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER UPPER			
DOR	X		---	0.950	---	1	0	0.964
SAT	X		---	2.018	---	1	0	0.908
GRF		X	---	0.001	---	1	0	1200.000
GRM		X	0.123	---	0.050	1	2	16.252

PART CLASS: SWITCH

TYPE: ROTARY

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER					
SAT	X		0.418	---	0.083	1.272	1	1	2.391	
GRF	X		0.691	---	0.610	0.785	15	52	75.242	
GRM	X		---	9.347	---	---	8	0	0.098	
A	X		16.001	---	15.098	16.966	2	225	14.062	
AI	X		37.313	---	21.428	63.076	2	4	0.107	
AIT	X		---	0.205	---	---	1	0	4.460	
AIT		X	131.579	---	102.581	169.017	2	15	0.114	
HEL	X		21.739	---	8.843	46.990	2	2	0.092	
SHS	X		1.465	---	1.329	1.616	4	84	57.344	
SUB	X		2.406	---	2.685	3.000	17	67	24.955	

PART CLASS: SWITCH

TYPE: SENSITIVE

ENVIRONMENT	APPLICATION MIL. COML.	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% UPPER SINGLE-SIDED CONFIDENCE			
				LOWER	UPPER				
DOR	X	---	0.409	---	---	---	3	0	2.237
GRF	X	2.707	---	2.379	3.087	---	11	49	18.098
A	X	14.650	---	13.735	15.634	---	1	184	12.560
HEL	X	107.500	---	93.558	123.738	---	1	43	0.400
SHS	X	---	0.347	---	---	---	2	0	2.636
SUB	X	1.104	---	0.972	1.255	---	2	51	46.202

PART CLASS: SWITCH

TYPE: SHAFT

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
	MIL.	COML.			LOWER	UPPER	
GRF		X	0.236	---	0.053	0.709	1
							NUMBER FAILED
							1
							OPERATING HOURS (x 10 ⁶)
							4.229

PART CLASS: SWITCH

TYPE: SNAP SLIDE

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
	MIL.	COML.			LOWER	UPPER	
GRM		X	---	0.271	---	---	1
SUB	X		0.216	---	0.170	0.275	1
							NUMBER FAILED
							0
							3.380
							74.050

PART CLASS: SWITCH

TYPE: STEPPING

ENVIRONMENT	FAILURE RATE/10 ⁶ HOURS						
	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS
	MIL.	COML.			LOWER	UPPER	
DOR	X		0.400	---	0.163	0.865	1
SUB	X		21.368	---	13.216	33.956	1
							NUMBER FAILED
							2
							5.000
							0.234

PART CLASS: SWITCH

TYPE: THERMAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		0.389	---	0.158	0.841	2	2	5.140	

PART CLASS: SWITCH

TYPE: THERMOSTAT

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR	X		---	0.170	---	---	4	0	5.382
GRF	X		1.784	---	1.452	2.187	7	21	11.769
GRF		X	---	2.462	---	---	4	0	0.372
GRM	X		---	0.862	---	---	1	0	1.063
A	N/A	N/A	6.554	---	5.714	7.531	4	44	6.713
HEL	X		41.284	---	29.528	57.595	2	9	0.218
SHS	X		0.599	---	0.505	0.713	2	29	48.381
SUB	X		1.099	---	0.744	1.612	4	7	6.370

PART CLASS: SWITCH

TYPE: THUMB WHEEL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRM	X		---	3.299	---	---	11	0	0.277	
AIT		X	15.856	---	8.093	29.372	1	3	0.189	

PART CLASS: SWITCH

TYPE: TOGGLE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		---	0.907	---	---	1	0	1.010	
GRF	X		0.270	---	0.254	0.292	19	163	598.769	
GRM	X		0.243	---	0.054	0.720	6	1	4.166	
A	X		7.194	---	6.813	7.600	4	255	35.446	
AI	X		29.732	---	19.369	45.164	6	6	0.201	
HEL	X		18.605	---	12.985	26.552	1	8	0.430	
SHS	X		0.553	---	0.495	0.619	16	66	119.306	
SUB	X		0.041	---	0.032	0.051	18	18	443.176	

PART CLASS: SWITCH

TYPE: WAVE GUIDE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER	UPPER				
GRF	X		1.643	---	0.366	4.926	2	1	.609	
GRM	X		3.653	---	2.098	6.175	1	4	1.095	

PART CLASS: SYNCHRO

TYPE: DIFFERENTIAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER	UPPER				
SUB	X		1.313	---	1.124	1.537	2	35	26.658	

PART CLASS: SYNCHRO

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRM	X		4.198	---	3.534	4.997	1	29	6.908	
A	X		336.831	---	320.935	353.648	1	321	0.953	
A		X	---	2.544	---	---	1	0	0.360	
AUT		X	---	10.178	---	---	1	0	0.090	
AUF	X		102.857	---	82.175	128.984	1	18	0.175	
HEL	X		150.000	---	116.942	192.679	1	15	0.100	
SUB	X		0.353	---	0.180	0.653	1	3	8.506	

PART CLASS: SYNCHRO

TYPE: RECEIVER, TRANSMITTER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10^6 HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		LOWER	UPPER				
A	X		0.649	---	0.129	1.975	1	1	1.540			
A		X	7.426	---	2.948	15.663	1	2	0.276			

PART CLASS: SYNCHRO

TYPE: RESOLVER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS						NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER					
					LOWER							
DOR	X		0.135	---	0.055	0.291	3	2	14.858			
GRF	X		---	2.398	---	---	1	0	0.382			
A	X		9.032	---	7.802	10.476	1	39	4.318			
A		X	3.378	---	1.940	5.711	2	4	1.184			
SHS	X		55.556	---	22.599	120.086	1	2	0.036			
SUB	X		1.986	---	1.899	2.066	7	348	175.215			

PART CLASS: TANK

TYPE: FUEL CELL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10^6 HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER	UPPER				
GRM	N/A	N/A	7.745	---	7.019	8.555	3	82	10.588	
A	X		152.358	---	149.440	155.345	1	1938	12.720	
HEL	X		108.824	---	93.600	126.762	1	37	0.340	

PART CLASS: TANK

TYPE: GENERAL

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
AUT HEL		X	---	6.887	---	---	1	0	0.133
	X		5.000	---	0.991	15.204	1	1	0.200

PART CLASS: TANK

TYPE: OIL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRM	N/A	N/A	4.058	---	2.510	6.449	2	5	1.232	
A	X		45.404	---	43.956	46.909	1	701	15.439	
AUT		X	14.604	---	12.533	17.051	5	36	2.465	
AUF	X		238.636	---	207.318	275.177	1	42	0.176	
HEL	X		159.322	---	145.384	174.782	2	94	0.590	

PART CLASS: TANK

TYPE: PRESSURE VESSEL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER				
					LOWER						
DOR	X		0.237	---	0.047	0.722	1	1	4.211		
AU	N/A	N/A	53.659	---	43.871	62.974	3	22	0.410		
HEL	X		260.000	---	198.427	340.972	1	13	0.050		

PART CLASS: TANK

TYPE: STORAGE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER	UPPER				
GRF	X		1.616	---		1.094	2.370	1	7	4.333

PART CLASS: TIME-TOTALIZING METER

TYPE: COUNTERS

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER	UPPER				
A	X		346.985	---	336.434	357.926	1	771	2.222	

PART CLASS: TIME-TOTALIZING METER

TYPE: TIMER, ELECTRO-MECHANICAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
					UPPER				
	MIL.	COML.			LOWER	UPPER			
GRF	X		42.641	---	35.650	51.108	2	27	0.633
GRM	X		95.238	---	38.741	205.862	1	2	0.021
A	X		10.830	---	7.055	16.452	1	6	0.554
AIT		X	171.756	---	162.067	182.118	1	225	1.310
AU	X		372.746	---	363.152	382.641	1	1075	2.884
HEL	X		332.103	---	302.407	365.115	1	90	0.271

PART CLASS: TRANSDUCER

TYPE: FLUID FLOW

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER					
AUT	N/A	N/A	194.836	---	176.689	215.200	2	83	0.426	

PART CLASS: TRANSDUCER

TYPE: GENERAL

FAILURE RATE / 10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
SAT A HEL	X		---	0.588	---	---	2	0	1.558
		X	91.917	---	87.067	97.082	3	257	2.796
	X		100.000	---	87.031	115.105	1	43	0.430

PART CLASS: TRANSDUCER

TYPE: MOTIONAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^5$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL						
	MIL.	COML.			LOWER	UPPER					
GRF	X		3.925	---	2.427	6.237	1	5	1.274		
AUF	X		254.237	---	198.207	326.575	1	15	0.059		
HEL	X		71.429	---	61.940	82.520	1	41	0.574		

PART CLASS: TRANSDUCER

TYPE: PRESSURE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^5$)
	MIL.	COML.				LOWER	UPPER			
DOR	X		1.998	---		1.147	3.378	1	4	2.002
GRF	X		6.757	---		1.339	20.546	1	1	0.148
GRM	N/A	N/A	79.055	---		72.247	86.593	2	97	1.227
A	X		151.815	---		146.046	158.200	2	506	3.333
AUT		X	54.106	---		51.611	56.743	3	336	6.210
HEL	X		154.622	---		140.948	169.805	5	92	0.595

PART CLASS: TRANSDUCER

TYPE: TACH GENERATOR

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^5$)
	MIL.	COML.				LOWER	UPPER			
A	N/A	N/A	54.331	---		51.173	57.715	5	212	3.902
HEL	X		57.944	---		51.694	65.042	1	62	1.070

PART CLASS: TRANSDUCER

TYPE: TEMPERATURE

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.			LOWER	UPPER			
GRF	X		2.413	---	0.981	5.215	1	2	0.829
GRF		X	21.964	---	18.758	25.768	1	34	1.548
A	N/A	N/A	86.938	---	83.977	90.022	4	615	7.074
HEL	X		62.992	---	57.016	69.678	1	80	1.270

PART CLASS: VALVE

TYPE: BALL

ENVIRONMENT	APPLICATION		FAILURE RATE / 10 ⁶ HOURS					NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.	$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		---	0.374	---	---	1	0	2.447	
GRF	X		0.647	---	0.400	1.029	2	5	7.723	
GRM	X		1.441	---	0.891	2.290	2	5	3.469	

PART CLASS: VALVE

TYPE: BUTTERFLY

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		1.316	---	1.052	1.651	5	18	13.675	

PART CLASS: VALVE

TYPE: CHECK

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.		50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		0.049	---	0.025	0.092	6	3	6.679	
GRF	X		3.180	---	2.735	3.704	8	37	11.636	
GRM	X		---	2.385	---	---	1	0	0.384	
A	N/A	N/A	27.288	---	26.852	27.288	8	2776	101.729	
HEL	X		10.050	---	6.547	15.267	1	6	0.597	

PART CLASS: VALVE

TYPE: DIAPHRAGM

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
	MIL.	COML.			LOWER	UPPER				
GRF	X		2.622	---	1.975	3.481	3	12	4.577	
GRF		X	---	7.387	---	---	1	0	0.124	

PART CLASS: VALVE

TYPE: FUEL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.				LOWER	UPPER			
DOR	X		---	0.127	---	---	---	1	0	7.220
GRF	X		---	8.327	---	---	---	1	0	0.110
AU	X		42.645	---	38.810	46.910		5	89	2.087
AUT		X	3.056	---	2.487	3.762		7	21	6.872
AUF	X		24.450	---	19.787	30.271		1	20	0.818
HEL	X		40.000	---	16.271	86.462		1	2	0.050

PART CLASS: VALVE

TYPE: GATE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE		60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.				LOWER	UPPER			
GRF	X		1.336	---	0.975	1.829		4	10	7.484
A	X		32.448	---	24.092	43.695		1	11	0.339
HEL	X		71.429	---	44.179	113.510		1	5	0.070

PART CLASS: VALVE

TYPE: GENERAL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL					
	MIL.	COML.			LOWER	UPPER				
DOR	X		---	0.006	---	---	---	7	0	148.475
SAT	X		---	0.640	---	---	---	1	0	1.432
GRF	X		---	0.175	---	---	---	2	0	5.248
GRF		X	15.121	---	13.463	17.008	---	2	60	3.968
GRM	X		14.423	---	7.362	26.718	---	4	3	0.208
A	N/A	N/A	101.086	---	100.154	378.907	---	8	8353	82.633
HEL	X		98.804	---	93.205	104.793	---	2	223	2.257

PART CLASS: VALVE

TYPE: GLOBE

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁵ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER					
GRF	X		0.173	---	0.034	0.526	2	1	5.784	
GRM	X		---	1.104	---	---	1	0	0.829	

PART CLASS: VALVE

TYPE: HYDRAULIC

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COMPL.		50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		0.005	---	0.001	0.015	7	1	208.651	
GRF	X		---	9.253	---	---	1	0	0.099	
GRM	X		7.302	---	6.320	8.452	2	40	5.478	
AU	X		52.144	---	50.163	54.301	13	760	14.575	
AUT		X	11.937	---	11.292	12.625	25	245	20.524	
AUF	X		17.309	---	14.163	21.198	4	22	1.271	

PART CLASS: VALVE

TYPE: NEEDLE

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRF	X		1.362	---	0.842	2.164	2	5	3.671
GRF		X	---	1.176	---	---	1	0	0.779

PART CLASS: VALVE

TYPE: OIL

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
GRF	X		2.412	---	1.571	3.663	1	6	2.488
A	X		32.895	---	20.345	52.274	1	5	0.152

PART CLASS: VALVE

TYPE: PLUG

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
	MIL.	COML.			LOWER	UPPER				
GRF	X		3.272	---	2.632	4.076	5	19	5.806	

PART CLASS: VALVE

TYPE: PNEUMATIC

FAILURE RATE/10 ⁶ HOURS									
ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR	X		0.019	---	0.004	0.057	4	1	52.908
GRF	X		0.608	---	0.451	0.818	9	11	18.101
A	X		22.242	---	21.455	23.064	16	569	5.482
AIT		X	10.094	---	9.709	10.497	15	490	48.544
AUF	X		31.852	---	27.456	37.022	6	38	1.193

PART CLASS: VALVE

TYPE: RELIEF

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	CONFL.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
DOR	X		0.001	---	0.0003	0.004	8	1	713.891	
GRF	X		1.586	---	1.2980	1.943	11	22	13.867	
GRM	X		2.517	---	2.1040	3.016	4	27	10.729	
GRM		X	0.868	---	0.1720	2.640	1	1	1.152	
A	X		26.796	---	26.1000	27.514	3	1056	39.409	
AU	X		9.769	---	8.3210	11.491	2	33	3.378	
AUT		X	9.207	---	7.3560	11.546	4	18	1.955	
AUF	X		78.857	---	70.7970	87.951	3	69	0.875	
HEL	X		133.501	---	122.5070	145.623	6	106	0.794	

PART CLASS: VALVE

TYPE: SERVO

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
	MIL.	COML.			LOWER	UPPER			
DOR	X		0.183	---	0.144	0.233	10	16	87.589
A	N/A	N/A	158.187	---	152.118	164.540	3	485	3.066
HEL	X		25.000	---	17.881	34.877	1	9	0.360

PART CLASS: VALVE

TYPE: SOLENOID

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER	UPPER				
DOR	X		0.009	---	0.006	0.013	14	7	807.376	
GRF	X		1.640	---	1.486	1.812	9	82	50.002	
GRM	X		18.519	---	3.669	56.310	1	1	0.054	
A	X		28.128	---	26.221	30.196	4	156	5.546	
AUT		X	18.990	---	16.468	21.939	4	41	2.159	
HEL	X		124.611	---	107.850	144.239	4	40	0.321	

PART CLASS: VALVE

TYPE: WATER

ENVIRONMENT	APPLICATION		$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER OF RECORDS	NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
	MIL.	COML.		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL					
					LOWER	UPPER				
GRF	X		1.895	---	1.630	2.208	4	37	19.521	

NONELECTRONIC PARTS RELIABILITY DATA

SECTION 2

NONELECTRONIC PARTS DETAILED DATA

Section 2

NONELECTRONIC PARTS DETAILED DATA

The detailed data entries presented in this section are arranged in alphabetical order by major family class and alphabetically by type within each family class. The environmental codes described on page 5 are utilized in this section.

Failure rate estimates are not presented for those entries having zero failures and less than 0.5×10^6 hours. The user of this document who wishes to derive the 60% upper single-sided confidence limit estimate for the zero failure case may do so by dividing the value 0.916 by the operating hours provided for that entry.

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DETAILED DATA TABLES

PART CLASS: ACTUATOR

TYPE: Linear

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
DOR		Hydraulic	0.222	---	0.127	0.375	4	18.028	
DOR		Hydraulic	40.770	---	23.216	64.239	5	0.123	
DOR		Hydraulic	19.027	---	15.908	22.805	27	1.419	
DOR		Hydraulic	---	0.030	---	---	0	31.000	
DOR		Hydraulic	---	1.230	---	---	0	0.745	
DOR		Hydraulic	8.302	---	5.795	11.848	8	0.964	
DOR		Hydraulic	---	0.233	---	---	0	3.929	
DOR		Hydraulic	0.832	---	0.514	1.322	5	6.012	
DOR		Hydraulic	0.066	---	0.055	0.078	29	440.200	
DOR		Hydraulic	---	0.727	---	---	0	1.260	
DOR		Hydraulic	---	0.739	---	---	0	2.700	
DOR		Hydraulic	0.998	---	0.573	1.672	4	4.008	
DOR		Hydraulic	---	0.033	---	---	0	27.040	
DOR		Pneumatic	---	1.459	---	---	0	0.628	
DOR		Pneumatic	0.063	---	0.048	0.082	13	207.100	
DOR		Pneumatic	0.256	---	0.179	0.365	8	31.250	

PART CLASS: ACTUATOR

TYPE: Linear (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	UPPER		
DOR		Pneumatic	---	1.458	---	---	0	0.628
GRF		Hydraulic	---	---	---	---	0	0.014
GRF		Pneumatic	3.2050*	---	0.635	9.746	1	0.312
GRF		Pneumatic	15.7480*	---	11.866	20.909	12	0.762
GRF		Hydraulic	15.2280*	---	7.773	28.210	3	0.197
GRF		Hydraulic Servo	125.4160	---	110.666	142.845	51	0.446
GRF		Pneumatic, 4 inch dia, 18 inch Stroke, 25 PSI	1.206	---	0.497	2.586	2	1.659
GRF		Pneumatic, 4 inch dia, 18 inch Stroke, 25 PSI	2.411	---	0.993	5.172	2	0.829
GRF		Pneumatic, 3 inch dia, 36 inch Stroke, 125 PSI	9.500	---	4.459	11.500	23	2.421
GRF		Pneumatic, 3 inch dia, 36 inch Stroke, 125 PSI	15.745*	---	11.856	20.810	12	0.762
GRM		Pneumatic, Piston Rolling Diaphragm	0.0015	---	0.001	0.002	10	6636.000
GRM		Hydraulic	363.421	---	249.480	540.558	7	0.019

*Actuation (cyc)

PART CLASS: ACTUATOR

TYPE: Linear (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS ($\times 10^5$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	60% CONFIDENCE INTERVAL		
					LOWER	UPPER		
GRM		Hydraulic	50.459	---	37.464	67.948	11	0.218
GRM		Hydraulic	2.207	---	0.437	6.712	1	0.453
GRM		Hydraulic	826.087	---	664.439	1029.050	19	0.023
A		Electrical	209.009	---	192.560	227.068	116	0.555
A		Electrical	285.714	---	116.224	617.586	2	0.007
A		Hydraulic	5608.696*	---	5190.240	6065.905	129	0.023
A		Hydraulic	149.948	---	139.400	161.417	145	0.967
A		Hydraulic	483.660	---	435.935	537.935	74	0.153
A		Hydraulic	97.087	---	81.993	115.195	30	0.309
A		Hydraulic	319.672	---	276.123	370.774	39	0.122
A		Hydraulic	500.887	---	494.793	507.072	4798	9.579
A		Hydraulic	235.294	---	201.921	274.707	36	0.153
A		Hydraulic	198.485	---	183.790	214.529	131	0.660
A		Hydraulic	164.807	---	159.283	170.556	635	3.853
A		Hydraulic	0.163	---	0.162	0.165	7776	47,561.000

*Actuation (cyc)

PART CLASS: ACTUATOR

TYPE: Linear (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			λ	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
AIT		Electrical, Passenger Door	21.280	---	---	---	---	---	---
AUT		Hydraulic Servo	498.335	---	484.298	512.854	898	1.802	
AUT		Hydraulic Servo	56.454	---	54.334	58.672	506	8.963	
AUT		Hydraulic	80.086	---	76.785	83.774	374	4.670	
AUT		Mechanical Spoiler, Slot Control	43.480	---	---	---	---	---	
AUT		Mechanical, Aileron/Rudder	2.000	---	---	---	---	---	
AUT		Mechanical Driven	5.503	---	4.991	6.076	83	15.082	
AUT		Mechanical Driven	227.829	---	221.926	233.918	1061	4.657	
AUT		Electrical	40.291	---	38.131	42.594	249	6.180	
AUT		Electrical	86.051	---	82.320	89.980	380	4.416	
AUT		Hydraulic	23.445	---	22.780	24.133	886	37.790	
AUT		Hydraulic	65.854	---	55.057	78.931	27	0.410	
AUT		Pneumatic	227.829	---	221.926	233.918	1061	4.657	
AUT		Pneumatic	71.605	---	63.617	80.715	58	0.810	

PART CLASS: ACTUATOR

TYPE: Linear (continued)

E-W	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				FOR UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL				
					LOWER	UPPER			
AUF		Hydraulic	48.132	---	43.446	53.389	76	1.579	
AUF		Hydraulic	0.110	---	0.108	0.113	1346	12,220.000	
AUF		Hydraulic	297.297	---	277.698	318.495	165	0.555	
HEL		Hydraulic	384.615	---	237.886	611.207	5	0.013	
HEL		Hydraulic	357.143	---	220.894	567.550	5	0.014	
HEL		Hydraulic	266.124	---	186.124	380.573	8	0.030	
HEL		Hydraulic	1120.482	---	1063.746	1180.750	279	0.249	
HEL		Hydraulic	146.154	---	133.436	160.253	95	0.650	
HEL		Hydraulic	15.217	---	10.305	22.327	7	0.460	
HEL		Hydraulic	300.000	---	214.570	418.521	9	0.030	
HEL		Hydraulic Servo	103.542	---	93.461	114.853	76	0.734	
HEL		Hydraulic Servo	200.000	---	130.287	303.806	6	0.030	
SHS		Hydraulic	10.707	---	6.622	17.014	5	0.467	

PART CLASS: ACTUATOR

TYPE: Rotary

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE / 10^6 HOURS			NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	UPPER		
AUT		Electrical	---	---	---	---	0	0.117
SUB		Electrical	---	0.528	---	---	0	1.893

PART CLASS: BATTERY

TYPE: Carbon-Zinc

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF		15 Cell	0.904	---	0.588	1.370		6	6.640
GRF		30 Cell	0.359	---	0.184	0.661		3	8.348

PART CLASS: BATTERY

TYPE: Lead Acid

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER		
GRF		3 Cell	1.162	---	0.259	3.486	1	0.861

PART CLASS: BATTERY

TYPE: Mercury

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE / 10^6 HOURS			NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER		
GRF		4 Cell	---	---	---	---	0	0.361
GRF		6 Cell	---	---	---	---	0	0.361
GRF		8 Cell	40.793	---	27.576	59.674	7	0.172
GRF		9 Cell	1.173	---	0.261	3.518	1	0.853

PART CLASS: BATTERY

TYPE: Nickel Cadmium

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁵ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁵)
				50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE LOWER	INTERVAL UPPER		
SAT		1 Cell	---	0.0216	---	---	0	42.398
SAT		1 Cell	0.092	---	0.053	0.154	4	43.465
GRF		2 Cell	3.290	---	2.294	4.664	8	2.431
GRF		3 Cell	---	---	---	---	0	0.143
GRF		4 Cell	0.596	---	0.454	0.783	13	21.806
GRF		5 Cell	2.219	---	2.059	2.437	136	61.277
GRF		6 Cell	2.471	---	1.265	4.546	3	1.214
GRF		8 Cell	---	0.0669	---	---	0	13.686
GRF		10 Cell	1.014	---	0.707	1.438	8	7.886
GRF		20 Cell	0.709	---	0.363	1.304	3	4.233
GRF		21 Cell	---	---	---	---	0	0.114

PART CLASS: BEARING

TYPE: Ball

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	Λ	FAILURE RATE / 10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER		
AI		4800 RPM, Grease Lube, Fractional HP Motor	4.830	---	3.777	6.126	16	3.313

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: Circuit Breaker

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL	60% LOWER		
GRF	M55629/3	Dustproof, .2A, 240VAC 60Hz	---	---	---	---	0	0.114
GRF	M39019/4	Environmental, 2 Pole Aux. Contacts	---	---	---	---	0	0.029
GRF	M55629/2	Dustproof, 1 Pole, .2A 50VDC	---	---	---	---	0	0.114
GRF		Dustproof, 3 Pole, 20A, 250VAC, 60Hz Triptime 20 sec. at 125% of Load.	---	---	---	---	0	0.029
AI	M524510-10 & M521984-1		---	---	---	---	0	0.017

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: Molded Case Circuit Breaker

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER					
GRF		1 Pole, 15-50A	0.311	---	0.069		0.943	1	3.211	
GRF		1 Pole, 15-50A	2.619	---	1.909		3.573	10	3.818	
GRF		2 Pole, 15-100A	1.886	---	1.228		2.860	6	3.182	
GRF		2 Pole, 15-100A	0.623	---	0.257		1.336	2	3.211	
GRF		3 Pole, 15-100A	---	0.840	---		---	0	1.090	
GRF		3 Pole, 15-100A	---	0.862	---		---	0	1.063	
GRF		3 Pole, 15-100A	1.046	---	0.431		2.243	2	1.913	
GRF		3 Pole, 15-100A	1.344	---	0.554		2.883	2	1.488	
GRF		3 Pole, 15-100A	---	---	---		---	0	0.425	
GRF		3 Pole, 125-400A	2.854	---	0.636		8.562	1	0.350	
GRF		3 Pole, 125-400A	1.835	---	0.756		3.935	2	1.090	
GRF		3 Pole, 125-400A	0.856	---	0.438		1.575	3	3.504	
GRF		3 Pole, 70-225A	---	0.620	---		---	0	1.478	
GRF		3 Pole, 15-100A	---	---	---		---	0	0.363	

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: Power Switch Circuit Breaker

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	INTERVAL		
					LOWER	UPPER		
GRF		3 Pole, 200-1600A	2.352	---	0.525	7.057	1	0.425
GRF		3 Pole, 200-1600A	2.411	---	0.993	5.172	2	0.829
GRF		3 Pole, 200-1600A	3.617	---	1.852	6.655	3	0.829

PART CLASS: CIRCUIT PROTECTION DEVICE

TYPE: Undervoltage Circuit Breaker

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE LOWER	INTERVAL UPPER		
GRF		Instant, 208/120 VAC	2.283	---	1.591	3.236	8	3.504
GRF		Time Delay, 208/120 VAC	---	1.178	---	---	0	0.774

PART CLASS: COMPRESSOR

TYPE: Air

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	LOWER	UPPER		
GRM		Reciprocal, 150 psi, 300 CFH	1.980	---		1.441	2.696	10	5.059
GRM		Reciprocal, 150 psi, 300 CFH	5.959	---		4.788	7.402	19	3.188
GRM		Reciprocal, 200 psi, 600 CFH	20.250	---		17.087	24.059	30	1.412
SHS		Reciprocal, 125 psi, 3000 CFH, 2 Stage	193.000	---		134.400	273.300	8	0.041
SHS		Reciprocal, 250 psi, 900 CFH, 2 Stage	235.000	---		155.000	304.500	14	0.060
SHS		Reciprocal, 3000 psi, 30 CFH, 6 Stage	721.000	---		632.800	823.700	49	0.068
SHS		Reciprocal, 4500 psi, 13 CFH, 4 Stage	1892.000	---		1736.000	2056.000	107	0.057

PART CLASS: CONNECTOR
TYPE: Circular

FAILURE RATE/10 ⁶ HOURS									
ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER FAILED	OPERATING HOURS (X10 ⁶)	
					LOWER	UPPER			
DOR	MIL-C-26482 UR Series Deutsch		---	0.027	---	---	0	34.627	
SAT	MIL-C-26482	Insert D, 4P, 20G, 7.5A	---	---	---	---	0	0.019	
SAT	MIL-C-26482	Insert D	---	---	---	---	0	0.010	
SAT	MIL-C-26482 UR Series Deutsch	Insert D	---	0.036	---	---	0	25.454	
GRF	MIL-C-5015	Insert D	0.166	---	0.137	0.202	24	144.319	
GRF	MIL-C-5015	Insert B, 42P	---	---	---	---	0	0.199	
GRF	MIL-C-81511	Insert B, 85P, 23G	---	---	---	---	0	0.398	
GRF	MIL-C-81511	Insert D	7.559	---	5.835	9.806	14	1.852	
GRF	MS3124E12	Insert E, 10P, 20G, Crimp	---	0.083	---	---	0	1.026	
GRF	MS3124E20	Insert E, 41P, 20G, Crimp	---	---	---	---	0	0.342	
GRF	MS3102A22	Insert A, 19P, 16G, Solder	---	---	---	---	0	0.342	
GRM	MIL-C-5015	Insert B, 7P, 8G, 73A	---	---	---	---	0	0.014	
GRM	MIL-C-5015	Insert B, 14P, 16G, 22A	---	---	---	---	0	0.014	
GRM	MIL-C-26482	Insert D, 5P, 16G, 22A	---	---	---	---	0	0.007	
GRM	MIL-C-26482	Insert D, 55P, 20G, 7.5A	---	---	---	---	0	0.007	

PART CLASS: CONNECTOR

TYPE: Circular (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	λ	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	LOWER	UPPER		
GRM	MIL-C-26482	Insert D, 55P, 20G, 7.5A	---	---	---	---	---	0	0.014
AI	MIL-C-26482	Insert A, 1P, 20G, 7.5A	---	---	---	---	---	0	0.004
AI	MIL-C-26482	Insert A, 1P, 20G, 7.5A	---	---	---	---	---	0	0.004
AI	MIL-C-26482	Insert A, 3P, 16G, 22A	---	---	---	---	---	0	0.004
AI	MIL-C-26482	Insert A, 6P, 16G, 22A	---	---	---	---	---	0	0.004
AI	MIL-C-26482	Insert A, 15P, 20G, 7.5A	---	---	---	---	---	0	0.004
AI	MIL-C-26482	Insert A, 16P, 20G, 7.5A	---	---	---	---	---	0	0.004
AI	MIL-C-26482	Insert A, 16P, 20G, 7.5A	---	---	---	---	---	0	0.004
AI	MIL-C-26482	Insert A, 30P, 20G, 7.5A	---	---	---	---	---	0	0.004
AI	MIL-C-26482	Insert B, 32P, 20G, 7.5A	---	---	---	---	---	0	0.004
AI	MIL-C-81511	Insert B, 30P, 22G	---	---	---	---	---	0	0.004

PART CLASS: CONNECTOR

TYPE: Circular (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE	INTERVAL UPPER		
AI	MIL-C-81511	Insert B, 68P, 20G	---	---	---	---	0	0.004
AI	MIL-C-81511	Insert B, 85P, 23G	---	---	---	---	0	0.099
AI	MIL-C-81511	Insert B	---	---	---	---	0	0.099
AI	MIL-C-81511	Insert B, 55P, 22G	---	---	---	---	0	0.004
AI	MIL-C-81511	Insert B, 68P, 22G	---	---	---	---	0	0.004
AU	MIL-C-5015	Insert D	0.961	---	0.890	1.038	133	138.465
AU	MIL-C-5015	Insert D	1.893	---	1.699	1.992	124	67.423
AU	MIL-C-26482	Insert D, 21P, 16G	0.281	---	0.183	0.426	6	21.387
AU	MIL-C-38999	Insert D	0.017	---	0.013	0.022	15	866.817
AU	MIL-C-81511	Insert D	---	---	---	---	0	0.028
AUF	MIL-C-38999	5P, 16G, 13A	---	---	---	---	0	0.096
AUF	MIL-C-38999	Insert B, 13P, 22G, 3A	---	1.231	---	---	0	0.744
AUF	MIL-C-38999	Insert B, 22P, 22G, 3A	---	---	---	---	0	0.060
AUF	MIL-C-38999	Insert B, 37P, 22G, 3A	---	---	---	---	0	0.036
AUF	MIL-C-38999	Insert B, 128P, 22G, 3A	---	---	---	---	0	0.060

PART CLASS: CONNECTOR

TYPE:		Circular (continued)						
ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			OPERATING HOURS (X10 ⁶)	
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	NUMBER FAILED		
SHS	MIL-C-5015	Insert D	0.691	---	0.397	1.168	4	5.791
SHS	MIL-C-38999	Insert D	0.650	---	0.129	1.976	1	1.539
SHS	MS3106A28	Insert D, 37P, 16G	---	0.920	---	---	0	0.996
SHS	MS3102R22	Insert D, 19P, 18G, Solder, Environmental, Gold Plate Contacts	---	---	---	---	0	0.498
SHS	MS3102R28	Insert D, 37P, 16G, Solder, Gold Plate Contacts	---	0.368	---	---	0	2.490
SUB	MIL-C-5015	Insert B, 3P, 16G, 22A	---	---	---	---	0	0.009
SUB	MIL-C-5015	Insert B, 3P, 16G, 22A	---	---	---	---	0	0.003
SUB	MIL-C-5015	Insert B, 4P, 16G, 22A	---	---	---	---	0	0.009
SUB	MIL-C-5015	Insert B, 4P, 16G, 22A	---	---	---	---	0	0.018
SUB	MIL-C-5015	Insert B, 4P, 16G, 22A	---	---	---	---	0	0.007
SUB	MIL-C-5015	Insert B, 4P, 16G, 22A	---	---	---	---	0	0.003
SUB	MIL-C-5015	Insert B, 5P, 12G, 41A	---	---	---	---	0	0.009
SUB	MIL-C-5015	Insert B, 5P, 12G, 41A	---	---	---	---	0	0.003
SUB	MIL-C-5015	Insert B, 10P, 16G, 22A	---	---	---	---	0	0.009
SUB	MIL-C-5015	Insert B, 10P, 16G, 22A	---	---	---	---	0	0.003
SUB	MIL-C-5015	Insert B, 14P, 16G, 22A	---	---	---	---	0	0.009
SUB	MIL-C-5015	Insert B, 14P, 16G, 22A	---	---	---	---	0	0.016
SUB	MIL-C-5015	Insert B, 14P, 16G, 22A	---	---	---	---	0	0.003
SUB	MIL-C-5015	Insert B, 14P, 16G, 22A	---	---	---	---	0	0.007

PART CLASS: CONNECTOR

TYPE: Circular (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
SUB	MIL-C-5015	Insert B, 28P, 16G, 22A	---	---	---	---	---	0	0.016
SUB	MIL-C-5015	Insert B, 28P, 16G, 22A	---	---	---	---	---	0	0.007
SUB	MIL-C-5015	Insert B, 37P, 16G, 22A	---	---	---	---	---	0	0.003
SUB	MIL-C-5015	Insert B, 37P, 16G, 22A	---	---	---	---	---	0	0.018
SUB	MIL-C-5015	Insert B, 37P, 16G, 22A	---	---	---	---	---	0	0.016
SUB	MIL-C-5015	Insert B, 37P, 16G, 22A	---	---	---	---	---	0	0.007
SUB	MIL-C-5015	Insert B, 37P, 16G, 22A	---	---	---	---	---	0	0.007
SUB	MIL-C-5015	Insert B, 48P, 16G, 22A	---	---	---	---	---	0	0.003
SUB	MIL-C-5015	Insert B, 48P, 16G, 22A	---	---	---	---	---	0	0.016
SUB	MIL-C-5015	Insert B, 48P, 16G, 22A	---	---	---	---	---	0	0.007
SUB	MIL-C-26482	Insert B, 4P, 16G, 22A; 8P, 20G, 7.5A	---	---	---	---	---	0	0.032
SUB	MIL-C-26482	Insert B, 4P, 16G, 22A; 8P, 20G, 7.5A	---	---	---	---	---	0	0.032
SUB	MIL-C-26482	Insert B, 6P, 20G, 7.5A	---	---	---	---	---	0	0.013
SUB	MIL-C-26482	Insert B, 6P, 20G, 7.5A	---	---	---	---	---	0	0.029

PART CLASS: CONNECTOR

TYPE: Circular (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	UPPER		
SUB	MIL-C-26482	Insert B, 32P, 20G, 7.5A	---	---	---	---	0	0.023
SUB	MIL-C-26482	Insert D, 4P, 16G, 22A; 8P, 20G, 7.5A	---	---	---	---	0	0.013
SUB	MIL-C-26482	Insert D, 4P, 16G, 22A; 8P, 20G, 7.5A	---	---	---	---	0	0.041
SUB	MIL-C-26482	Insert D, 4P, 16G, 22A; 8P, 20G, 7.5A	---	---	---	---	0	0.032
SUB	MIL-C-26482	Insert D, 4P, 16G, 22A; 8P, 20G, 7.5A	---	---	---	---	0	0.013
SUB	MIL-C-26482	Insert D, 6P, 20G, 7.5A	---	---	---	---	0	0.032
SUB	MIL-C-26482	Insert D, 6P, 20G, 7.5A	---	---	---	---	0	0.026
SUB	MIL-C-26482	Insert D, 6P, 20G, 7.5A	---	---	---	---	0	0.035
SUB	MIL-C-26482	Insert D, 32P, 20G, 7.5A	---	---	---	---	0	0.010
SUB	MIL-C-26482	Insert D, 32P, 20G, 7.5A	---	---	---	---	0	0.003
SUB	MIL-C-26482	Insert D, 32P, 20G, 7.5A	---	---	---	---	0	0.010

PART CLASS: CONNECTOR

TYPE: Circular (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	LOWER	UPPER		
SUB	MIL-C-26482	Insert D, 32P, 20G, 7.5A	---	---	---	---	---	0	0.025
SUB	MIL-C-26482	Insert D, 61P, 20G, 7.5A	---	---	---	---	---	0	0.006
SUB	MIL-C-26482	Insert D, 61P, 20G, 7.5A	---	---	---	---	---	0	0.009
SUB	MIL-C-26482	Insert D, 61P, 20G, 7.5A	---	---	---	---	---	0	0.009
SUB	MIL-C-38999	Insert B, 37P, 22 G, 3A	---	---	---	---	---	0	0.012
SUB	MIL-C-38999	Insert B, 56P, 22G, 3A	---	---	---	---	---	0	0.054
SUB	MIL-C-38999	Insert B, 100P, 22G, 3A	---	---	---	---	---	0	0.052

PART CLASS: CONNECTOR

TYPE: Coaxial

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
SAT	MIL-C-39012	Insert C	---	---	---	---	0	0.019	
GRF	MIL-C-39012	Insert C	---	---	---	---	0	0.042	
GRF	MIL-C-39012	Insert C	---	---	---	---	0	0.042	
GRF	MIL-C-39012	Insert C	---	---	---	---	0	0.031	
GRF	MIL-C-39012	Insert C	---	---	---	---	0	0.073	
GRF	MIL-C-39012	Insert C	---	---	---	---	0	0.146	
GRF	MIL-C-39012	Insert C	0.030	---	0.017	0.051	4	133.333	
GRF		2 Port	---	1.350	---	---	0	6.785	
GRF		3 Port	---	---	---	---	0	0.405	
GRF		8 Port	---	0.064	---	---	0	14.351	
GRF		Insert C	---	---	---	---	0	0.199	

PART CLASS: CONNECTOR

TYPE: Power

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER		
GRF	MIL-C-3767	Insert D, 3P, 15A, 30°C	---	---	---	---	0	0.032
GRF	MIL-C-3767	Insert D, 10A, 0.1 Stress, 30°C	---	0.136	---	---	0	6.740

PART CLASS: CONNECTOR

TYPE: Printed Circuit Board

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS $\times 10^5$
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	UPPER		
DOR	MIL-C-55302 /23, /24 AMP 202	75° - 125°C	---	0.0648	---	---	0	14.140
SAT	MIL-C-55302 /23, /24 AMP 202		---	0.0881	---	---	0	10.397
GRF	MIL-C-21097	Insert B, 44P, 5A	---	---	---	---	0	0.022
GRF	MIL-C-21097	Insert B, 44P, 5A	---	---	---	---	0	0.023
GRF	MIL-C-21097	Insert B, 44P, 5A	---	---	---	---	0	0.028
GRF	MIL-C-21097	Insert B, 44P, 5A	---	---	---	---	0	0.013
GRF	MIL-C-21097	Insert B, 50P, 5A	---	---	---	---	0	0.026
GRF	MIL-C-21097	Insert B, 72P	---	---	---	---	0	0.009
GRF	MIL-C-21097	Insert B, 72P	---	---	---	---	0	0.013
GRF	MIL-C-21097	Insert B, 72P	---	---	---	---	0	0.066
GRF	MIL-C-21097	Insert B	---	0.630	---	---	0	1.454
GRF	MIL-C-21097	Insert B, 72P, 5A	---	---	---	---	0	0.016
GRM	MIL-C-21097	Insert B, 80P, 5A, 30°C	---	0.058	---	---	0	15.714
GRM	MIL-C-21097	Insert B, 80P, 5A, 30°C	---	0.044	---	---	0	21.031

PART CLASS: CONNECTOR

TYPE: Printed Circuit Board (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS ($\times 10^5$)
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
AI	MIL-C-55302	Insert B, 96P, 55°C	---	---	---	---	0	0.090	
AI	MIL-C-55302	Insert B, 112P, 45°C	0.173	---	0.034	0.527	1	5.770	
AIF	MIL-C-55302	Insert B, 16P, 40°C	---	0.495	---	---	0	1.850	
AIF	MIL-C-55302	Insert B, 32P, 40°C	---	0.603	---	---	0	1.520	
AIF	MIL-C-55302	Insert B, 41P, 40°C	---	0.565	---	---	0	1.620	
AIF	MIL-C-55302	Insert B, 62P, 40°C	---	0.077	---	---	0	11.930	
AIF	MIL-C-55302	Insert B, 62P, 40°C	---	0.090	---	---	0	10.200	
AIF	MIL-C-55302	Insert B, 64P, 40°C	---	1.735	---	---	0	0.528	
AIF	MIL-C-55302	Insert B, 71P, 40°C	---	0.475	---	---	0	1.930	
AIF	MIL-C-55302	Insert B, 72P, 40°C	---	0.190	---	---	0	1.870	
AIF	MIL-C-55302	Insert B, 77P, 40°C	---	0.391	---	---	0	2.340	
SHS	MIL-C-21097	Insert B, 30°C	0.011	---	0.002	0.034	1	88.339	
SUB	MIL-C-55302	Insert B, 110P, 26G, 3A, 25°C	---	---	---	---	0	0.018	
SUB	MIL-C-55302	Insert B, 110P, 26G, 3A	---	---	---	---	0	0.036	
SUB	MIL-C-55302	Insert B, 110P, 26G, 3A	---	---	---	---	0	0.008	
SUB	MIL-C-55302	Insert B, 110P, 26G, 3A	---	---	---	---	0	0.014	

PART CLASS: CONNECTOR

TYPE: Rectangular

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
SAT	MIL-C-24308	Insert B, 25°C	---	1.105	---	---	---	0	0.829
GRF	MIL-C-24308	Insert B, 14P, 45°C	---	---	---	---	---	0	0.298
GRF	MIL-C-24308	Insert B, 14P, 45°C, 0.2 Stress	---	---	---	---	---	0	0.198
GRF	MIL-C-24308	Insert B, 42P, 45°C	---	---	---	---	---	0	0.199
GRF	MIL-C-24308	Insert B, 42P, 45°C 0.2 Stress	---	---	---	---	---	0	0.198
GRF	MIL-C-24748	Insert B, 104P, 20G, 7.5A, 30°C	---	---	---	---	---	0	0.041
GRM	MIL-C-24308	Insert B, 9P, 20G, 30°C	---	---	---	---	---	0	0.014
GRM	MIL-C-24308	Insert B, 15P, 20G, 5A, 30°C	---	---	---	---	---	0	0.028
GRM	MIL-C-24308	Insert B, 15P, 20G, 5A, 30°C	---	---	---	---	---	0	0.021
GRM	MIL-C-24308	Insert B, 25P, 20G, 5A, 30°C	---	---	---	---	---	0	0.014
AI	MIL-C-24308	Insert A, 16P, 22G, 3A, 55°C	---	---	---	---	---	0	0.008
AI	MIL-C-24308	Insert A, 16P, 22G, 5A, 55°C	---	---	---	---	---	0	0.004

PART CLASS: CONNECTOR

TYPE: Rectangular (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
					LOWER				
AI	MIL-C-24308	Insert A, 17P, 20G, 5A, 55°C	---	---	---	---	0	0.008	
AI	MIL-C-24308	Insert A, 25P, 20G, 5A, 55°C	---	---	---	---	0	0.004	
AI	MIL-C-24308	Insert A, 25P, 20G, 5A, 55°C	---	---	---	---	0	0.004	
AI	MIL-C-24308	Insert A, 37P, 22G, 5A, 55°C	---	---	---	---	0	0.004	
AI	MIL-C-24308	Insert B, 6P, 45°C	---	---	---	---	0	0.050	
AI	MIL-C-24308	Insert B, 14P, 45°C	---	---	---	---	0	0.075	
AI	MIL-C-24308	Insert B, 14P, 45°C	---	---	---	---	0	0.050	
AI	MIL-C-24308	Insert B, 15P, 20G, 5A, 55°C	---	---	---	---	0	0.004	
AI	MIL-C-24308	Insert B, 20P, 45°	---	---	---	---	0	0.149	
AI	MIL-C-24308	Insert B, 28P, 45°C	---	---	---	---	0	0.597	
AI	MIL-C-24308	Insert B, 42P, 45°C	---	---	---	---	0	0.050	
AI	MIL-C-24308	Insert B, 42P, 45°C, 0.2 Stress	---	---	---	---	0	0.050	

PART CLASS: CONNECTOR

TYPE: Rectangular (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL			
					LOWER	UPPER		
AI	MIL-C-24308	Insert B, 55P, 45°C	---	---	---	---	0	0.024
AI	MIL-C-24308	Insert B, 55P, 45°C	---	---	---	---	0	0.075
AI	MIL-C-24308	Insert B, 66P, 45°C	---	---	---	---	0	0.050
AI	MIL-C-24308	Insert B, 168P, 45°C	---	---	---	---	0	0.447
AIF	MIL-C-83733	Insert B, 131P, 22G, 5A, 40°C	---	---	---	---	0	0.144
AIF	MIL-C-83733	Insert B, 185P, 22G, 5A, 40°C	---	---	---	---	0	0.048
AIF	MIL-C-83733	Insert B, 185P, 22G, 5A, 40°C	---	0.877	---	---	0	1.044
SUB	MIL-C-24308	Insert B, 9P, 20G, 5A, 25°C	---	---	---	---	0	0.032
SUB	MIL-C-24308	Insert B, 9P, 20G, 5A, 35°C	---	---	---	---	0	0.013
SUB	MIL-C-24308	Insert B, 25P, 20G, 5A, 25°C	---	---	---	---	0	0.014
SUB	MIL-C-24308	Insert B, 25P, 20G, 5A, 25°C	---	---	---	---	0	0.086

PART CLASS: CONNECTOR

TYPE: Rectangular (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL	LOWER	UPPER		
SUB	MIL-C-24308	Insert B, 25P, 20G, 5A, 25°C	---	---	---	---	---	0	0.014
SUB	MIL-C-24308	Insert B, 25P, 20G, 5A, 25°C	---	---	---	---	---	0	0.007
SUB	MIL-C-24308	Insert B, 25P, 20G, 5A, 35°C	---	---	---	---	---	0	0.032
SUB	MIL-C-24308	Insert B, 37P, 20G, 5A, 35°C	---	---	---	---	---	0	0.010
SUB	MIL-C-24308	Insert B, 37P, 20G, 5A, 25°C	---	---	---	---	---	0	0.026
SUB	MIL-C-24308	Insert B, 50P, 20G, 5A, 35°C	---	---	---	---	---	0	0.003
SUB	MIL-C-24308	Insert B, 50P, 20G, 5A, 35°C	---	---	---	---	---	0	0.006
SUB	MIL-C-24308	Insert B, 50P, 5 A, 25°C	---	---	---	---	---	0	0.016
SUB	MIL-C-24308	Insert B, 50P, 20G, 5A, 25°C	---	---	---	---	---	0	0.009
SUB	MIL-C-24308	Insert B, 78P, 22G, 3A, 25°C	---	---	---	---	---	0	0.009

PART CLASS: CONNECTOR

TYPE: Rectangular (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
					LOWER				
SUB	MIL-C-24308	Insert B, 78P, 22G, 3A, 350C	---	---	---	---	0	0.003	
SUB	MIL-C-24308	Insert B, 104P, 22G, 3A, 250C	---	---	---	---	0	0.016	

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: Compass

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL LOWER	50% CONFIDENCE INTERVAL UPPER		
AI		Magnetic	2388.704	---	2313.486	2466.813	719	0.301
AIT		Magnetic	16.667	---	8.507	30.874	3	0.180
AIT		Magnetic	41.379	---	33.059	51.890	18	0.435
AIT		Bearing Heading Indicator	582.969	---	552.792	615.069	267	0.458

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: Indicator

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
GRF		Liquid Level	11.905	---	4.843		25.733	2	0.168
GRF		Liquid Quantity - Storage Tank, Float Type	6.718	---	4.541		9.827	7	1.042
GRF		Meter	0.363	---	0.208		0.608	4	11.028
GRM		Temp Gauge	62.016	---	54.406		70.807	48	0.774
GRM		Fuel Quantity	78.811	---	70.240		88.556	61	0.774
AI		Fuel Quantity	35.124	---	27.855		44.367	17	0.484
AI		Vertical Speed	942.197	---	879.700		1009.821	163	0.173
AI		Slip Turn	1346.939	---	1247.601		1455.368	132	0.098
AI		Slip Turn	---	---	---		---	0	0.090
AIT		Fuel Quantity	170.492	---	164.176		177.094	520	3.050
AIT		Fuel Quantity	145.902	---	132.782		160.495	89	0.610
AIT		Fuel Quantity	191.892	---	178.250		206.736	142	0.740
AIT		Temp	24.490	---	20.229		29.709	24	0.980
AIT		Temp	242.574	---	229.463		256.558	245	1.010
AIT		Temp	66.667	---	61.420		72.427	116	1.740

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: Indicator (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
AIT		Vertical Speed	275.000	---	250.130	302.679	88	0.320	
AIT		AIM Control System	69.451	---	64.531	74.803	143	2.059	
HEL		Vertical Speed	41.958	---	27.333	63.736	6	0.143	
HEL		Vertical Speed	27.273	---	13.920	50.521	3	0.110	
HEL		Temp	133.816	---	120.611	148.653	74	0.553	
HEL		Temp	126.829	---	111.882	144.002	52	0.410	
HEL		Fuel Quantity	305.419	---	272.474	342.834	62	0.203	
HEL		Fuel Quantity	10.938	---	7.406	16.048	7	0.640	
HEL		Fuel Quantity	4666.667	---	3915.458	5573.458	28	0.006	
HEL		Fuel Quantity	150.000	---	136.113	165.494	84	0.560	
HEL		Fuel Quantity	285.714	---	164.074	482.985	4	0.014	
HEL		Engine Torque	75.000	---	56.510	99.581	12	0.160	
HEL		Engine Torque	84.416	---	64.424	110.705	13	0.154	
HEL		Engine Torque	275.862	---	255.200	298.446	128	0.464	
HEL		Engine Torque	666.667	---	576.998	771.680	40	0.060	
HEL		Engine Torque	357.143	---	220.894	567.550	5	0.014	

PART CLASS: CONTROLS AND INSTRUMENTS

TYPE: Indicator (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL LOWER	50% CONFIDENCE INTERVAL UPPER		
HEL		Slip Turn	187.617	---	171.707	205.209	100	0.533
HEL		Slip Turn	192.001	---	168.441	219.219	48	0.250
HEL		Slip Turn	714.286	---	521.333	977.653	10	0.014
HEL		Altitude	142.857	---	58.112	308.793	2	0.014
HEL		Altitude	362.667	---	336.318	391.389	136	0.375
HEL		Altitude	180.000	---	128.742	251.113	9	0.050

PART CLASS: EMERGENCY LIGHT

TYPE: Stand-By

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
GRF		Charger, Battery	1.311	---	0.886		1.918	7	5.339
GRF		Lighting Unit, 50 watt Battery, Automatic Recharging	2.622	---	2.022		4.533	14	5.339

PART CLASS: EMERGENCY POWER

TYPE: General

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF		Stand-By Power System	0.0049	---	0.002	0.011		2	405.050
GRF		6V - Emergency Light - ing Unit	1.4980	---	1.044	2.124		8	5.339

PART CLASS: FAN

TYPE: General

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF		Exhaust, 130 CFM, 1/25 HP	2.411	---	0.993	5.172		2	0.829
GRF		Exhaust, 9800 CFM, 1 HP, Belt Driven	6.340	---	4.770	8.373		12	1.894
GRF		Exhaust, 980 CFM, 1/6 HP	0.904	---	0.463	1.664		3	3.318
GRF		Centrifugal, 4330 CFM, 2 HP	---	1.104	---	---		0	0.829
GRF		Box, 117 CFM	---	1.148	---	---		0	0.798
GRF		Axial	---	1.004	---	---		0	0.912

PART CLASS: GENERATOR

TYPE: General

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL	LOWER	UPPER		
DOR		Motor Generators, 10 KVA	56.080	---	---	47.014	66.791	28	0.499
DOR		Gas Turbine	38.050	---	---	19.482	70.015	3	0.079
DOR		Diesel Engine, 150-440 KW	1.209	---	---	0.873	1.890	7	5.419
DOR		Diesel Engine, 500-1400 KW	12.802	---	---	9.640	16.921	12	0.937
DOR		Diesel Engine, 40-140 KW	7.470	---	---	5.542	10.022	11	1.437
DOR		Diesel Engine, 3000 KW	1385.000	---	---	1377.000	1399.000	4384	3.165
DOR		Gas Engine, 3-15 KW	6.820	---	---	2.808	14.619	2	0.293
DOR		Gas Engine, 30-60 KW	---	---	---	---	---	0	0.447
GRF	HDI-650-60	Gas Turbine, 300 KW	626.200	---	---	597.900	656.300	338	0.540
GRM		Motor Generator Set, Output - 250V, 400HZ, 3000W; Input - 416V, 400HZ, 3800 RPM	20.350	---	---	---	---	---	---

PART CLASS: GENERATOR

TYPE: General (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER		
AUT		AC, Brushless, 8000RPM, Air Cooled	66.600	---	---	---	---	---

PART CLASS: GYRO

TYPE: Rate Integrating

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS $\times 10^6$
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	UPPER		
AU		Gas Bearing	3.704	---	0.734	11.262	1	0.270

PART CLASS: HEATER

TYPE: Electric

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	FAILURE RATE/10 ⁶ HOURS						NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER					
GRF		Coil Heating, Hot water, 120,000 BTU/HR	0.904	---	0.463		1.664	3	3.318	
GRF		Space, 1KW, 208 VAC	0.804	---	0.331		1.724	2	2.488	
GRF		Space, 30 KW, 480 VAC, 2 Stage	2.363	---	1.461		3.744	5	2.116	

PART CLASS: MECHANICAL DEVICE

TYPE: Gear Assembly

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE LOWER	INTERVAL UPPER		
SHS		Speed Decreaser Recorder	59.224	---	41.279	83.950	8	0.135
SHS		Speed Decreaser Servo	49.380	---	20.346	105.926	2	0.041
GRF		Spur-Drive 130 Teeth Brass Alloy 260, PD-2.0312, PA-20 ⁰	---	0.876	---	---	0	1.046
GRF		Spur-Drive 130 Teeth, Brass Alloy 260, PD-64, PA-20 ⁰	---	0.876	---	---	0	1.046

PART CLASS: MECHANICAL DEVICE

TYPE: Power Transmittal

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁵)
				50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE LOWER	50% CONFIDENCE UPPER		
GRF		Fan Belt	1.378	---	0.962	1.966	8	5.806
GRF		Fan Belt	86.957	---	68.404	110.719	16	0.184
GRF		Couplings	5.340	---	3.067	9.028	4	0.749
GRF		Couplings	---	---	---	---	0	0.109
GRF		Clutch Spring	0.594	---	0.571	0.619	478	804.347
GRF		5 HP Motor Coupling	5.341	---	3.066	8.945	4	0.749
GRM		Sprocket	---	---	---	---	0	0.373
GRM		Magnetic Clutch	11.508	---	10.886	12.083	238	20.682
GRM		Magnetic Clutch	3.289	---	1.888	5.510	4	1.216
AU		Couplings	120.062	---	117.762	122.509	1796	14.959
SHS		Magnetic Clutch	---	1.708	---	---	0	0.536

PART CLASS: MOTOR

TYPE: Full Horse Power

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				60% UPPER SINGLE-STDED CONFIDENCE	60% CONFIDENCE INTERVAL	LOWER	UPPER		
DOR		3 HP	0.499	---	0.111		1.497	1	2.004
GRF		2 HP (AC)	5.917	---	2.407		12.790	2	0.338
GRF		2 HP (AC)	2.413	---	0.981		5.215	2	0.829
GRF		2 HP (AC)	11.765	---	4.786		25.430	2	0.170
GRF		2 HP, 110 VAC, NEMA Size 1	---	0.036	---		---	0	25.455
GRF		3 HP (AC)	5.831	---	2.372		12.604	2	0.343
GRF		3 HP (AC)	1.206	---	0.239		3.668	1	0.829
GRF		5 HP (AC)	4.825	---	2.771		8.157	4	0.829
GRF		5 HP, 440 VAC, NEMA Size 1	0.943	---	0.210		2.829	1	1.061
GRF		7.5 HP (AC)	10.101	---	2.001		30.715	1	0.099
GRF		10 HP (AC)	1.206	---	0.239		3.668	1	0.829
GRF		10 HP (AC)	205.882	---	139.415		302.076	7	0.034
GRF		20 HP (AC)	1.206	---	0.239		3.668	1	0.829
GRF		5 to 20 HP, 230/460 VAC	5.943	---	4.582		7.705	14	2.355

PART CLASS: MOTOR

TYPE: Full Horse Power (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	UPPER		
GRM		1 to 3 HP, 230/460 VDC	3.599	---	2.742	4.728	13	3.612
SHS		2 HP (AC)	2000.000	---	813.569	4323.103	2	0.001

PART CLASS: MOTOR

TYPE: Solenoid

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER		
DOR	008-939-1 IMC	Rotary	---	---	---	---	0	0.385
SAT	008-939-1 IMC	Rotary	---	0.034	---	---	0	26.975

PART CLASS: PUMP

TYPE: Centrifugal

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF		8 GPM, 90 Ft.Hd, 1 HP, 1 in.	19.02	---	13.863	25.939	10	0.526	
GRF		20 GPM, 50 Ft Hd, 3 HP, 2 in.	10.605	---	6.087	17.763	4	0.377	
GRF		30 GPM, 25 Ft Hd, 1 HP, Sump	9.346	---	6.318	13.672	7	0.749	
GRF		170 GPM, 173 Ft Hd, 15 HP	8.439	---	5.705	12.346	7	0.829	

REGULATOR

Pressure

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
GRF		Temp, Valve, 1/2 in., 150 lb., 3-way, Pneumatic Diaphragm Operated	4.823	---	2.768	8.078	4	0.829	
GRF		Temp, Valve, 5/8 in., Refrigeration Expansion	2.411	---	0.993	5.172	2	0.829	
GRF		Temp, Valve, 5/8 in., Refrigeration Expansion	2.251	---	1.607	3.127	9	3.998	
GRF		Temp, Valve, 5/8 in., Refrigeration Expansion	4.799	---	2.965	7.601	5	1.042	
GRF		Temp, Valve, 5/8 in., Refrigeration Expansion	0.941	---	0.387	2.017	2	2.127	
GRF		Temp, Valve, 3/4 in., 150 lb, 3-way, Pneumatic, Diaphragm Operated	1.206	---	0.269	3.617	1	0.829	
GRF		Valve, 1 in., 150 lb., Self Contained, 5 GPM	3.617	---	2.355	5.486	6	1.659	

PART CLASS: REGULATOR

TYPE: Pressure (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE LOWER	INTERVAL UPPER		
GRF		Valve, 1 in., 150 lb., Self Contained, 56 GPM	3.332	---	2.379	4.628	9	2.701
GRF		Valve, 2 in., 125 lb., Gas Service, 650 CFH Expansion	2.879	---	1.474	5.298	3	1.042
GRF		Pneumatic, Differential 0.6-12 IWG	1.280	---	0.735	2.146	4	3.122
GRF		Pneumatic, Differential 0.15-3 IWG	1.206	---	0.617	2.218	3	2.488

PART CLASS: REGULATOR

TYPE: Thermostatic

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF		Temp, Pneumatic, Remgte Bulb, 0 to 100 F	9.042	---	7.043	11.574	15	1.659	
GRF		Temp, Pneumatic, Bi-Metal, Room	7.234	---	4.709	13.503	6	0.829	

PART CLASS: RELAY

TYPE: Armature

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF	MIL-R-5757 M5757/9	Hermetic, 2PDT	2.924	---	0.652	4.386	1	0.342	
GRF	MS24376	Hermetic, 3PST, 3X Contact Form, High Voltage	2.922	---	1.677	4.894	4	1.369	
GRF	MS24143	Hermetic, 3PST, 3X Contact Form, High Voltage	---	0.893	---	---	0	1.026	
AIT	MIL-R-39016 M39016/13	Hermetic, 2PDT	0.051	---	0.032	0.081	5	98.000	
AIT	MIL-R-39016	Hermetic, 4PDT	0.054	---	0.048	0.069	16	294.000	
SHS	MIL-R-5757 M5757/15	Hermetic, 4PDT, 4C Contact Form, Low level	4.016	---	1.655	8.614	2	0.498	
SHS	MIL-R-5757 M5757/18	Hermetic, 4PDT, 4C Contact Form, Low level	1.967	---	0.744	3.875	2	1.017	

PART CLASS: RELAY

TYPE: Crystal Can

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF		Non-Latching, DPDT, 10A	0.200	---	0.045	0.608	1	5.000	
GRF		Non-Latching, DPDT, 2A	0.500	---	0.203	1.081	2	4.000	
GRF		Non-Latching, DPDT	0.050	---	0.026	0.093	3	59.480	
AIT	MIL-R-5757 M5757/9	Half size	8.667	---	7.198	10.440	26	3.000	
AIT	MIL-R-39016 M39016/6	Half size	3.810	---	2.187	6.381	4	1.050	
SHS		Low level, 2PDT, 1A, Max. Coil Voltage 26.5 VDC	---	0.920	---	---	0	0.996	

PART CLASS: RELAY

TYPE: General Purpose

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS ($\times 10^5$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER					
DOR	MIL-R-39016 432-850 Teledyne	DPDT	---	---	---	---	---	0	0.193	
SAT	MIL-R-39016	DPDT, 125°C	---	---	---	---	---	0	0.182	
SAT	MIL-R-39016 432-850 Teledyne	DPDT	---	---	---	---	---	0	0.182	
GRF	MIL-R-5757		---	---	---	---	---	0	0.031	
GRF	MIL-R-6016	SPST, 50A	---	---	---	---	---	0	0.041	
GRF	MIL-R-6016	4PDT, 10A	---	---	---	---	---	0	0.010	
GRF		DPDT	0.435	---	0.177	0.941		2	4.596	
GRF		3PDT	0.109	---	0.022	0.332		1	9.170	
GRF		3PDT	0.046	---	0.009	0.140		1	21.740	
GRF		6PDT, 10A	---	1.182	---	---		0	0.755	
GRF		6PDT, 10A	---	0.303	---	---		0	3.019	
GRF	MS25269	6PDT, Hermetic, 5A	---	---	---	---		0	0.057	
GRM	MIL-R-39016		---	---	---	---		0	0.353	
GRM	MIL-R-39016	ER, DPDT, 125°C, 1A	---	---	---	---		0	0.350	

PART CLASS: RELAY

TYPE: General Purpose (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE LOWER	60% CONFIDENCE INTERVAL UPPER		
GRM	MIL-R-5757	DPDT, 125°C, 2A	---	---	---	---	0	0.007
GRM	MIL-R-5757	DPDT, 2A	---	---	---	---	0	0.035
GRM		SPST	0.211	---	0.047	0.633	1	4.742
AIT	MIL-R-6016	4PDT, 125°C, 10A	---	---	---	---	0	0.004
AIT	MIL-R-6016	4PDT, 125°C, 10A	---	---	---	---	0	0.008
AIT		10A	---	1.741	---	---	0	0.526
AIT	MIL-R-39016	DPDT	0.054	---	0.044	0.066	21	392.000
SHS	MS27401	2PDT, Hermetic	0.287	---	0.006	0.860	1	3.487
SUB	MIL-R-5757	DPDT, 125°C, 2A	---	---	---	---	0	0.018
SUB	MIL-R-5757	6PDT, 125°C, 5A	---	---	---	---	0	0.010
SUB	MIL-R-6016	DPDT, 125°C, 10A	---	---	---	---	0	0.073
SUB	MIL-R-6016	DPDT, 125°C, 10A	---	---	---	---	0	0.029
SUB	MIL-R-6016	DPDT, 125°C, 10A	---	---	---	---	0	0.006
SUB	MIL-R-6016	DPDT, 125°C, 10A	---	---	---	---	0	0.015
SUB		DPDT, 2A	---	---	---	---	0	0.013
SUB	MIL-R-6016	4PDT, 125°C, 10A	---	---	---	---	0	0.044

PART CLASS: RELAY

TYPE: General Purpose (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				60% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL LOWER	50% CONFIDENCE INTERVAL UPPER		
SUB	MIL-R-6016	4PDT, 125°C, 10A	---	---	---	---	0	0.009
SUB	MIL-R-6016	4PDT, 125°C, 10A	---	---	---	---	0	0.029
SUB	MIL-R-6016	4PDT, 125°C, 10A	---	---	---	---	0	0.007
SUB	MIL-R-6016	125°C	0.500	---	0.099	1.520	1	2.000
SUB	MIL-R-6016	125°C	---	1.832	---	---	0	0.500

PART CLASS: RELAY

TYPE: Latching

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER			
					LOWER					
GRF		10A	0.500	---	0.112	1.500		1	2.000	
GRF		10A	---	0.131	---	---		0	7.000	
GRF	MIL-R-39016 M39016/9	DPDT, 2C Contact Form, Hermetic, Sensitive	---	1.786	---	---		0	.513	
AIT	MS27745	4PDT, DC operated	0.043	---	0.0095	0.128		1	23.400	

PART CLASS: RELAY

TYPE: Power

FAILURE RATE/10 ⁶ HOURS								
ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
					LOWER	UPPER		
GRF		Heavy Duty Industrial, 115 VAC	2.352	---	1.530	3.940	4	1.701
GRF		Heavy Duty Industrial, 25 VDC	2.411	---	0.993	5.172	2	0.829
GRF		Heavy Duty Industrial, 120 VAC	---	1.077	---	---	0	0.850
GRF	MS24192	3PST, Hermetic, 25A	---	---	---	---	0	0.029
GRF	MS25271	4PDT, Hermetic, 10A, Contact Form 4C	---	---	---	---	0	0.029

PART CLASS: RELAY

TYPE: Reed

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	INTERVAL		
					LOWER	UPPER		
GRF		SPST	1.032	---	0.812	1.314	16	15.500
GRF		SPST	2.320	---	1.953	2.761	29	12.500
GRF		DIP, SPST	8.391	---	7.557	9.328	73	8.700
GRF		Dry, 4PST	0.391	---	0.159	0.846	2	5.109
GRM		DPDT, 2A, 125°C	---	---	---	---	0	0.014

PART CLASS: RELAY

TYPE: Time Delay

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE / 10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		50% UPPER		
					LOWER		UPPER		
SUB		SPST, Thermal Time	---	1.832	---		---	0	0.500

PART CLASS: SOCKET

TYPE: Pin, DIP

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
					LOWER				
GRF	Circuit Assembly Corp.	Formed Phosphor Bronze, Tin Plate	0.00056	---	0.00012	0.0017	1	1801.200	
SHS	Augat	Machined Beryllium Copper, Gold Plate	---	0.0046	---	---	0	200.500	

PART CLASS: SPRINKLER HEAD

TYPE: General

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (X 10 ⁵)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF		Fire Protection 1½ in., 60 GPM	1.206	---	0.617	2.218	3	2.488	
GRF		Fire Protection 1 in., 35 GPM	0.603	---	0.134	1.808	1	1.659	
GRF		Fire Protection 1/2 in., STD	0.591	---	0.500	0.702	31	52.426	

PART CLASS: SWITCH

TYPE: Centrifugal

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	UPPER		
GRF		Fan Shut-off, Shaft Mtd., 120 VAC	1.808	---	0.926	3.328	3	1.659

PART CLASS: SWITCH

TYPE: Diaphragm

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF		Differential, 0.5 - 1.5 IWG, Air	1.206	---	0.269	3.617	1	0.829	
GRF		4 PSI, with Panel Light	9.645	---	6.723	13.672	8	0.829	
GRF		Differential, 0-100 IWG, Water	2.411	---	0.993	5.172	2	0.829	
GRF		Differential, 0-100 IWG, Water	2.977	---	1.840	4.715	5	1.678	
GRF		Differential, 0-100 IWG, Water	3.529	---	1.807	6.493	3	0.850	

PART CLASS: SWITCH

TYPE: FLOW

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
					LOWER				
GRF		Paddle Type, Air Flow 500 FPM, 120 VAC	3.315	---	2.460	4.449	11	3.318	
GRF		Paddle Type, Air Flow 500 FPM, 120 VAC	4.823	---	4.036	5.794	28	5.806	
GRF		Paddle Type, Air Flow 500 FPM, 120 VAC	6.832	---	5.425	8.608	17	2.488	

PART CLASS: SWITCH

TYPE: Humidity

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	FAILURE RATE/10 ⁶ HOURS					OPERATING HOURS (X 10 ⁶)
			$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	UPPER	NUMBER FAILED	
GRF		Type HT, Wallmounted, Adjustable, 120 VAC	16.775	---	9.629	28.099	4	0.238

PART CLASS: SWITCH

TYPE: Push Button

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
					LOWER				
GRF	MIL-S-8805	4PST	0.218	---	0.043	0.662	1	4.590	
GRF	MIL-S-8805	4PST	---	0.088	---	---	0	10.400	
GRF	MIL-S-22885		---	---	---	---	0	0.218	
GRF	MIL-S-22885	SPST, 5A	---	---	---	---	0	0.135	
GRF	MIL-S-22885	Illuminated	---	---	---	---	0	0.010	
GRF		Push On-Push Off, Snap in mount, 30 or 115VDC at 2A Res., 1A Induc- tive Actuation = 100,000, Lighted	3.160	---	2.057	4.793	6	1.899	
GRF	MS25089	Pushbutton Switch, 2PDT Push-Pull Operation, Dustproof Construction, 125VAC at 10A RES.	---	---	---	---	0	0.028	
GRF	MS25089	Pushbutton Switch, 2PDT Momentary Operation, Dustproof Construction, 28VDC at 10A RES.	---	---	---	---	0	0.029	
GRM	MIL-S-8805	4PST, 4A	---	---	---	---	0	0.007	
GRM	701222 C.P. Clare		---	---	---	---	0	0.298	
GRM	701222 Clare Pendar		---	---	---	---	0	0.301	
AI		4PDT, 5A, 28VDC	2.28	---	0.508	6.840	1	0.439	
SUB	MIL-S-3950	5A	---	---	---	---	0	0.029	

PART CLASS: SWITCH

TYPE: Reed

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	UPPER		
DOR	MIL-S-55433 MRR-2 Hamlin	SPST	---	0.950	---	---	0	0.964
SAT	MIL-S-55433 MRR-2 Hamlin	SPST	---	1.009	---	---	0	0.908

PART CLASS: SWITCH

TYPE: Rotary

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER		
GRF	MIL-S-3786		0.218	---	0.043	0.662	1	4.590
GRF	MIL-S-3786		---	---	---	---	0	0.021
GRF	12L22 Digitran		---	---	---	---	0	0.241
GRF	67-1950 JANCO		---	---	---	---	0	0.069
GRM		1 Deck, 1 Pole, 3 POS	---	---	---	---	0	0.014
GRM		1 Deck, 1 Pole, 4 POS	---	---	---	---	0	0.014
GRM		1 Deck, 2 Pole, 5 POS	---	---	---	---	0	0.007
GRM		1 Deck, 1 Pole, 5 POS	---	---	---	---	0	0.007
GRM		1 Deck, 1 Pole, 7 POS	---	---	---	---	0	0.014
GRM		1 Deck, 1 Pole, 8 POS	---	---	---	---	0	0.028
GRM		5 Deck, 1 Pole, 9 POS	---	---	---	---	0	0.007
GRM		1 Deck, 1 Pole, 11 POS	---	---	---	---	0	0.007
AI	MIL-S-3786 M3786/20-089 M3786/20-093	6 Position & 10 Position, 1/5 A, 28 VDC	---	---	---	---	0	0.017
AIT	MIL-S-3786	4P, 3 POS 6P, 2 POS	---	0.205	---	---	0	4.460

PART CLASS: SWITCH

TYPE: Sensitive

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		60% LOWER		
DOR	MIL-S-8805 1HM25 Micro Switch	SPDT, 75° - 125° F	---	---	---	---	---	0	0.193
GRF		125 VDC, SPDT, 2 oz Operating Force	5.249	---	---	---	2.163	2	0.381
GRF		120 VAC, SPDT	12.812	---	---	---	6.560	3	0.234
GRF		120 VAC, SPDT	4.737	---	---	---	3.302	8	1.689
GRF		120 VAC, SPDT	5.591	---	---	---	4.260	13	0.233
GRF		120 VAC, SPDT	7.857	---	---	---	4.856	5	0.636
GRF		2PDT, Push-Pull Oper., Dustproof, 28VDC at 10A RES.	.264	---	---	---	.109	2	7.584

PART CLASS: SWITCH

TYPE: Thermostat

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF	49-13521	Remote Bulb, 30°-110°F, SPDT, 24 VDC	2.411	---	1.384	4.039		4	1.659
GRF	T-302	Bi Metal, 55°-85°F, 24 VDC, SPDT	2.411	---	1.993	5.172		2	0.829
GRF	1-28013	Bi Metal, 55°-85°F, 24 VDC, SPDT	2.411	---	1.384	4.039		4	1.659
AI	11L-24236		---	---	---	---		0	0.004

PART CLASS: SWITCH

TYPE: Thumbwheel

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	UPPER		
GRM	8-L-116 Digitran		---	---	---	---	0	0.014
GRM	8-L-126 Digitran		---	---	---	---	0	0.028
GRM	9-L-34 Digitran		---	---	---	---	0	0.069
GRM	9-L-41 Digitran		---	---	---	---	0	0.007
GRM	9-L-45 Digitran		---	---	---	---	0	0.007
GRM	9-L-46 Digitran		---	---	---	---	0	0.076
GRM	9-L-48 Digitran		---	---	---	---	0	0.021
GRM	9-L-49 Digitran		---	---	---	---	0	0.021
GRM	9-L-51 Digitran		---	---	---	---	0	0.014
GRM	9-L-52 Digitran		---	---	---	---	0	0.007

PART CLASS: SWITCH

TYPE: Thumbwheel (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER		
GRM	9-L-53 Digitran	12 and 16 position	---	---	---	---	0	0.014
AIT			15.860	---	8.118	29.175	3	0.189

PART CLASS: SWITCH

TYPE: Toggle

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL			
					LOWER	UPPER		
GRF	MIL-S-3950	Environmentally Sealed	---	---	---	0	0.083	
GRF	MIL-S-3950	Environmentally Sealed	---	---	---	0	0.042	
GRF	MIL-S-3950	Environmentally Sealed	---	---	---	0	0.010	
GRF	MIL-S-8834	5A	---	---	---	0	0.177	
GRF	MIL-S-8334		---	0.239	---	0	3.840	
GRM		SPST, 5A	---	---	---	0	0.167	
GRM		DPDT, 5A	---	---	---	0	0.083	
GRM		DPDT, 5A	---	---	---	0	0.007	
GRM	MIL-S-8834	DPDT, 25A	---	---	---	0	0.12	
AI	MIL-S-8834 MS90310-231	SPDT, 4A, 28 VDC	116.000	---	59.535 213.953	3	0.026	
AI	MIL-S-8834 MS90311-211	SPDT, 4A, 28 VDC	---	---	---	0	0.052	
AI	MIL-S-8834 MS90311-231	SPDT, 4A, 28 VDC	---	---	---	0	0.017	

PART CLASS: SWITCH

TYPE: Toggle

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE / 10^6 HOURS			NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE LOWER	INTERVAL UTTFP		
GRF	MS35059	2PDT, Momentary Oper., Dustproof Construction, 28VDC at 28A RES.	---	1.339	---	---	0	0.684
GRF	MS35059	2PDT, 2 Position Oper., Dustproof Construction, 28VDC at 20A RES.	---	0.892	---	---	0	1.029
GRF	MS90311	2PDT, 2 Position Oper., Dustproof Construction, 28VDC at 5A RES.	---	0.289	---	---	0	3.165
GRF	MS35059	1PST, Momentary Oper., Dustproof Construction, 28VDC at 8A RES.	---	1.839	---	---	0	0.498

PART CLASS: TIME-TOTALIZING METER

TYPE: Timers, Electro-Mechanical

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL			
					LOWER	UPPER		
GRF		Elapsed Time, 1 Phase 120V, 60HZ	42.210	---	30.141	58.630	9	0.213
GRF		Clock	42.850	---	34.190	53.560	18	0.420
GRM		Clock	95.230	---	39.240	204.290	2	0.021
AI		Clock	1338.000	---	1211.136	1482.112	79	0.059
AI		Clock	45.450	---	28.090	72.000	5	0.110
AI		Clock	194.600	---	184.100	205.200	255	1.310
AU		Clock	372.700	---	360.800	385.900	1075	2.884
HEL		Clock	86.360	---	69.610	107.270	19	0.220
SHS		Elapsed Time	---	---	---	---	0	0.230

PART CLASS: VALVE

TYPE: General

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (X 10 ⁶)
				50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
					LOWER				
GRF		Ball - 1 in., 250 lb., SCRD Stainless Steel Body	1.441	---	0.891	2.283	5	3.469	
GRF		Butterfly - 3 in., 150 lb., Wafer Type, Steel	3.617	---	1.852	6.655	3	0.829	
GRF		Butterfly, 3 in., 150 lb., Wafer Type, Steel	1.206	---	0.269	3.617	1	0.829	
GRF		Check - Swing, 2 in., 150 lb., FLGD	2.399	---	1.483	3.800	5	2.084	
GRF		Check - Swing, 2 in., 150 lb., FLGD	2.858	---	1.464	5.260	3	1.050	
GRF		Check - Swing, 2 in., 200 lb., FLGD	2.873	---	2.051	3.990	9	3.133	
GRF		Check - Swing, 1/2 in., 200 lb., SCRD	1.206	---	0.269	3.617	1	0.829	
GRF		Check - Swing, 1/2 in., 200 lb., SCRD	5.997	---	3.904	9.905	6	1.001	
GRF		Check - Swing, 1 in., 150 lb., SCRD	2.880	---	1.475	5.300	3	1.042	

PART CLASS: VALVE

TYPE: General (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x 10 ⁵)
				60% UPPER TWO-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
					LOWER	UPPER			
GRF		Check - Swing, 1 in., 150 lb., SCRD	6.028	---	3.725	9.549		5	0.829
GRF		Diaphragm 1 in., 150 lb., SCRD, Stainless Steel Body	2.411	---	1.008	5.172		2	0.829
GRF		Diaphragm - 150 PSIG, Water	1.205	---	0.497	2.586		2	1.659
GRF		Diaphragm - 20 PSIG, Pneumatic	3.829	---	2.669	5.428		8	2.089
GRF		Diaphragm - 3 way, Water Temp. Control	---	---	---	---		0	0.124
GRF		Fixed Flow Control - 1/2 in., Air	13.632	---	6.980	25.083		3	0.220
GRF		Fixed Flow Control - 1/2 in., Air	---	---	---	---		0	0.321
GRF		Gate - 2 in., 200 lb., SCRD	1.920	---	1.102	3.216		4	2.083
GRF		Gate - 1 in., 200 lb., SCRD Bronze Body	1.206	---	0.497	2.586		2	1.659
GRF		Gate - 1/2 in., 200 lb., SCRD Bronze Body	0.603	---	0.134	1.808		1	1.659

PART CLASS: VALVE

TYPE: General (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE / 10^6 HOURS			NUMBER FAILED	OPERATING HOURS ($\times 10^6$)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE LOWER	INTERVAL UPPER		
GRF		Gate - 3 in., 150 lb., FLGD Steel	1.440	---	0.737	2.650	3	2.082
GRF		Globe - 2 in., 175 lb., SCRD	1.206	---	0.269	3.617	1	0.829
GRM		Globe - 1 in., 200 lb., SCRD Bronze Body	---	1.104	---	---	0	0.829
A		Hydraulic - 4 way Spool	463.700	---	414.200	520.500	64	0.138
A		Hydraulic - 3 way Spool	35.211	---	25.669	48.028	10	0.284
AUT		Hydraulic - 3 way Spool	---	---	---	---	0	0.212
AU		Motor Driven - Fuel	47.850	---	38.450	59.450	19	0.397
GRF		Needle - 1/4 in., 3000 PSI, Steel	1.690	---	0.696	2.898	2	1.183
GRF		Needle - 1/2 in., 3000 PSI, Steel	1.206	---	0.617	2.218	3	2.488
GRF		Plug - 1/2 in., 150 lb., SCRQ, Steel w/stainless steel plug	1.219	---	0.272	3.657	1	0.820

PART CLASS: VALVE

TYPE: General (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS			NUMBER FAILED	OPERATING HOURS (x 10 ⁶)
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE LOWER	60% CONFIDENCE UPPER		
GRF		Plug - 1/2 in., 150 lb., SCRD, Steel w/stainless steel plug	3.840	---	2.204	6.433	4	1.042
GRF		Plug - 1 in., 150 lb., SCRD, Steel w/stainless steel plug	0.969	---	0.216	2.908	1	1.032
GRF		Plug - 2 in., 300 lb., SCRD, Steel w/stainless steel plug	1.206	---	0.269	3.617	1	0.829
GRF		Plug - 2 in., 300 lb., SCRD, Steel w/stainless steel plug	5.761	---	4.338	7.614	12	2.083
GRF		Relief - 3/4 in., 150 lb., Set 80 PSI, 56 PM	2.411	---	0.993	5.172	2	0.829
GRF		Relief - 3/4 in., 150 lb., Set 80 PSI, 56 PM	1.568	---	0.350	4.705	1	0.638
GRF		Relief - 3/4 in., 150 lb., Set 80 PSI, 56 PM	1.206	---	0.269	3.617	1	0.829
GRF		Relief - 1/2 in., 150 lb., Set 85 PSI, 20 SCFM	1.808	---	0.926	3.328	3	1.654

PART CLASS: VALVE

TYPE: General (continued)

ENV	SPEC NUMBER PART NUMBER MANUFACTURER	CHARACTERISTICS	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS $\times 10^6$
				60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL	LOWER	UPPER		
GRF		Vent - 3/4 in., Float operated tank vent	---	---	---	---	---	0	0.321
GRF		Solenoid - 2 in., 380 PSI, 2 way, shuttle	1.608	---	---	0.331	2.693	4	2.488
GRF		Solenoid - 1/2 in., 4 way, 3 POS. shuttle	0.826	---	---	0.340	1.772	2	2.421
GRF		Solenoid - 1/2 in., 110V, Refrigerant.	6.816	---	---	3.490	12.542	3	0.440
GRF		Solenoid - 3/8 in., 150 lb., 110V, Air	9.618	---	---	4.924	17.697	3	0.312

NONELECTRONIC PART RELIABILITY DATA

SECTION 3

**NONELECTRONIC PARTS DATA FROM COMMERCIAL
EQUIPMENT APPLICATIONS**

Section 3

NONELECTRONIC PARTS DATA FROM COMMERCIAL EQUIPMENT APPLICATIONS

The detailed data presented in this section have been selected and grouped on the basis of direct applicability to electronic data processing, point of sales and test equipments. Data from these areas have proven to be limited and have been grouped in this section in order to improve visibility for the user of the databook. The environmental codes described on page 5 are utilized in this section.

The user should take care to note the terms in which the failure data are given, i.e., hours or cycles, since this is a variable in this section. **An asterisk (*) to the right of the data line is provided to alert the user to note that the column headings are in cycles.**

INDEX FOR COMMERCIAL EQUIPMENT APPLICATION DATA

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COMMERCIAL EQUIPMENT APPLICATION DATA TABLES

PART DESCRIPTION	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (X10 ⁶)
	$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL		73		
			LOWER	UPPER			
PART: Teflon Sleeve Bearing APPLICATION: Tape Guide, Magnetic Tape Unit APPLICATION CONDITIONS: GRF (45°C Internal) FAILURE MODES: Erratic Movement Worn	14.180	---	12.813	15.862	73	5.148	
PART: Bearing (Pair) APPLICATION: Capstan, Magnetic Tape Unit APPLICATION CONDITIONS: GRF (45°C Internal) FAILURE MODES: Noisy, Worn	13.985	---	9.986	19.424	9	0.644	
PART: Belt APPLICATION: Capstan Drive, Magnetic Tape Unit APPLICATION CONDITIONS: GRF (45°C Internal) FAILURE MODES: Worn, stretched, broken	41.956	---	35.050	50.385	27	0.644	

PART DESCRIPTION	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x10 ⁶)
	$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL		UPPER		
			LOWER				
PART: Belt APPLICATION: Data Entry, Data Preparation Equipment APPLICATION CONDITIONS: GRF FAILURE MODES: -----	0.456	---	0.419	0.498	106	232.406	
PART: Ceramic Bushing and Spring APPLICATION: Tape Guide, Magnetic Tape Unit APPLICATION CONDITIONS (45°C Internal) FAILURE MODES: Worn Bushing, Spring Tension Lost	33.409	---	29.060	38.290	43	1.287	
PART: Spring Clutch APPLICATION: Data Entry, Preparation Equipment APPLICATION CONDITIONS: GRF FAILURE MODES: -----	0.594	---	0.572	0.619	478	804.347	

PART DESCRIPTION	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x10 ⁶)
	$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE		INTERVAL UPPER		
			LOWER				
PART: Memory Disk APPLICATION: ----- APPLICATION CONDITIONS: DOR FAILURE MODES: -----	0.148	---	0.033		0.444	1	6.760
PART: LED Display, 7 Segment, 1 Character APPLICATION: Test Instruments APPLICATION CONDITIONS: GRF FAILURE MODES: -----	0.226	---	0.214		0.238	258	1141.741
PART: LED Display, 7 Segment, 4 Character APPLICATION: Test Instruments APPLICATION CONDITIONS: GRF FAILURE MODES: -----	0.146	---	0.0325		0.437	1	6.864

PART DESCRIPTION	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x10 ⁶)
	$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
			LOWER				
PART: LED Display, 7 Segment, 5 Character APPLICATION: Test Instruments APPLICATION CONDITIONS: GRF FAILURE MODES: -----	0.114	---	0.077	0.166	7	61.529	
PART: LED Display, 7 Segment, 9 Character APPLICATION: Test Instruments APPLICATION CONDITIONS: GRF FAILURE MODES: -----	---	1.559	---	---	0	0.588	
PART: LED Display, Dot Matrix, 1 Character APPLICATION: Test Instruments APPLICATION CONDITIONS: GRF FAILURE MODES: -----	0.163	---	0.137	0.193	29	178.303	

PART DESCRIPTION	FAILURE RATE / 10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x10 ⁶)
	$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	50% CONFIDENCE INTERVAL				
			LOWER	UPPER			
PART: LED Display, Dot Matrix, 3 Character APPLICATION: Test Instruments APPLICATION CONDITIONS: GRF FAILURE MODES: -----	---	7.190	---	---	0	0.127	
PART: LED Display, Dot Matrix, 4 Character APPLICATION: Test Instruments APPLICATION CONDITIONS: GRF FAILURE MODES: -----	0.962	---	0.214	2.885	1	1.040	
PART: LED Display, Dot Matrix, 5 Character APPLICATION: Test Instruments APPLICATION CONDITIONS: GRF FAILURE MODES: -----	---	0.157	---	---	0	5.829	

PART DESCRIPTION	FAILURE RATE / 10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x10 ⁶)
	$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
			LOWER				
PART: LED Display, Dot Matrix, 6 Character APPLICATION: Test Instruments APPLICATION CONDITIONS: GRF FAILURE MODES: -----	1.095	---	0.891	1.345	21	19.175	
PART: Fan APPLICATION: Data Entry, Preparation Equipment APPLICATION CONDITIONS: GRF FAILURE MODES: -----	0.312	---	0.274	0.356	49	156.952	
PART: Vacuum Fan APPLICATION: Magnetic Tape Unit APPLICATION CONDITIONS: GRF (45°C Internal) FAILURE MODES: Bearings Worn, Noisy	12.431	---	8.665	17.662	8	0.644	

PART DESCRIPTION	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x10 ⁶)
	$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
			LOWER				
PART: Gear APPLICATION: Data Entry, Preparation Equipment APPLICATION CONDITIONS: GRF FAILURE MODES: -----	0.169	---	0.130	0.218	14	83.067	
PART: Magnetic Tape Head APPLICATION: Magnetic Tape Head APPLICATION CONDITIONS: GRF (45°C Internal) FAILURE MODES: Signal Distortion, Head Worn	43.510	---	36.479	52.184	28	0.644	
PART: Motor APPLICATION: Data Entry, Preparation Equipment APPLICATION CONDITIONS: GRF FAILURE MODES: -----	1.499	---	1.401	1.619	154	102.789	

PART DESCRIPTION	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (X10 ⁶)
	$\hat{\lambda}$	50% UPPER SINGLE-TAILED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
			LOWER				
PART: Relay APPLICATION: Data Entry, Preparation Equipment APPLICATION CONDITIONS: GRF FAILURE MODES: -----	2.693	---	2.591	2.806	488	181.208	
PART: General Purpose Relay Silver or Gold Bonded Contacts APPLICATION: Medical Electronics APPLICATION CONDITIONS: GRF FAILURE MODES: Fatigue of Swinger 7 Contact Resistance 9 Contact Bounce Greater than 30 Milliseconds 13	0.00107	---	0.000904	0.00128	29	27000.000*	

PART DESCRIPTION	FAILURE RATE / 10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (X10 ⁵)
	$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL LOWER	60% CONFIDENCE INTERVAL UPPER		
PART: General Purpose Relay 10A, 25VDC Contact Res. Initial 0.05 Ω Contact Res. After Life Test 0.10 Ω APPLICATION: Electronic Data Processing APPLICATION CONDITIONS: Test, 105 cyc each FAILURE MODES: Mechanical 1 at 18,000 cyc Electrical 10	2.115	---	1.570	2.838	11	5.200*
PART: Keyboard Switch Colorado Instruments Gold Contacts, 10A, 28VDC, 0.2 Ω 90GM Force; 0.080 in. Pretravel, 0.020 in. Overtravel APPLICATION: Point-of-sale Equipment APPLICATION CONDITION: Test, 30 cyc per minute FAILURE MODES: Contact Miss 19 Spring Fatigue 7 Broken Actuator 2	0.0622	---	0.0522	0.0744	28	450.000*

PART DESCRIPTION	$\hat{\lambda}$	FAILURE RATE/10 ⁶ HOURS				NUMBER FAILED	OPERATING HOURS (x10 ⁶)
		60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
			LOWER				
PART: Keyboard Switch Cherry Electrical Products Gold Alloy Crosspoint Contacts 10A, 24VDC, Operating Life 5 x 10⁶ cyc APPLICATION: Intelligent Terminal APPLICATION CONDITIONS: GRF (35°C - 40°C Internal) FAILURE MODES: Contact Miss 4 Burned Contact 3 Broken Return Spring 3 Broken Actuator Stem 1	0.0105	---	0.00777	0.0141	11	1050.000*	
PART: Key Push Button Switch Contacts - 3A, 115-200VAC; Resistance 50mΩ at 6VDC & 100mA Life Mechanical - 100,000 cyc Life Electrical - 25,000 cyc APPLICATION: Electronic Data Processing APPLICATION CONDITIONS: GRF FAILURE MODES: -----	2.317	---	1.508	3.514	6	2.589	

PART DESCRIPTION	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x10 ⁶)
	$\hat{\lambda}$	50% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL				
			LOWER	UPPER			
PART: Push Button Switch Contacts - Silver Plate; Contact Resistance Initial 0.015Ω at 2A, 30VDC; After Life Test 0.030Ω APPLICATION: Electronic Data Processing APPLICATION CONDITIONS: Test FAILURE MODES: Contact Resistance 6	3.000	---	1.953	4.550	6	2.000*	
PART: Rocker Switch C&K Components - 5101, 5103, 5108 APPLICATION: ----- APPLICATION CONDITIONS: Test 105 cyc each 15 cyc per minute; duty cycle - 1 sec. on, 3 secs. off; resistive load, 20mA, 20VDC FAILURE MODES: -----	---	0.916	---	---	0	1.000	

PART DESCRIPTION	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x10 ⁶)
	$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		8.919		
			LOWER	UPPER			
PART: Toggle Switch OAK-12A-2B1-1A0 APPLICATION: Electronic Data Processing APPLICATION CONDITIONS: Test 105 cycles each at 18 cycles per minute; 20mA, 20VDC, resistive load FAILURE MODES: Actuator Broken 1 Contacts Pitted 1	4.158	---	1.713		2	0.481*	
PART: Toggle Switch Contact Resistance Initial - 0.01Ω at 30VDC; Contact Bounce - 6 milliseconds at 0.1A, 4VDC APPLICATION: Electronic Data Processing APPLICATION CONDITIONS: Test FAILURE MODES: Mechanical 1 @ 20,369 cycles	1.479	---	0.330	4.438	1	0.676*	

PART DESCRIPTION	FAILURE RATE/10 ⁶ HOURS					NUMBER FAILED	OPERATING HOURS (x10 ⁶)
	$\hat{\lambda}$	60% UPPER SINGLE-SIDED CONFIDENCE	60% CONFIDENCE INTERVAL		UPPER		
			LOWER				
PART: Switch APPLICATION: Data Entry, Preparation Equipment APPLICATION CONDITIONS: GRF FAILURE MODES: -----	27.234	---	26.771		27.779	21096	774.613

NONELECTRONIC PARTS RELIABILITY DATA

SECTION 4

FAILURE MODES AND MECHANISMS

OPERATIONAL FAILURE MODES AND MECHANISMS

The following discussions provide information which serves to identify the major problem areas associated with the failures of certain nonelectronic parts under operational conditions. To a limited extent, guidelines are provided for limiting the failure modes identified.

Batteries

There are two basic types of batteries, primary and secondary. Primary batteries are nonrechargeable, discarded when the energy runs out. Secondary batteries are rechargeable batteries and can be used time and time again. This discussion is limited to specific secondary batteries such as lead-acid and nickel-cadmium.

Lead-Acid Batteries

Lead-acid systems are not new; they have not been used widely in electronic systems because of packing problems, their weight and size, and the danger of acid leakage. The newly developed gelled lead-acid system, however, has overcome most of the drawbacks of its predecessor (except packaging inadequacies), but it is new and not yet in great supply and usage.

Lead-acid batteries have one area which greatly affects their useful life, the recharge cycle. Recharging efficiency is a function of temperature and charge rate. To properly recharge many secondary batteries the charge rate must be tapered with time. Not doing so shortens the life of the battery and can lead to overcharging. In lead-acid batteries, overcharging will cause the generation of gases (H_2 and O_2) within the cell to dangerously high levels. Though almost all lead-acid batteries have venting techniques to allow the gases to escape and thereby reduce cell pressure, the loss of these gases can greatly reduce the life of the cell. Several manufacturers of lead-acid batteries utilize a separate compartment to recombine the gases into water via a catalyst. This is done at the expense of compactness. In the worst case, if the gases are not vented or are vented at too high a pressure, the cells will explode.

Charging, and especially overcharging, also causes the battery cells to generate heat. It should be noted that many rechargers use this condition to increase the tapering of the charge rate and so reduce the possibility of overcharging.

Other reliability considerations lie in the packaging and basic design of lead-acid cells. Examining packaging first, it is incorrect to assume that any battery is hermetically sealed. Corrosion can be found on lead-acid cells that have never been used and have been left in storage. Lead-acid batteries have been known to leak acid either through the case itself or through the terminal seals.

The basic design of the lead-acid battery is also responsible for several problems. The nature of the lead-acid system does not lend itself well to being packaged in a cylindrical package. This tends to lower the energy density per cell and also to cause the package failures mentioned previously.

Nickel-Cadmium Batteries

The charging information stated for lead-acid can be applied to the nickel-cadmium. There is also specific information which only applies to the nickel-cadmium.

Memory effect is a reversible failure mode that causes a nickel-cadmium battery to fall below its rated performance because of certain modes of operation. It is caused by repetitive discharge to a shallow depth. A nickel-cadmium battery repeatedly discharged only 25% (75% of charge unused) and then fully recharged will, after 50 or more of such cycles, deliver 25% of its rated capacity when a deep discharge is then attempted. A nickel-cadmium battery exhibiting memory effects can be restored to normal capacity simply by deep discharging it and then fully recharging it. Memory effect is not a problem when the battery is subjected to random depths of discharge or is overcharged for random periods of time. It occurs only when a precise, repetitive pattern of shallow discharge and full recharges is followed. This is not a prevalent problem in all NiCd battery systems but is the product of several design techniques.

Cell polarity reversal is another hazard of the NiCd battery. If a battery (consisting of several cells in series) is discharged to too low a level and one or more of the composing cells is completely depleted of charge, there is the chance that the depleted cell's polarity may reverse. In this instance, the reversal cell would accept a charge from the remaining charged cells, generate internal heat and pressure, and destroy the battery.

Chemical breakdown of the nylon separator is the most frequent failure of nickel-cadmium batteries. Oxygen produced continuously while the cell is in an overcharge mode reacts with the nylon; as a result, a NiCd cell at 50°C has a useful life about half that at 40°C. NiCds for emergency power are almost always run in such a continuous low-rate overcharge mode.

Conclusions

Part level failure problems associated with batteries can be lumped under four basic categories: catastrophic short; catastrophic open circuit; deviations in electrical performance; and mechanical anomalies. The most predominant failure mode is a mechanical anomaly, leakage from a cell seal.

System level failures in charge control or thermal design, while not caused by the battery, may be falsely interpreted as a defect in the battery.

Bearings

The predominate failure modes of bearings are related to their lubrication. Much emphasis has been placed on the study of bearing fatigue life and reliability and the types of lubrication systems used to enhance long life, since bearings are acknowledged as the life-limiting elements of most motors. To reach the longest motor life possible, bearing wear must be reduced to a minimum, usually by the application of lubricants. The selection of lubricants is almost always a compromise, since there are so many significant characteristics to consider. Some of the important application considerations include: operating temperature range,

oxidation and thermal stability properties, type of environment, evaporation rate, and viscosity. Depending on the specific application certain tradeoffs are inevitable, as in the case of silicon, which has an excellent viscosity index rating but poor boundary condition lubrication.

The failure mechanisms of bearings usually result in the reduction of lubrication. These mechanisms include: excessive bearing load, excessive temperature, bearing misalignment, brinnelling (plastic deformation of raceways), fretting corrosion, contamination of raceways (gear wear debris, brush wear debris, corrosion products), evaporation or migration of lubricant, high viscosity (operating temperature lower than anticipated) and spalling or galling.

Circuit Breakers

The function of a circuit breaker is to protect electrical circuitry by acting as a manual switch that can open itself under overload conditions. The major circuit breaker problem is mechanical failure due to the complexity of some activation mechanisms. Contamination caused by the formation of oxides or loose metal particles is also a problem and could result in an open or short condition. Contact corrosion due to external impurities (such as solder resin, body oils, sulfides, or wire lubricants) can also create the same condition. Poor process control can cause deformed, loose, or broken contacts, and termination separation.

Connectors

A device consisting of a plug and a receptacle that provides a disconnect capability between the various components in an electrical circuit is classified under the general heading of connector. The plug or receptacle is the termination of the internal circuit leads. The connection made between the connector and the conductor itself is made by several different methods: crimping, soldering, welding, and the clamping action of mechanical closures. The type of connector depends on the style of the coupling system. Some of the common connector types are radio frequency, cylindrical multipin, rectangular, and printed wiring.

Connector failure problems may be lumped into three basic categories: mechanical parameter deviation, electrical parameter deviation, and mechanical damage. It should be noted that catastrophic opens and shorts are worst-case conditions of certain electrical parameter deviations. These failures may be the result of several different failure mechanisms. The prevalent failure mode for all connectors is an electrical parameter deviation (open condition) generally caused by contamination interfering with normal operation. Corrosion is another failure mechanism resulting in an open circuit: the oxides formed may tend to act as an insulator. Even gold plated contacts have corrosion problems: the base metal may diffuse through the gold and form an oxide on the surface. Mechanical damage is often the result of improper installation techniques. Wear factor is also a major problem. With hard gold you can expect mating and demating cycles of 200 or more. With tin plating or solder coating, the cycles may drop to 50 or more. This can be a problem when using high density connectors. Other common failure modes are creep or relaxation of the materials in the connection and overheating of the termination by the flow of current.

Coolant Hose

A coolant hose failure often results in the shutdown of a whole system which, in many cases, could have been avoided by routine inspection and replacement. Most equipment owners have established maintenance schedules that include the cooling system. By recognizing the signs of coolant hose failures and eliminating their causes, equipment downtime can be reduced.

Coolant hose failures may be attributed to five major failure mechanisms. Excessive heat, one of the more prevalent failure mechanisms, causes hardening or cracking of the hose cover. Hose "overcure" due to excessive internal or external heat will result in the hose becoming stiff and failing. Weathering and cracking can result from pollution in the environment around the hose; ozone especially has an adverse effect. Large irregular cracks in the hose cover without hardening are caused by vibration. To correct vibration problems, use a flex or humped hose or

dampen the vibration source. Coolant deterioration will cause the interior of the hose to crack and flake off and enter the coolant. These particles can clog the cooling system and cause a failure. The final failure mechanism is contamination of the hose. This occurs primarily when oil or grease soaks the hose, causing it to become soft or spongy. An oil-softened hose can collapse under sudden application of vacuum as in sudden acceleration. To correct this problem, eliminate the source of the oil (may be external or internal) and replace the hose.

Electron Tubes

Electron tubes are devices sealed in a gas-tight envelope or "tube" using the motion of electrons through a gas or vacuum for the desired effect. The first class of electron tubes is the vacuum tube, where a vacuum or a near-vacuum is employed. The second class is gas tubes, where the electrons impact atoms of the gas, which then ionize. Many electron tubes have had extensive military use, and failure rates are available in MIL-HDBK-217C.

Four primary modes are associated with electron tubes: deterioration or destruction of the seal, wearout of electron emission surfaces, evolution of gas, and contaminated or damaged emission surfaces resulting in increased electron emission. The failure mechanism most likely to be directly or indirectly responsible for all four failure modes is excessive heat. Both heat from the environment around the tube and heat generated within the tube create this adverse effect. Internal heat rise is due to one of two sources: the current flow from one element of the tube to another element, and power used to raise the electron-emitting cathode to operating temperature.

Fuses

The basic function of a fuse is to protect electrical circuits. When the current flow through the circuit exceeds the rated capacity of the fuse, the circuit is opened by the fuse element. Fuses provide safety against overload conditions which could result in either damage to the electrical system or a fire.

Fuses have two principal failure modes: open, and failure to open. Any premature interruption of the current flow such as a mechanical breaking of the fuse element would be classified as an open. A failure to open is when current flow levels exceed the fuse rating and the fuse element does not open the circuit. Failure to open is most commonly caused by electrically conductive material shorting the fuse terminals together. The principle failure mechanism is contamination including corrosive products. The source of the contaminants is dependent on the type: conductive and nonconductive. The conductive contaminant can come from solder balls or metal flashings and is usually detectable by x-ray screening. However, the nonconductive material, which can cause failure to open as well as open, is difficult to detect. The source of nonconductive contaminants is sometimes the fuse case or body.

Slow blow fuses are treated a little differently. Slow blow fuses are used when a high in-rush of current is desired to initially start a system and after initial start-up, to maintain the system at a lower current level. If the fuse blows too fast the system will not start or energize. If the fuse blows too slow, damage may occur to the system. Therefore, the most prevalent failure mode of slow blow fuses is the delay time.

Gaskets and Seals

Fluid seals are devices used to effect separation of gaseous or liquid environments at points of structural transition and at movable component interfaces. Seals used in applications where the involved surfaces do have relative motion are commonly called gaskets. An example of structural transition seal is the gasket used in the internal combustion engine between three distinctly separate environments, ambient air, cooling fluid, and combustible gases. An example of a seal for a movable component interface is the gland seal around the shaft of a rotary pump, separating the fluid being pumped from the ambient surroundings. This type of seal is commonly known as a dynamic seal and is used to effectively separate the various environments at movable interfaces where there may be reciprocating longitudinal movement as well as rotary motion.

The most common failure mode for fluid sealing devices is leakage, classified into three basic types: (1) permeation, (2) molecular, and (3) viscous flow. Permeation, as the name implies, is a capillary flow directly through the material. This is primarily because of the degree of porosity of the batch material from which the seal was fabricated. Molecular flow is a similar phenomenon, but it occurs at the interface surfaces and is caused by a finite unoccupied space between the two surfaces of the interface. Molecular flow is proportional to the pressure differential between the separated environments. Viscous flow also occurs on the interface surfaces and is encountered when the minimum cross-sectional area of the leakage path becomes large in comparison to the mean free path requirement for gas flow. Viscous flow leakage rate is proportional to the difference between the square of the internal pressure and the square of the external pressure.

In addition to leakage (limited loss of contained fluid), fluid sealing devices fail by rupture because of inadequate back-up rings or excessive pressures and the introduction of corrosion products or other contaminants. Rupture may be caused either by excessive pressure differentials applied to the sealing device or by shearing mechanical forces applied in an unforeseen rotational mode or as an excessive transverse force. Corrosion products and other contaminants may be caused by normally anticipated environmental considerations, or they may be the result of galvanic corrosion and/or contaminants in inadequately filtered fluid.

Gyroscope

A gyroscope is a device developed to detect angular motion with respect to inertial or Newtonian space. Each design is somewhat unique; however, the usual construction is a spinning wheel with one or two degrees of freedom. A gyroscope normally consists of six functional components: wheel, spin bearings, spin motor, gimbel, pickoff and torquer. The primary source of failures are the spin bearings. The normal life of each gyroscope is dependent on the environment it is used in and the conditions it operates under. The prevalent failure mode of gyros using ball bearings is deterioration of the lubricant or running surface due to contamination.

Gas bearings are excellent for continuous operation because of no wear under run conditions. The major failure mechanism occurs during starting and stopping. Grease bearings offer a greater tolerance to contamination and potentially much longer life. Drift instability is also a problem since a very small amount of creep in the gyro float material can cause a drift equivalent to a nautical mile. Material creep is caused by instability due to time and temperature cycling effects.

IC Sockets

There are two basic types of contacts in IC sockets: screw machined, closed-entry sleeves with screw machined or stamped-and-rolled four-leaf contact inserts; or one-piece stamped and formed contacts with single or dual-leaf contacts. Either socket type is available with solder tail on wire-wrapable terminations.

Sockets with stamped contacts come in two configurations. In one, the contacts mate with the broad sides of the leads. In the others, the contact mates with the side and are called side-wipe or face-grip. The merits of these two approaches have been debated at great length.

Zero insertion force connectors have a sliding mechanism that provides effortless insertion and withdrawal of ICs when the sockets are in the open position but locks them securely in place when the mechanism is closed. Zero insertion force sockets are expensive but not compared to a 40 pin IC with a broken lead. Therefore, these sockets are mainly used in "high pin" ICs.

For contact materials, beryllium copper when used for high reliability application is an excellent choice. It retains good spring qualities, although it requires plating because of a tendency to form surface oxides. Phosphor bronze provides excellent spring qualities, adequate conductivity, and generally gives the best combination of economy and reliability. It also usually requires plating with solder lead contacts in order to aid solderability.

Socket bodies are commonly made of thermoplastic materials like glass nylon, glass polyesters and polycarbonates. Thermosets like DAP and phenolics are also used. They provide excellent dimensional stability and heat resistance but are generally more expensive.

One of the major failure modes for sockets is high resistive connections. If the application is in a high contamination area there is the risk of oxidation forming on the contacts or of the accumulation of dust or dirt particles. This condition creates a high resistive connection which may result in a false indication when using sensitive circuitry.

Intermittents are even a larger problem due to problems of location of the intermittents. This is especially difficult in digital systems where there are either high or low logic levels.

The contact must maintain its spring qualities after several removal and insertion cycles. The amount of pressure exerted on the IC lead must be adequate to break through any oxidation which may have formed.

Sufficient caution must be taken during soldering to insure that solder does not enter the barrel of the IC socket, preventing proper installation of the IC.

The following is a listing of failure modes for IC sockets:

- 1) Increase in contact resistance with repeated insertion because of fatigue and deformation of spring material in contact fingers
- 2) Damage to contact and pin plating with repeated insertion and exposure of base metal to corrosive atmosphere
- 3) Corrosion of contact and pin surfaces because of porous plating, plating that is too thin, diffusion of base metal into plating, scratched plating, etc.

- 4) Insulation resistance failure of plastic socket housing because of water absorption or change of mechanical properties of housing at high temperatures
- 5) Electrochemical reaction between socket contact and IC pin
- 6) Poor contact resistance caused by surface films on socket contacts and IC pins

Motors

Motors can be classified into two basic types, ac motors and dc motors. In direct-current motors, speed adjustment is inexpensive and easily obtained; therefore, a wide variety of industrial applications use DC motors. Alternating-current type motors are frequently used in aerospace applications. Overheating causing premature motor failure can be the result of the selection of too small a motor for the given application or of a unit unsatisfactory for the given environment. Therefore, it is important to implement a proper selection and application program for reliable motor operation.

The principal failure modes associated with motors are related to the lubrication of the bearings or the commutation of the brushes. Bearing failure can be caused by various failure mechanisms, of which the most common are: inadequate lubrication due to migration or evaporation or severe operating conditions, brinnelling (plastic deformation of the raceways), fretting corrosion, raceway contamination, and spalling of raceways. Bearings have proven to be the life-limiting items in motors. Most dc motors have the additional failure modes associated with brushes (i.e., fracture, rapid brush wear due to high altitudes, and bearing failures due to contamination from brush wear) and in general are more prone to failure than ac motors.

Printed Circuit Boards

There exists a variety of printed circuit boards commercially available. The choice of interconnection board depends on many different factors. Required packaging density, desired delivery time, cost limitations, usage environment and

size of production run are all factors which can be used to determine the optimal type of interconnection board for a particular application. Circuit board reliability is also an important consideration, and this section includes failure modes and mechanisms for double sided, multilayer, multiwire and wirewrap interconnection boards.

The plated through hole is used in double sided, multilayer and multiwire printed circuit boards to connect component leads to board circuitry. The plated through hole is the largest contributor to circuit board failures for these types of boards. Problems arise because of the differences in thermal expansion of the epoxy glass base material and the copper plating. The epoxy glass and the copper expand and contract at different rates during thermal cycling. This results in axial strains on the plated through hole barrel wall, weakening the mechanical properties of the copper plating and eventually leading to open circuits. In the case where the ductility of the copper plating is already poor, this process is accelerated. Additionally, poor drilling or excessive acid etching during the plated through hole cleaning process can lead to imperfections in the barrel wall. These imperfections will amplify the level of axial strain in the plated through hole and contribute to possible open circuits.

Multilayer boards, as compared to double-sided boards have additional layers of circuitry separated by epoxy glass laminations. This allows for higher packaging density but also creates additional plated through hole problems. Electrical connections to the plated through hole can be made at a number of different layers in the circuit board. This adds to the number of areas which are affected by strains related to thermal cycling. At each layer where a copper run must connect to the plated through hole, a shearing force is applied to the copper run - plated through hole interface, resulting in possible open circuits.

The multiwire type of interconnection board is unique because insulated wire is laid down on the epoxy glass as an alternate to the copper runs used in double-sided and multilayer printed circuit boards. This results in high packaging density because the insulated wires can be crossed on a single level of circuitry. There are several advantages in this type of system but there are also different failure modes

which must be considered. Problem areas are the points of wire crossover and the wire to plated through hole connection. Under extreme environmental conditions, the wire insulation and the wire deform at a point of wire crossover and potentially cause short circuit. The wire to plated through hole can be the source of an open circuit if exposed to vibration and thermal cycling.

One advantage of wirewrap interconnection boards is the absence of plated through holes and the associated problems. However, several failure modes do exist. Insufficient tension in the wire can result in a poor connection between the wire and the wirewrap post. This occurs particularly when applied to a high vibration environment. Additionally, caution must be observed concerning wire insulation cold flow; adjacent wires or contact with a part can result in short circuits due to cold flow. Some materials which exhibit cold flow are teflon, polyvinyl chloride, etc.

Pumps

Hydraulic Pump

Nearly all hydraulic pumps work in rotary fashion. As a pump is rotated, it develops a partial vacuum on the inlet (suction) side, permitting fluid under atmospheric pressure in the reservoir to flow into the pump inlet. Then the pump ejects this fluid, usually at a higher atmospheric pressure. It is worth noting that a pump does not create pressure; it merely moves fluid, causing the flow. Pressure is created by the load on the fluid; if no load exists, the fluid will have very little pressure. As the load is placed on the fluid, the pressure at the outlet side of the pump increases to a value that is normally indicated as the pump maximum.

Failure modes for hydraulic pumps include:

- 1) Bearing or bushing failure
- 2) Incorrect fluid used, causing excessive wear
- 3) Seal deterioration
- 4) Cavitation causing pump internal part failures

Pneumatic Pumps (Compressors)

An air compressor delivering air to a pneumatic system performs the same job as a hydraulic pump. The main substantive difference between pump and compressor is that the fluid delivered by the compressor-air is compressed and under pressure at the time it is delivered, even if there is no load on the system. The only other substantive difference between the two is that most hydraulic systems are powered by a single pump that is actually part of the system, whereas the hose of the pneumatic systems is often powered by a single compressor, which is almost a "utility" in the plant, like water or electric service.

Failure modes for pneumatic pumps (compressors) include:

- 1) Bearing or bushing failure
- 2) Seal deterioration and leakage
- 3) Foreign material entering pump, causing damage or excessive wear to internal parts
- 4) Check valve leakage (when valves are integral with the pump)

Quick Disconnect Couplings

The malfunction modes of quick disconnect couplings are:

- 1) Failure to open or remain open
- 2) Failure to close or remain closed, including leakage, while uncoupled
- 3) External leakage while coupled

The possible causes for mode 1 include deformation or failure of the actuation plunger of connectors and binding of the movable engaging clamp ring. The possible causes for mode 2 include binding or cocking of the moving assembly of the connectors and failure or permanent deformation of the plunger return spring. Possible causes for mode 3 include leakage of the sleeve O-ring and leakage at the lip seal.

Relays

A relay is basically a remotely controlled, electrically operated switch which contains two or more contacts arranged so as to control external circuits. This broad definition applies to all relays regardless of type and internal construction. Most relay types, with the exception of simple thermal time delay and reed types, are complex electromechanical devices. Experience with these devices has indicated that, because of imperfections in materials and workmanship, a relay cannot be satisfactorily specified by contact rating alone. Physical considerations force us to recognize such compromising characteristics built into a relay as operate and release time, temperature effects on pickup and dropout voltages, dielectric breakdown, contact resistance, and insulation resistance. These characteristics are not simply design controlled but are directly affected by the materials employed and the care with which the relay is assembled. The factors of design, materials, and workmanship are the ones usually associated with relay failure.

Part level failure problems associated with relays may be lumped under four basic categories:

- 1) Failure of contacts to make or break
- 2) Short
- 3) Electrical parameter deviation
- 4) Mechanical anomaly

These categories are used for both latching and nonlatching type relays. For this discussion, relays have been grouped into two categories according to their basic internal construction-armature and reed types.

Armature Relays

The relay style most often used in high reliability application (and considered here) is the balanced armature type because of its demonstrated ability to withstand mechanical shock and vibration. In these relays the armature is pivoted at

its center of mass so as to place it in equilibrium with the static and dynamic forces which act upon it during operation. The moving contacts are either mounted on the armature or activated by movement of the armature.

Almost all armature type relays use copper magnet wire in the coil windings. In such copper windings the coil resistance is directly proportional to the temperature of the windings. The ampere-turns required for the coil to actuate the armature is, therefore, proportional to temperature since the coil resistance varies with coil temperature. To maintain the required ampere-turns, the pickup and dropout voltages will vary over the application temperature range.

One of the most crucial and troublesome areas in armature relay reliability is that associated with the contacts. Many of the problem areas result from the users' lack of understanding of the parameters which affect contact performance. As a consequence, contacts are operated under a wide spectrum of load conditions and a multiplicity of performance criteria which, when reviewed singularly or in combination, are inconsistent with the design parameters of the contacts.

There is a wealth of information available on contact theory and the various materials used in obtaining specific contact characteristics. The user of relays in high reliability applications should be thoroughly familiar with the information since reliability is frequently achieved through carefully limiting certain service applications.

Contamination is also a major concern in high reliability relays because it is a prime contributor to relay failures. Contamination is predominately introduced during the assembly of the relay. The contamination level can be reduced by careful selection of materials which are used for fabrication of the end product. The user should pay particular attention to the materials used for spacers, washers, insulators, and coil insulation, as well as plating requirements, before specifying a particular manufacturer's relay for his applications. These areas are considered critical to the reduction and control of contamination.

The above discussion has served to define a few of the characteristics associated with armature relays. These and other limitations can be described as specification limits for manufacturers and designers. Deviations from the limitations can lead to equipment failure.

Reed Relays

Reed relays are made from one or more reed capsule switches inside a common actuating coil. In those cases where the reed capsule switch is used in conjunction with a coil, it is generally classified as a relay; and in those cases where the reed capsule switch is used in conjunction with permanent magnet actuation, it is classified as a magnetic switch.

A basic magnetic reed switch consists of a pair of low reluctance ferromagnetic, slender flattened reeds, hermetically sealed into a glass tube with a controlled atmosphere, arranged in cantilever fashion so that the ends align and overlap with a small air gap in between. The overlapping ends assure opposite polarity when brought into the influence of a magnetic field. When the magnetic flux density is sufficient, the attraction forces of the opposing magnetic poles overcome the reed stiffness, causing them to flex toward each other and make contact. The restoring force provided by the elasticity of the reeds returns the reeds to their original position when the magnetic field is removed. Reed capsule switches, when used within their rated limits, generally have contact life ratings in the one to one hundred million cycle range, depending on contact voltage and current loads used.

The reed switch is inherently a low current, low voltage device. Its contact areas are small and contact pressures are low because the reeds become magnetically saturated; therefore, additional contact force cannot be developed by increasing the applied magnetic flux. These factors limit the continuous current rating of the switch. The interruption rating of the switch is limited by the gap between fully open contacts and by the restoring force provided by the elasticity of

the reeds. Low contact pressures and small contact gap between fully open contacts limit the reed capsule switch use in severe vibration and shock environments.

The unpredictable random occurrence of contact sticking inherent in these switches is caused by tiny magnetic wear fragments accumulated at, and sometimes binding, the contact gap. Arcing caused by dc loads between the contacts causes metal transfer, resulting in spike and crater formation which sometimes results in contact sticking due to friction between the spike and crater surfaces. For these reasons, application should be limited to those uses where an occasional contact miss is not considered a catastrophic event and those uses where voltage and current loading of the switch contacts minimizes spike and crater formation. Careful handling of the switch is a mandatory requirement. The switch contact members extend beyond each end of the glass capsule and are used as switch terminals. Bending, cutting, or applying excessive heat to the switch leads during soldering and installation changes the switch operating sensitivity. Operating one reed switch adjacent to another or in a stray magnetic field can also change its sensitivity. Magnetic shielding around reed relays is relatively ineffective in reducing the effects of uniform stray magnetic fields. Reed relays are inherently more sensitive to stray magnetic fields by one or two orders of magnitude than any other type of sealed relay in common use today. Stray magnetic fields in the order of 5 to 10 gauss have been known to cause reed relays to malfunction.

In those special applications where usage of reed switch capsules occurs, the above factors should be carefully reviewed and considered with respect to each application prior to usage.

Solder Connections

One of the most prevalent modes of failure for solder connections is the cracking of the connection due to thermal fatigue. In many instances, it is very difficult to distinguish between solder cracking as a result of thermal fatigue and

solder cracking because of poor workmanship (cold solder joints). But there are differences and they become apparent upon very close investigation. Thermal fatigue cracks will predictably occur on sequentially manufactured items and will also propagate with storage time. Solder cracks due to poor workmanship will appear randomly on sequentially produced items. These failures can be reduced by applying and controlling appropriate design criteria. The following list of criteria is provided as a guide to minimize solder connection problems:

- 1) Use only silicone or polyurethane based conformal coatings; the coatings should be of minimum thickness.
- 2) Avoid gold-plated boards; use solder-plated or solder-coated boards.
- 3) Do not use rigid encapsulating systems to secure and/or protect connected parts on printed wiring boards.
- 4) Resilient spacers, when used, should be of minimum thickness between the solder connected part and printed wiring board.
- 5) Do not hard mount parts to printed boards with mechanical fasteners unless leads are parallel to the board and of sufficient length as to provide strain relief. Also, do not hard mount parts by using minimum lead length inserted through feed-through holes.
- 6) Use terminals only when necessary and then only use terminals designed to be used on printed wiring boards.

Switches

The most consistently documented failure modes for switches are opens and shorts. The mechanism most often responsible is contamination both of the particulate and oxide nature. Particulate material in the form of solder balls or loose metal flashings can produce varied conductive paths or shorts and switch lockup due to wedging or jamming. Nonconductive particulate contamination could result in contact interference or opens as well as switch lockup. Corrosion of the contact surface due to the introduction of external sources such as polluted or heavy industrial environment, moisture and salt, body oils, solder resin, and wire lubricants also can cause high contact resistance and opens. Successful deterrents to this corrosion include: using corrosive resistive metals (gold, platinum, and palladium) and their alloys, using hermetically sealed switches, stringent control of the cleanliness of the package.

Switch screening inspections and tests are recommended to discover failures before actual part implementation. MIL-STD-202 has many effective tests ranging from temperature cycling to hermeticity and radiographic inspection.

Valves

Valves are used to control the flow of fluids, either liquids or gases, with respect to amount and direction. Industry employs many varieties of valves, such as gate, globe, poppet, plug, and needle valves, plus specialized varieties like check, metering, and relief valves. A common feature of all these valves is that they contain a solid movable member (gate, disk, poppet face, needle, or plug) that impinges on, or into, an orifice in such a manner as to create a fluid-tight separation between the entry and outflow sections of the valve. The contacting surface of this orifice, i.e., valve seat, is normally of an elastomeric material. Where this is not true, the contacting surface of the movable member is deformable or elastomeric in nature or the seat is of a deformable material and the movable member is hard.

The most prolific problem or failure mode detected and described for the valves is leakage. Deterioration of the contacting surfaces, whether due to wear, damage during installation, chemical attack, misalignment, etc., will result in imperfect sealing resulting in internal leakage. All valves, with the exception of relief and check valves, are actuated by an external mechanical force that is transferred to the movable member by a stem or riser. This actuating mechanism is subject to failure by seizure as the result of corrosion, contamination or failure. The required opening into the valve body for entry of the operating stem is an additional source of leakage, due to inadequate design and/or packing. As the valve body is generally formed from a casting, valves are subject to all of the hydrostatic problems associated with castings such as porosity and fracture from mechanical damage or pressure stress fracture due to inadequate section thickness.

Supports for valves and their associated piping are fabricated from flatbar, channel, or angle configurations. These supports should be installed in such a manner that they do not impose undue stresses on the valve piping. Valve actuating media, such as a handwheel, crank or bar should be unhindered by support

installation, permitting a complete clearance radius. When a system is subjected to stress imposed by high temperature and pressure, the supports and hangers should be designed to "walk" with the system, imposing minimal loading and maintaining support integrity.

Primary consideration in the selection of valves includes knowledge of the physical property of materials from which the valve is manufactured in order to assure compatibility with: (1) applicable fluids, (2) operating temperatures, and (3) pressure limits. The function the valve must perform and its dimensional limitations are also important considerations. Life and wear factors must be taken into account as well as maintainability. The valve should be designed to facilitate replacement of gaskets, seals and seat. The applicable limits that are the result of design considerations should be delineated at the design review that is conducted at time of first approval and should be confirmed by proof testing. Furthermore, these limits should be reflected in resulting specification and design handbooks as application notes in order that the system design does not inadvertently contribute to premature failure of the finished system.

DORMANT FAILURE MODES AND MECHANISMS

Bearings

The primary dormant failure mechanism is inadequate lubrication. Some of the common causes of this problem are: evaporation loss, migration loss, and contamination of the lubricant. To eliminate or minimize these failure modes use an oil or grease with a lower evaporation rate or a sealed motor. Periodic rotation every six months will reduce the problem of migration.

Connectors, General

Improper cleaning of connector sockets or pins prior to plating results in plating flaking on subsequent mating/demating. This results in circuit resistance increases or possible short circuits.

Clutches

Drying out of the clutch fibers lowers the required frictional coefficient and results in slippage. Conversely, if clutch faces are left in compression, the clutch materials tend to equalize out any surface roughness, but this causes interlocking of the fibers from each face and sticking. This problem can be overcome by exercising the clutch at least once each year so that the plate fibers are realigned.

Gyros

Gyro drift is the primary aging concern and is usually caused by molecular metallic interchange of the spin bearing detail parts. This phenomenon is similar to cold welding and results in excessive bearing friction that produces drift. The molecular interchange at points of metallic contact is minimized by maintaining a constant temperature on the gyros. Periodic operation at 6 to 12 month intervals is essential in preventing migration of the lubricant away from the wear path and subsequently prevents metal to metal contact.

Magnetrons

The filaments tend to become gaseous unless the unit is operated periodically. The outgassing is a result of time-oriented liberation of gas molecules that have been absorbed on the walls of the magnetron. When enough gas molecules have been generated, activation of the magnetron imparts high velocities to these molecules; they strike the filament and possibly cause shorting.

DC Motors

Brush-type motors are prone to cold welding of the brushes to the armature. The cold welding is caused by brush pressure and the galvanic coupling of the two materials in contact. Periodic operation of this type of motor is recommended.

Relays, Latching

The use of anodic materials such as tin, copper or silver as contact materials have resulted in cold welding or highly resistive contacts after sustained periods of dormancy/storage. The use of more cathodic materials, such as gold as the contact material, overcomes these problems.

Relays, Nonlatching

The same comments that were used for Relays, Latching also apply here. In addition, if the nonlatching relay is a miniature relay, e.g., TO-5 can package, an additional failure mechanism is possible. Cold welding of the relay armature to the backstop has occurred and was caused by plating incompatibility. If the activating coil voltage is in the low range, this age-oriented cold weld is more readily exposed, e.g., no transfer.

Seals

Inherent porosity tends to let seals dry out and become semi-brittle unless kept wetted. The resultant embrittlement creates leakage paths as a function of

osmosis. Ozone (caused by electric motors or electric welding) concentrations also tend to accelerate seal aging by breaking down the seal fibers. All system containing seals should be activated at least once a year to assure rewetting of seals.

Switches, Sensitive

The same comments that apply to Relays, Latching also apply here except that the consequences may be more severe for switches. The wiping action of the contacts is about 50% less than for relays. Thus, resistive oxides or contaminants are less likely to be scrubbed from the contacts.

Transformer

Coil shorting can be caused by improper removal of cleaning agents that erode the dielectric off the wire windings or by cold flow of the insulation material covering the wire windings.

PART FAILURE MODE DISTRIBUTION

The failure mode information presented in this section is limited to those modes considered to have a significant frequency of occurrence. Failure modes resulting from workmanship, inadequate inspection, screening and misapplication have not been included.

PART FAILURE MODE DISTRIBUTION

PART TYPE	FAILURE MODE	FREQUENCY OF OCCURRENCE IN PERCENT
ACCELEROMETERS	BINDING	33
	DRIFT	27
	OPEN	23
	UNSTABLE	17
BATTERIES		
Lithium-Sulfur Dioxide	INTERNAL SHORT	21
	INTERNAL OPEN	7
	LARGE STARTUP DELAY	50
	LOW ENERGY CAPACITY	2
	HERMETICITY	20
BEARINGS	WEAR	73
	BINDING	20
	SCORED	7
CIRCUIT BREAKERS	SHORT	38
	OPEN	38
	UNSTABLE	19
	ARCING	5
CONNECTORS	OPEN	36
	MECHANICAL DAMAGE	24
	INTERMITTENT	22
	CONTACT RESISTANCE	9
	SHORT	9
CYLINDERS, ACTIVATING	LEAKING	52
	WEAR	18
	STRUCTURAL	13
	MECHANICAL DAMAGE	11
	DRIFT	6
FUSES	SLOW OPEN	75
	EXCEEDS AMP RATING	15
	PREMATURE OPEN	10

PART FAILURE MODE DISTRIBUTION (Cont'd)

PART TYPE	FAILURE MODE	FREQUENCY OF OCCURRENCE IN PERCENT
GEAR BOXES	LEAKING	40
	MATERIAL FAILURE	35
	BINDING	25
GENERATORS	WEAR	44
	CONTAMINATION	17
	DRIFT	16
	BEARING	13
	ELECTRICAL	10
GYROS	DRIFT/UNSTABLE	64
	BINDING	16
	OUT OF TOLERANCE	8
	UNBALANCED	6
	BEARING	4
	RATE ERROR	2
MOTORS	BRUSH BREAKAGE	32
	OR WEAR	
	CONTAMINATION/LOSS OF LUBRICANT	31
	OPEN/SHORT STATOR	14
	COMMUTATOR FAILURE	12
	OPEN/SHORT ROTOR	11
PUMPS	LEAKING	53
	INTERNAL PART FAILURE	20
	IMPROPER OPERATION	13
	WEAR	8
	BEARING FAILURE	6
RELAYS	CONTACT RESISTANCE	25
	OPEN	24
	DRIFT	16
	NO TRANSFER	16
	CONTACTS BURNED	7
	MECHANICAL	5
	INTERMITTENT	4
	SHORT	3

PART FAILURE MODE DISTRIBUTION (Cont'd)

PART TYPE	FAILURE MODE	FREQUENCY OF OCCURRENCE IN PERCENT
SEALS	PHYSICAL DAMAGE	54
	LEAKING	39
	DETERIORATION	7
SOLENOIDS	SHORT	52
	BINDING	29
	WEAK SPRING	19
SPRINGS	FATIGUE	45
	WEAK	28
	WEAR	23
	DISTORTED	4
SWITCHES	MECHANICAL	51
	INTERMITTENT	13
	FAILED TO OPERATE	9
	OPEN	9
	SHORT	9
	DRIFT/UNSTABLE	8
	CONTAMINATION	1
SYNCHROS	DRIFT	28
	MECHANICAL	22
	OUTPUT ERROR	22
	INTERMITTENT	17
	OPEN	11

NONELECTRONIC PART RELIABILITY DATA

APPENDIX

ADDITIONAL RAC SERVICES

ADDITIONAL RAC SERVICES

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