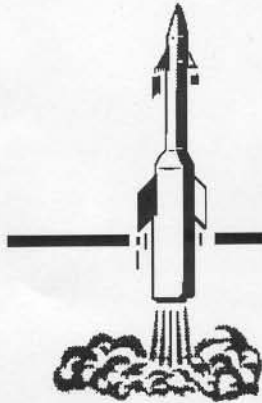


Reliability Prediction

Astrolab minibend® family
(minibend®, mini141™ and microbend™)

(based on MIL-HDBK-217F, Notice 2)

Prepared by:



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Page	1	2	3	4	5
Rev.	B	B	B	B	B
Date	12/12/2003	12/12/2003	12/12/2003	12/12/2003	12/12/2003

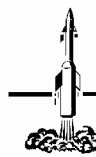
Author: 	Date: 12/12/2003				
Mech. Eng. 	Date: 12/12/03				
Cable Eng. 	Date: 12/12/03				
RF Eng. RF	Date: 12/12/03	Dwg. #	Page 1 of 5	Rev. B	
QC 	Date: 12/12/03	RPMBF		12/12/2003	

Reliability Prediction

Astrolab minibend[®] family

Revision Record

Rev.	Description of Change	Date	Approvals	
-	Initial release	11/11/2003		
A	Page 3, 'Assumptions': Add explanation for use of 'crimp' values for 'clamp' connections. Page 5: Add new page for alternate environments	12/03/2003		
B	Page 3: Add 'Scope' paragraph.	12/12/2003		



ASTROLAB[®] INC.

	Dwg. #		Rev. B
	RPMBF	Page 2 of 5	12/12/2003

Reliability Prediction

Astrolab minibend[®] family

Scope:

The purpose of this document is to predict the reliability of the Astrolab minibend[®] family of products using an established and recognized baseline. MIL-HDBK-217F, Notice 2, was used as a reference to calculate the reliability prediction. This handbook provides a common basis for comparing and evaluating reliability predictions of related or competitive designs. The initial calculations assume that the minibend[®] family of products will be used in an Airborne Inhabited Fighter application. This scenario was chosen as the typical 'worse case' environment. Predictions for alternate environments are included at the end of this document.

Description of test sample:

- The minibend is a coaxial cable assembly with an RF Coaxial Connector on each end.
- Each end of the cable assembly is terminated with a connector that complies with MIL-PRF-39012.
- Each connector has one reflow soldered electrical connection to the inner conductor and one clamped electrical connection to the outer conductor of the coaxial cable.
- The inner and outer conductors of the coaxial cable are continuous from end to end.

Assumptions:

- Part Stress Analysis formulas of MIL-HDBK-217F, Notice 2, Section 15.1 and 17.1 are used in this analysis.
- The A_{IF} environment (Airborne Inhabited Fighter) per Table 3.2 was assumed.
- The minibend consists of two unmated MIL-PRF-39012 compliant connectors.
- The number of active contacts is 4 (2 inner and 2 outer).
- It is assumed that the connectors will be mated/demated 5 to 50 times per 1,000 hours.
- The minibend cable assembly has 2 direct hand solder joint connections plus 2 semi-automatic clamped connections. The MIL-HDBK-217F, Notice 2 failure rate for a 'crimp' connection was used in this analysis.

Reliability Model:

$$F = (F1) + 2(F2) + 2(F3)$$

F1 = Failure rate of unmated connector pair

F2 = Failure rate of direct solder connection (connector contact to center conductor)

F3 = Failure rate of mechanical crimp connection (connector body to outer conductor)

Calculations:

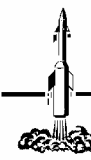
$$F1 = \lambda_p = \lambda_{pb} \times (p_T \times p_k \times p_Q \times p_E) \text{ failures}/10^6 \text{ hours.}$$

(per MIL-HDBK-217F, Notice 2 para. 15.1)

where:

λ_{pb}	= 0.00041	(per Table, page 15-1 for 'RF Coaxial' connectors)
p_T	= 4.1	(per Table, 15-1 for 130°C [125°C operation + 5°C rise])
p_k	= 3.0	(per Table, 15-1 for >5 to 50 mates/demates)
p_Q	= 1	(per Table, 15.1 for MIL-SPEC)
p_E	= 5.0	(per Table, 15.1 for service A_{IF})

$$F1 = \lambda_p = .00041 \times 4.1 \times 3.0 \times 1 \times 5.0 = 0.025215 \text{ failures}/10^6 \text{ hours}$$

 ASTROLAB[®] INC.			
	Dwg. #		Rev. B
	RPMBF	Page 3 of 5	12/12/2003

Reliability Prediction

Astrolab minibend[®] family

Refer to MIL-HDBK-217F, Notice 2, section 17.1:

$$F2 = \lambda_b \times P_E \text{ failures}/10^6 \text{ hours}$$

where: $P_E = 6.0$ (per Table, page 17-1 for service A_{IF})
 $\lambda_b = 0.0013$ (hand solder w/o wrapping base failure rate)

$$= 6.0 \times .0013 = \mathbf{0.0078 \text{ failures}/10^6 \text{ hours}}$$

$$F3 = \lambda_b \times P_E \text{ failures}/10^6 \text{ hours}$$

where: $P_E = 6.0$ (per Table, page 17-1 for service A_{IF})
 $\lambda_b = 0.00026$ (crimp connection base failure rate)

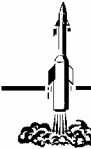
$$= 6.0 \times .00026 = \mathbf{0.00156 \text{ failures}/10^6 \text{ hours}}$$

$$F = (F1) + 2(F2) + 2(F3) = (0.025215) + 2(0.0078) + 2(0.00156)$$
$$= \mathbf{\underline{0.043935 \text{ failures}/10^6 \text{ hours}}}$$

Comparison with Part Count Model:

The 'Generic Failure Rate Part Count Model' of MIL-HDBK 217F, Notice 2, Appendix A, page A-9 rates a 'CONNECTOR', 'RF Coaxial' at 0.0034 in 'USE ENVIRONMENT - A_{IF}'.

A Quality factor of 1 from page A-11 was applied resulting in an overall prediction of **0.0068** for the two connections. This compares favorably to the Part Stress Analysis computation.

 ASTROLAB[®] INC.			
	Dwg. # RPMBF	Page 4 of 5	Rev. B 12/12/2003


Reliability Prediction

Astrolab minibend[®] family

Reliability predictions for alternative environments:

Application	Environment	Mates/Demates	Reliability Prediction
Ground, Fixed	0° to +50°C	>50	0.0118/10E6 hrs
Ground, Fixed	-45° to +85°C	>50	0.0144/10E6 hrs
Naval, Sheltered	-45° to +85°C	>50	0.0289/10E6 hrs
Airborne, Uninhabited, Cargo	-55° to +125°C	<50	0.0490/10E6 hrs
Airborne, Inhabited, Fighter	-55° to +125°C	>50	0.0523/10E6 hrs
Space Flight	-45° to +85°C	<5	0.0027/10E6 hrs
Missile, Launch	-55° to +125°C	<50	0.1959/10E6 hrs
Missile, Flight	-55° to +125°C	<50	0.0735/10E6 hrs



			
	Dwg. #		Rev. B
	RPMBF	Page 5 of 5	12/12/2003