

壹. 章節說明

1. 範圍 (SCOPE)
2. 參考文件 (REFERENCE DOCUMENTS)
3. 介紹 (INTRODUCTION)
4. 可靠度分析評估 (Reliability Analysis Evaluation)
5. MICROCIRCUITS, Introduction
6. DISCRETE SEMICONDUCTORS
7. TUBES
8. LASERS
9. RESISTORS
10. CAPACITORS
11. INDUCTIVE DEVICES
12. ROTATING DEVICES
13. RELAYS
14. SWITCHES
15. CONNECTORS
16. INTERCONNECTION ASSEMBLIES
17. CONNECTORS
18. METERS
19. QUARTZ CRYSTALS
20. LAMPS
21. ELECTRONIC FILTERS
22. FUSES
23. MISCELLANEOUS PARTS

附錄 A/B/C 及「表和圖」

貳. 零件故障率，基本計算模式

1. $\lambda_p = \lambda_b \cdot \pi_T \cdot \pi_A \cdot \pi_R \cdot \pi_S \cdot \pi_C \cdot \pi_Q \cdot \pi_E \cdot \pi_L \cdot \pi_F \dots\dots\dots$ (見 P3-6)

λ_b : 基本失效率，可從零件使用應力及溫度決定之。資料於各章節中。

π_T : 溫度因子，從電子活化能、界面溫度來決定，參考 P5-13

π_A : Application Factor 應用因子，參考 P5-8

π_R : Resistance Factor, 電阻因子，參考 P9-4

π_S : Electrical Stress Factor, 應力因子，參考 P6-3

π_C : Construction Factor, 結構因子參考 P6-3

π_Q : Quality Factor, 品質因子，參考 P3-3 及 P6-3

π_E : Environment Factor, 環境因子，參考 P3-4/3-5/3-6 及 P6-3

π_L : Learning Factor, 學習因子，參考 P5-15

π_F : Function Factor, 機能因子，參考 P5-9

2. 從第 5 章到第 23 章，不同零件皆列有不同零件故障模式，即

$$\lambda_p = \lambda_b \times \dots \times \pi_Q \times \pi_E \times \pi_L \times \dots\dots\dots$$

以上式中的各個因子皆可於 217F 各章中查表而得

3. $\lambda_{Total} = \lambda_{P1} \times n_1 + \lambda_{P2} \times n_2 + \dots\dots\dots + \lambda_{Pn} \times n_n$

因此產品可靠度預估，可經由各個不同零件的故障率計算而得，假設該裝備或產品各個零件是串連方式而成

MILITARY HANDBOOK

Reliability Test Methods, Plans, and
Environments for Engineering Development,
Qualification, and Production

壹. 章節說明：(page1 ~ page72)

- 1 SCOPE (範圍)
- 2 REFERENCE DOCUMENTS (參考文件)
- 3 DEFINITIONS (定義)
- 4 RELIABILITY TEST METHODS AND TEST PLANS
(可靠度測試方法和測試計劃)
- 5 COMBINED ENVIRONMENTAL TEST CONDITIONS
(混合環境測試條件)
- 6 TEST INSTRUMENTATION AND FACILITIES
(測試儀器和設備)
- 7 REFERENCES (參考文件)

- TABLES , Page73 ~ 180 , TOTAL 60 TABLES
- FIGURES , Page181 ~ 356 , TOTAL 153 FIGURES

以上第四章及其有關“表”和“圖”，對產品可靠度
測試和計劃，參考工具價值較高

貳. “表”和“圖”符號基本認識

- 1 MTBF, 平均故障期間, $MTBF = \text{Total Test Time} / \text{故障數}(r)$
- 2 Q_0 : 可接收認可的 MTBF 值(及以上)
- 3 Q_1 : 不能認可的 MTBF 值(及以下)
- 4 Total Test Time(總測試時間) $= (n-r) \cdot t + \Delta r$
- 5 α : 生產者風險, 好的可靠度(Q_0)判為不好的機率
- 6 β : 消費者風險, 不好的可靠度(θ_1)判為好的機率
- 7 d : 識別比 $d = Q_0 / Q_1$

參. Probability Ratio Sequential Test Plan (PRST)

1 試驗計劃為 I-D 到 VI-D

- TABLE 9A (P81-85) , $d/\alpha/\beta$
Lower Confidence/Acceptance Boundary
- TABLE 9B (P86-89) , $d/\alpha/\beta$
Upper Confidence/Acceptance Boundary
- TABLE 10A (P90-94) , $d/\alpha/\beta$
Lower Confidence/Rejection Boundary
- TABLE 10B (P95-99) , $d/\alpha/\beta$
Upper Confidence/Rejection Boundary
- PRST 例, 以 P187 說明(圖 8)
- FIGURE 9-14(P188-P199) , $d/\alpha/\beta$
以 P192/Figure 11 為例說明之

肆. Short Run High-Risk Prst Plans

1. 試驗計劃為 VII-D and VIII-D (P99)

- $\alpha=B=30\%$, $d=1.5$, VII-D
- $\alpha=B=30\%$, $d=2.0$, VIII-D

2. FIGURE 15-16 (P200-203)

$\alpha/B/d$ 同上，只是用圖形表達

伍. Fixed-duration test plans , 固定期間試驗計劃

1. 試驗計劃為 IX-D 到 XVII-D(P100, TABLE11)及 XIX-D 到 XXI-D(P100, TABLE12)

2. TABLE15, 固定期間試驗，接收倍數(Q_1)相對故障數表

3. TABLE16 及 17 , 為上述兩種之參考比較表

4. 固定期間試驗(Fixed-duration test plan), 圖 17, 以 P204 為例，舉例說明

陸. ALL EQUIPMENT PRODUCTION RELIABILITY ACCEPTANCE TEST PLAN

1. 所有裝備於生產期間之可靠度接收試驗計劃 XVIII-D, 圖 35, 以 P234 為例，舉例說明

2. $d/\alpha/B$ 變動時，相對於本試驗計劃之改變，參考圖 37-44 即 P238- P253

柒. 使用上的參考點

- | | |
|-------------------|----------------|
| 1 時機：研發樣品、試產、量產 | 2 買賣合約對可靠度規格協定 |
| 3 選定 $d/\alpha/B$ | 4 決定何種試驗方式 |

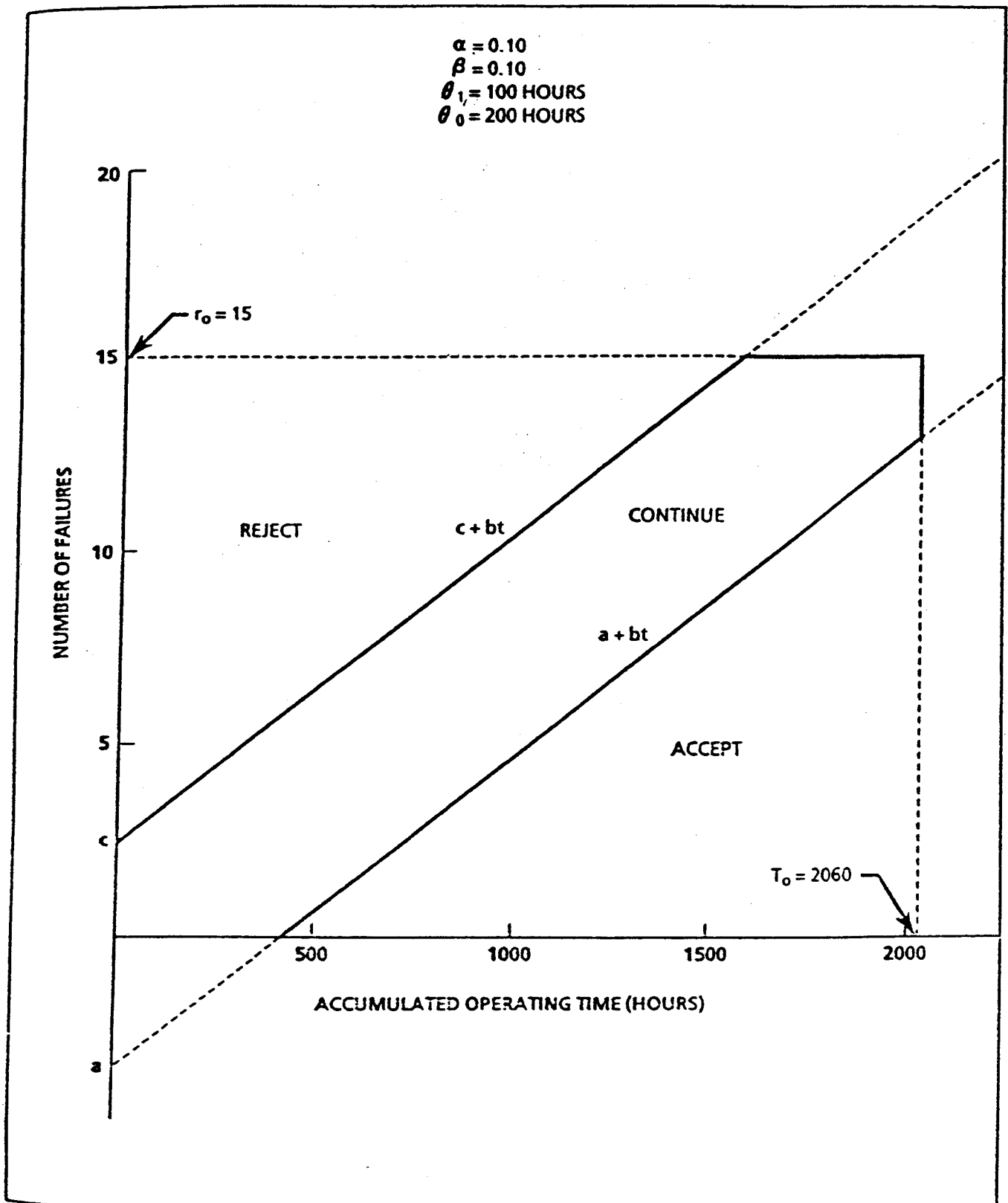
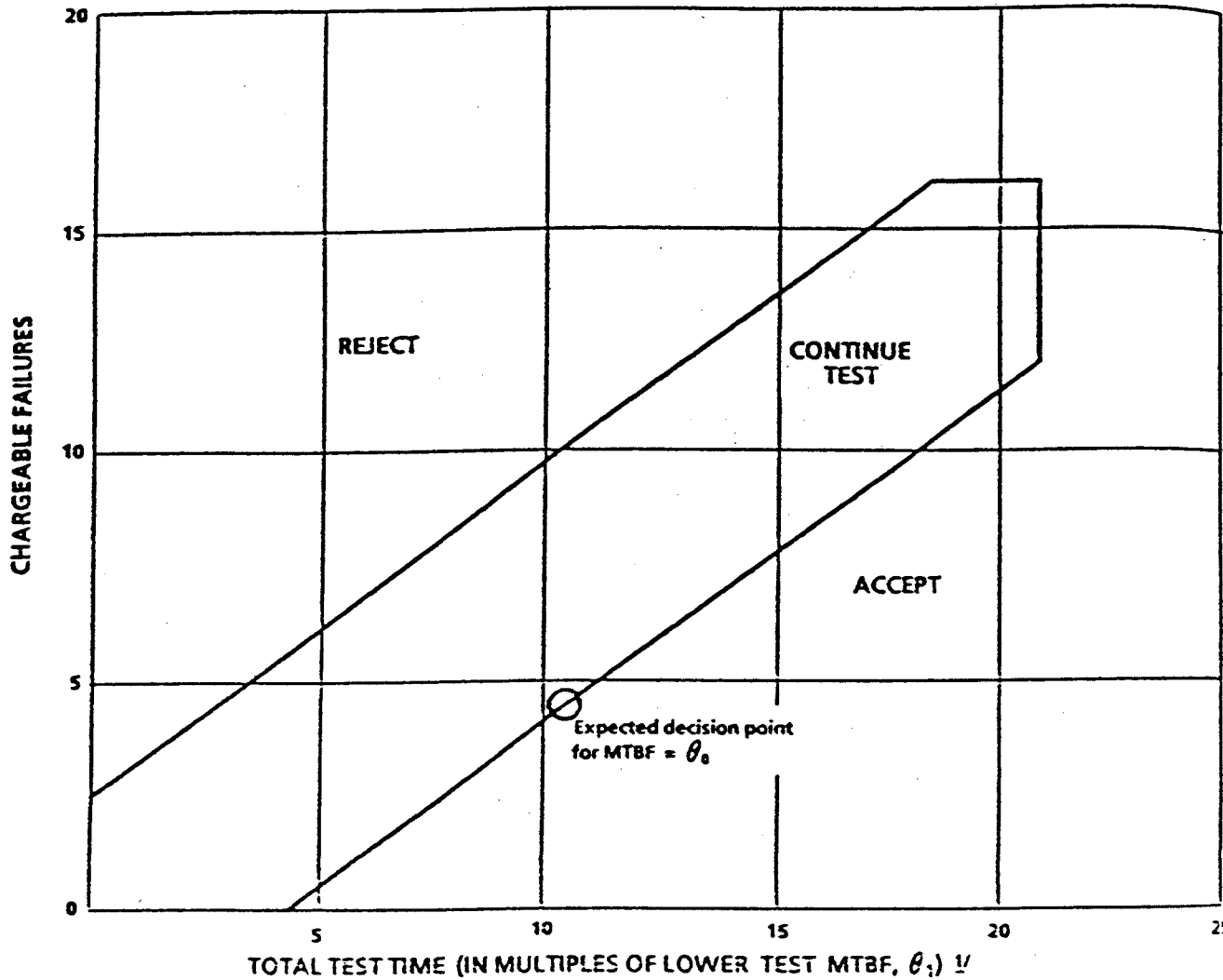


FIGURE 8. Probability ratio sequential test (example).

Decision Risks (Nominal) 10 Percent
Discrimination Ratio (d) 2.0 : 1



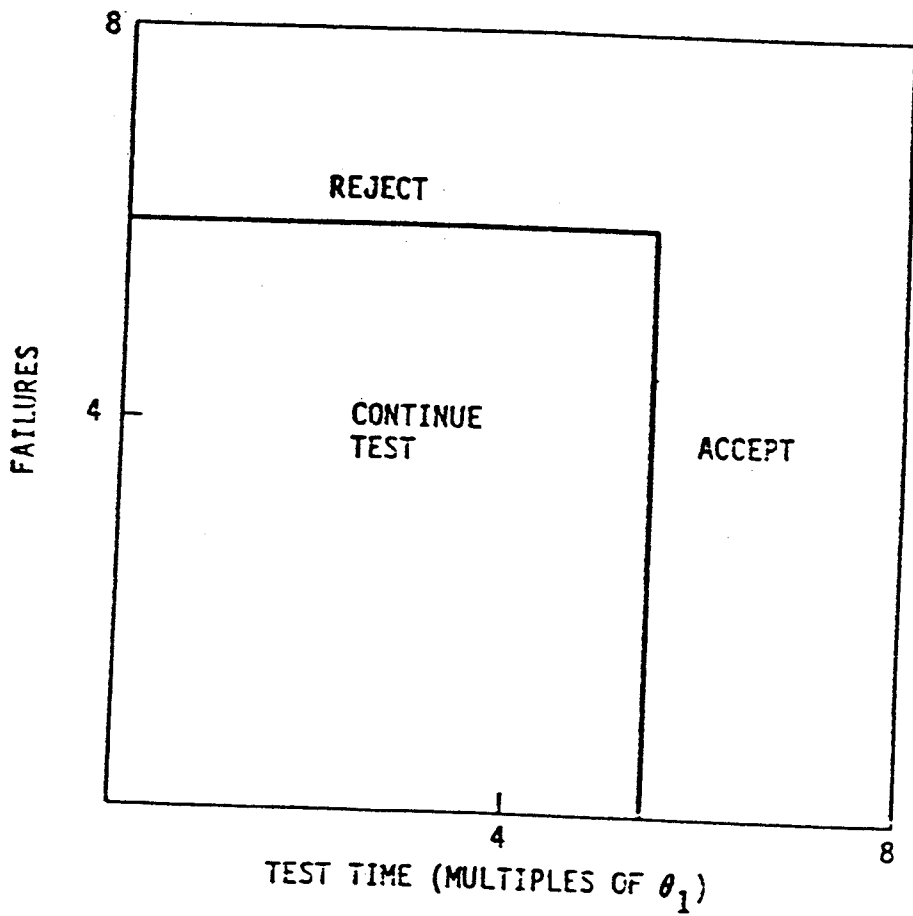
Chargeable failures	Standardized termination time, t ^{2/}		Chargeable failures	Standardized termination time, t ^{2/}	
	Reject at $t_R \leq$	Accept at $t_A \geq$		Reject at $t_R \leq$	Accept at $t_A \geq$
0	N/A	4.40	9	9.02	16.88
1	N/A	5.79	10	10.40	18.26
2	N/A	7.18	11	11.79	19.65
3	.70	8.56	12	13.18	20.60
4	2.08	9.94	13	14.56	20.60
5	3.48	11.34	14	15.94	20.60
6	4.86	12.72	15	17.34	20.60
7	6.24	14.10	16	20.60	N/A
8	7.63	15.49			

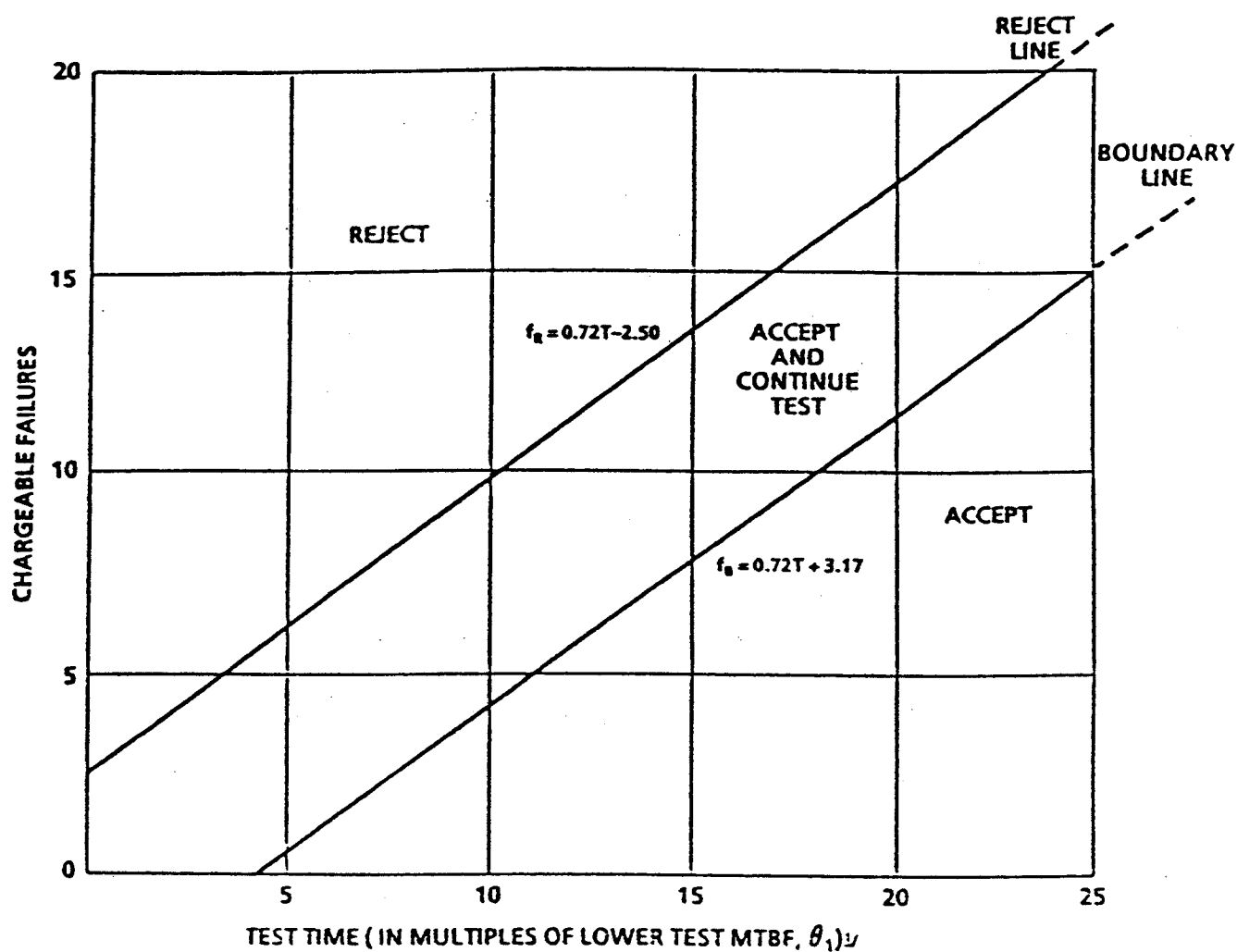
Accept-Reject criteria

^{1/} Total test time is the summation of operating time of all units included in test sample.

^{2/} To determine the actual termination time, multiply the standardized termination time (t) by the lower test MTBF (θ_1).

FIGURE 11. Test Plan III-D.

FIGURE 17. Fixed-duration test plan (example).



Chargeable failures	Standardized test time, $t \frac{2}{1}$		Chargeable failures	Standardized test time, $t \frac{2}{1}$	
	Reject line	Boundary line		Reject line	Boundary line
0	N/A	4.40	9	9.02	16.88
1	N/A	5.79	10	10.40	18.26
2	N/A	7.18	11	11.79	19.65
3	.70	8.56	12	13.18	21.04
4	2.08	9.94	13	14.56	22.42
5	3.48	11.34	14	15.95	23.81
6	4.86	12.72	15	17.33	25.19
7	6.24	14.10	16	18.72	26.58
8	7.63	15.49			

^{1/} Total test time is the summation of operating time of all units included in test sample.
^{2/} To determine the actual test time, multiply the standardized test time (t) by the lower test MTBF (θ_1) (See 4.8.3.3.)

ALL-EQUIPMENT PRODUCTION RELIABILITY ACCEPTANCE TEST PLAN.

FIGURE 35. Test Plan XVIII-D.