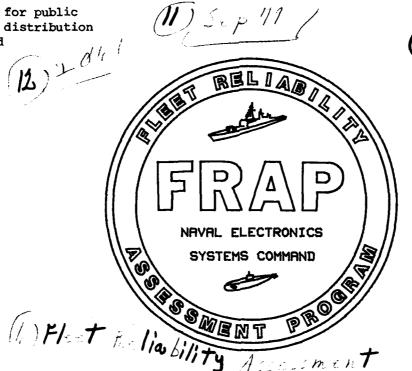
NAVAL WEAPONS SUPPORT CENTER CRANE IN F/G 17/7 FLEET RELIABILITY ASSESSMENT PROGRAM. VOLUME 2A. EQUIPMENT REPO--ETC(U) SEP 79 AD-A093 921 NL UNCLASSIFIED 40 A - 3 - 2





VOLUME 2A

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EQUIPMENT REPORT CATCC-DAIR.

NAVAL WEAPONS SUPPORT CENTER CRANE, INDIANA

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### DEPARTMENT OF THE NAVY NAVAL ELECTRONICS SYSTEMS COMMAND

PREPARED UNDER THE DIRECTION OF

RELIABILITY ENGINEERING BRANCH

REVIEWED BY

SYSTEMS EFFECTIVENESS DIVISION

CAPTAIN, USN
DEP CDR LOGISTICS DIRECTORATE

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### VOLUME 2A CATCC-DAIR

### EQUIPMENT REPORT

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### VOLUME 2 CATCC-DAIR EQUIPMENT REPORT

SECTION I - RESULTS

### 1-1 RESULTS SUMMARY

Between August 1978 and May 1979 FRAP collected data on the AN/TPX-42A(V)8 CATCC-DAIR systems installed aboard the USS INDEPENDENCE, USS KITTY HAWK, and the USS RANGER. The results of the aralysis of the data are summarized in Table 1-1.

### 1-1.1 SUMMARY OF HARDWARE PROBLEMS

Most of the failures (7 out of 11) occurred in WRA 19, the Control Group PPI Console, OD-146, of which 5 are used in the CATCC-DAIR system. Most of these failures (3 out of 7) were O-level 19002, the Deflection Amplifier. Table 1-2 summarizes the WRA and O-levels reported as failed. Identification WRA and O-levels are as follows:

- WRA 11 Signal Processor CN-1506
- WPA 13 A-D Converter CV-3477
- WRA 16 Cartridge Mag Tape Unit AN/USH-26(v)
- WRA 18 Alphanumeric Digital Display AN/USO-69
- WPA 19 Indicator Control Group OD-146
  - 19002 Deflection Amplifier
  - 19008 Interface and Logic
  - 19009 Video Amplifier
  - 19016 Panel (Fight Side)

[O-level 099 indicates the O-level failed could not be identified from the available information]

### 1-1.2 SOFTWARE PROBLEMS

CATCC-DAIR is currently recovering from very severe problems with the software used in the Tracking and Display computer. The software in use during the FRAP study period is an interim release which will be replaced by a "fourth generation" software package currently under development.

### 1-1.3 RECOMMENDATIONS

- a. It is recommended that FCPs and retrofits be developed to improve the reliability performance of the Control Group Console, OD-146, with emphasis on the Deflection Amplifier and Power Supply.
- b. It is recommended that the "Numan Engineered" keyboards be replaced with standard typewriter or teletype style keyboards.
- c. It is also recommended that consideration be given to converting the AN/UYK-20(V) to use Concurrent Pascal, a new high-level programming language.
- d. It is recommended that the feasibility of converting CATCC-DAIR software to Pascal be investigated.

### LEGEND

- 1. All Data All Collected Data (Failures/Maintenance Actions) \*\*
- 2. EQUIP EQUIPMENT \*\*
- 3. PARTS PARTS REPLACEMENT \*\*
- 4. EXP = EXPONENTIFL
- 5. LN LOGNORMAL

TABLE 1-1. DATA SUMMARY	FOR CATO	C-DAIR.	
PARAMETER	All Data	EQUIP	PARTS
OPERATIONAL			
Calendar Hours	11,616	11,616	
Operating Hours	5073	5073	5073
Duty Cycle	0.437	0.437	0.437
Sample Size	2#	2*	2#
RELIABILITY			
Number of Failures	12	10	9
Time Between Failures-Mean	661	971	1304
Time Between Failures-Median	111	126	111
Distribution	WEIBULL	WEIBULL	WEIBULL
MAINTAINABILITY			
Total Repair Time	126	110	110
Number of Repairs	7	6	8
Time to Repair-Mean	18	18.3	17.5
Time to Repair-Median	5.3	4.4	4.6
Distribution	LN	LN	LN
Total Down Time	1132	772	783
Repairs (or Maint. Act.)	7	6	8
Down Time-Mean	162	129	102
Down Time-Median	112	89	46
Distribution	EXP	EXP	HEIBULL
AVAILABILITY			
Inherent	0.9734	0.9815	0.9868
Observed-Mean		0.525	
Observed-Median		0.577	
Effective	0.9996		F \$1-0 \$1-0

<sup>#</sup>CATCC-DAIR SUMMARY Does Not Include USS INDEPENDENCE Data.

Reference Volume 1, Paragraph 3-4, and Volume 2A, Paragraph 7-2 NOTE: All Time Units Are in Hours

	PORTED	1n O-LEVEL		1		1		1		1		E	1	1	1	1	11
	RES RE	tn WRA		1		1		1		1	2						11
VEL	NUMBER OF FRILURES REPORTED	by CASREPT				17					71					17	75
RND O-LE NG	NUMBER	by 4798/2K		1				1		1	9	/3	11	71	11		<b>o</b> n
TABLE 1-2. SUMMARY OF WRA AND O-LEVEL ASSEMBLIES FAILING		DESCRIPTION (NAME)	SIG. PROC. CN-1506/1PX		RAD CONVTR CV-4372/TPX	POWER SUPPLY	MAG TAPE DRV RN/USH-26		DISPLAY AN/USQ-89	CRT DRIVER ELECTRONICS	CONTROL GROUP OD-146	DEFLECTION PAPLIFIER	INTERFACE AND LOGIC	VIDEO PAPLIFIER	PANEL (RIGHT SIDE)		TOTAL
T.		0-LEVEL		888		288		888		683		882	800	600	916	888	
		MRR	=		13		16		18		13						

### SECTION II - SYSTEM DESCRIPTION

### 2-1 GENERAL

The Carrier Air Traffic Control Center Direct Altitude and Identity Readout (CATCC-DAIR) System consists of a programmable Interrogator Set AN/TPX-42A(V)8 in which the hardwired Indicator Data Processor of the AN/TPX-42A(V)5 has been replaced by an electronic digital mini-computer, the AN/UYK-20(V). To enhance reliability, a second AN/UYK-20(V) may be installed in a parallel redundant scheme. All systems in the FRAP study were so configured.

CATCC-DAIR provides five consoles consisting of OD-58/T Plan Position Indicators (PPI) modified to display alphanumeric information. To each of these has been added a keyboard to allow control of the AN/UYK-20(V) Tracking and Display Processor (TDP) Computer, and an Indicator Control box. One console, designated the supervisory position, has an additional System Control box attached. The TDP Computer(s) are normally located remotely from the consoles and are rack mounted with the radar video processor and other such ancillary and interface equipment as required to interface to the NTDS and ACLS systems and the shipboard radars.

The older AN/TPX-42A(V)5 is installed at Navy and Marine Corps air stations. The (V)8 version, CATCC-DAIR, is essentially the (V)5 system hardware with minor changes (primarily to the power supplies) to allow operation from ship's power and to provide interface into existing ship's radar and data system. The TDP computer with its software provides the operational features that distinguish the (V)8 version from the less capable (V)5 system.

### 2-2 MISSION

CATCC-DAIR is used to identify and coordinate aircraft operating within a fifty mile radius of the aircraft carrier on which it is installed. In addition to a conventional radar display, CATCC-DAIR provides altitude and identity readouts on all transponder equipped aircraft, both civilian and military, in that 50 mile radius. In addition a number of software features are provided to support flight operations. CATCC-DAIR is normally operational at all times while the ship is underway. This system is essential to the safety and combat readiness of the ship on which it is installed.

### 2-3 EQUIPMENT DESCRIPTION

The CATCC-DAIR system is a shipboard configuration of the AN/TPX-42A(V)5 currently used at all Naval and Marine Air Station RATCCs (Radar Air Traffic Control Centers). Though similar in appearance, CATCC-DAIR uses a programmable TDP(Tracking and Display Processor), which replaces the hardwired indicator data processor in the AN/TPX-42A(V)5. The TDP consists of (a) two AN/UYK-20 data processing sets, (b) a keyboard for communications with the computers, (c) an OD-58/T indicator modified for display of alphanumeric data, (d) a radar video processor, (e)

various ancillary computer equipment, and (f) the required interface hardware that will permit the system to function and be compatible with shipboard radars, and interface with NTDS (Naval Tactical Data System) and ACLS (Automatic Carrier Landing System).

The system is designed for dual-channel processing (one channel active and the other in hot standby), and has the capability to switch channels, if a failure occurs, without loss of data or interruption to operations. The CATCC-DAIR system consists of the following major units:

### a. Data Processing Group OL-201

- (1) [WRA 10] Interference Blanker MX-8757/UPX. Eliminates non-synchronous signals, sometimes referred to as "fruit", and sends "defruited" video to the signal processor.
- (2) [WRA 13] Analog-to-Digital Converter CV-3477. Accepts single speed synchro (antenna shaft) inputs and outputs two signals, the ARP (Azimuth Reference Pulse) and the ACP (Azimuth Change Pulse). Three units provide ACP/ARPs for two radars, with the extra unit on standby.
- (3) [WRA 11] Signal Processor CN-1506. Re-formats the video and mode tags received from either the AN/UPX-233 or the AN/UPX-27 into video and mode sensitive triggers.
- (4) Video Signal Processor CP-1310. Generates a signal report message, one per antenna scan, for each transponder equipped aircraft within a selected range. After it is properly formatted, the output message is transmitted to the data processor shortly after the beam of the antenna has passed the position of the aircraft. An extra CP-1310 is provided for dual-channel capability.
- (5) Radar Target Data Processor CP-1319. Detects the primary radar normal video, triggers, and azimuth data and develops a signal digital report for each aircraft on each antenna scan. The radar target data processor transfers the messages to the tracking display processor.

### b. Conversion-Switching Group OU-131

- (1) [WRA 15] Signal Data Converter CV-3476. Has dual channels "A" and "B", one active and one in hot standby, which transfer data between the AN/UYK-20(V) data processing set, keyset control, ACLS, NTDS, CP-1319 and ADD (Alphanumeric Digital Display) utilizing the relay switching assembly. Acts as the AN/UYK-20(V) device controller for video signal processors data, the analog-to-digital converter ACP data and PEM (Position Encoding Module) lines.
- (2) [WRA 14] Data Processing Set AN/UYK-20(V). A programmable mini-computer used as the display processor. Two AN/UYK-20(V)s are installed for dual channel capability.
- (3) [WRA 17] Data Signal Switching Unit SA-2164. Interconnects the Keyset Central, ACLS, NTDS, Operator Consoles, CP-1319, and AN/UYK-20(V) data processing sets when switching to the standby channel.

- (4) [WRA 16] CMTU (Cartridge Magnetic Tape Unit) AN/USH-26(V). Provides for data storage and program loading. Interfaces with the AN/UYK-20(V) data processing sets. It is a self-contained tape storage system consisting of tape drives, power supplies, and a built-in maintenance test panel.
- c. [WRA 19] Indicator Control Group OD-146 (5 used in CATCC-DAIR). A modified AN/TPX-42A(V) 5 OD-58/T Indicator Group with the following additions:
- (1) Keyboard Controller KY-844. Accepts user inputs from a "Human Engineered" keyboard or a joystick style analog positioner and formats them for the AN/UYK-20(V) data processing sets.
- (2) Indicator Control C-10330. Provides for selection of interrogation modes, visual system status indication, and display of symbology and alphanumerics. Audio and visual alarms are provided for detected emergency, lost communication, and hijack beacon returns.
- (4) Indicator Set Control C-10329 (One only, placed on the console designated as the Supervisor's Console). Provides for range selection of radar and gives visual indication of the type of radar in use, alarm conditions, and channel in use.
- (5) Interrogator Set AN/UPX-23 or AN/UPX-27. Challenges Mark XII IFF/SIF (Identification Friend or Foe/Selective Identification Feature) transponder sets and re-structures the replies into video signals for decoders and indicators.

### d. Ancillary Equipment

(1) [WRA 18] Alphanumeric Digital Display (ADD) AN/USQ-69. A computer terminal located in the equipment spaces (near the TDP) to assist technicians in maintenance actions.

### SECTION III - SPECIFICATIONS

The specification for the AN/TPX-42A(V)8 is ELEX-I-198 dated 21 October 1974. The following specification requirements were taken from this document.

### 3-1 RELIABILITY

CATCC-DAIR is specified to have a greater than 700 hour equipment MTBF (Theta<sub>0</sub> as defined by MIL-STD-781) per paragraph 3.5.11.1 of ELEX-I-198.

### 3-2 MAINTAINABILITY

CATCC-DAIR is specified to have an average repair time of not more than 0.75 hours and shall have a maximum repair time not greater than 1.5 hours at the 90% confidence limit per paragraph 3.5.12.1 of ELEX-I-198. The AN/UYK-20(V) is maintained by replacement of printed circuit cards,

most of which are throw-aways (the memory arrays being an exception). The TDP computer has its own diagnostic routines to aid fault isolation. The remainder of the system is maintained by piece-part replacement on-site. Since the users have access to a sophisticated electronics repair shop on board, no intermediate level or depot level maintenance is defined.

### SECTION IV - PROBLEMS

### 4-1 ADDITIONAL HARDWARE PROBLEMS

An operational problem has been identified concerning the modified OD-58 console. Strong negative comment has been received from the Fleet about the "Human Engineered" keyboard used. This keyboard starts with "A" in the upper left corner and proceeds across in "ABC" order. The keys are so placed that touch typing is impossible. Whereas any teletype machine or typewriter can serve as a training aid for a typewriter style keyboard (in fact, many people can already touch type), the CATCC DAIP operators can practice only on a system keyboard.

There is also the safety aspect to be considered. The Federal Aviation Administration has standardized on the "ABC" style keyboards for use in civilian air traffic control centers. The situation there beard little resemblance to the operational profile of a Fleet carrier air traffic control center (CATCC). For one thing, civilians do not have to deal with hostile intruders into their air space. For another, civilian air traffic is required to have both an alternate destination and sufficient fuel on board to get there. CATCC traffic has no alternative to carrier landing except ditching at sea. Plus, CATCC aircraft may arrive back from a mission with battle damage and be very low on fuel. These factors make it manditory that the human-machine interface on CATCC DAIR be as natural, rapid and error free as possible. Fleet users feel the "ABC" style keyboard obstructs this rapid interchange because operators must "hunt and peck" to use it.

A related problem outside the FRAP study scope is reported here without comment or recommendation: Several reports have been received from Fleet users concerning the intercom system used with CATCC DAIR. The additional coordination necessary to compensate for the interim software's problems reportedly has overloaded the intercom system. One report also observed that the system did not withstand shipboard wear and tear well.

### 4-2 SOFTWARE PROBLEMS

CATCC DAIR has been roundly criticized for its software problems. Practically everything new in the AN/TPX-42A(V)8 is software or software related (like the AN/UYK-20(V)) so software problems should have been expected. To be sure, the Fleet did not like the marginally acceptable interim software. It is an unpleasant fact of life that, at this stage in the software art, a hardware design is more likely to shakedown and work correctly quicker than a software design of similar complexity. After comparison with similar software efforts, one must conclude that CATCC DAIR's software development is noteable neither for its success

nor its lack of success. In short, it reflects the common industrial experience with software.

This is not to indicate that such experiences are not frustrating, costly and thoroughly unpleasant. Both Industry and the Department of Defense (DOD) are painfully aware of the cost of software problems in terms of dollars lost and schedules slipped. Even with the contractual muscle of DOD and a three billion dollar yearly volume, DOD has not succeeded in lowering the average error rate for delivered and tested software below one error in every 300 statements. In other words, a computer running unlooped code would run less than one second without encountering a mistake.

The situation is so serious that both DOD and Industrial software developers are actively seeking solutions. DOD has announced a "Software Quality Initiative" to be launched this summer from the Under Secretary of Defense level. Both Industry and DOD are preparing to alter the way the software art is practiced in America.

SECTION V - CORRECTIVE ACTIONS

### 5-1 HARDWARE COPRECTIVE ACTIONS

It is recommended that the "Human Engineered" keyboard used on CATCC DAIR be replaced by a standard typewriter or teletype style keyboard. The joystick function has been successfully replaced in many microcomputer applications by the arrowed keys on a standard ASCII keyboard. However, Fleet comments on the joystick have been mixed and retaining it have some merit.

### 5-2 SOFTMARE CORPECTIVE ACTIONS

Followup discussions with the USS KITTY MARK indicate that effective solutions to CATCO DAIR's software problems are being found. It is reported that these are being integrated into the Pelease IV software package, which should solve most Pelease III problems.

It is recommended that consideration be given to converting the AM/OYR-20(V) to run Pascal, either by obtaining a Pascal compiler or altering the microprogramming or both. It is further recommended that the feasibility of converting CATCC DAIP software to Pascal be investigated Published industrial cost comparisons indicate that the cost savings in maintainability will be significant. Further, a DOD wide shift to Pascal appears to be certain. Being among the first to shift to Pascal could well counter some of the criticism leveled at this developmental effort.

It is noted that AIL has enlisted the aid of Boeing Computer Services in the CATCC DAIR effort. Boeing is a licensee of UCSD Pascal. It is likely that Pascal is being used in developing Release IV and source code in that language may be obtainable via a contractual modification at modest cost. In any case, Sperry Univac has also shifted its minicomputer operations to Pascal as a cost control measure. It is likely that their inhouse support tools for the AN/UYK-20(V) will be

likewise converted to Pascal and that a Pascal compiler for the AN/UYK-20(V) already exists at Sperry.

It is recommended that NAVELEX assume the initiative in the creation of a software problem reporting system comparable to that already in existence for hardware. It is probable that the most effective way to do this would be as an extension of the existing 3-M system. Since NAVELEX has a vital need for software problem information, an active role in creating the mechanism to obtain that information does not seem inapproriate.

### SECTION VI - EQUIPMENT RELIABILITY MODEL

System reliability is defined as the probability of performing a specified function or mission under specified conditions for a specified time. Reliability models are word statements or block diagrams which represent the requirements for mission success. The FRAP equipment models are used to determine the achieved operational reliability and to assess the effect of ECPs and other corrective action upon system reliability. Maintenance Action Reports are compared against the model to determine if a reported failure results in a system failure, or if not a failure, then the degree of system degradation. In addition, the model is used in determining logistic support requirements.

Maintenance of Naval shipboard equipment is accomplished by replacement or repair of components at Organizational (O), Intermediate (I), or Depot (D) repair levels. Ships Maintenance and Material Management (3-M) normally collects organizational level repair data but not intermediate or depot level repair data. Using 3-M field data requires that the lowest components of the model be the lowest level reported by 3-M, i.e., the O-level replaceable component. This O-level component can be a piece-part, printed circuit board, major assembly, or whatever is planned for the O-level maintenance concept.

The CATCC-DAIR system reliability model is represented in Figure 6-la through Figure 6-lc. The model illustrates the redundant features of the system and the alternate modes of operation.

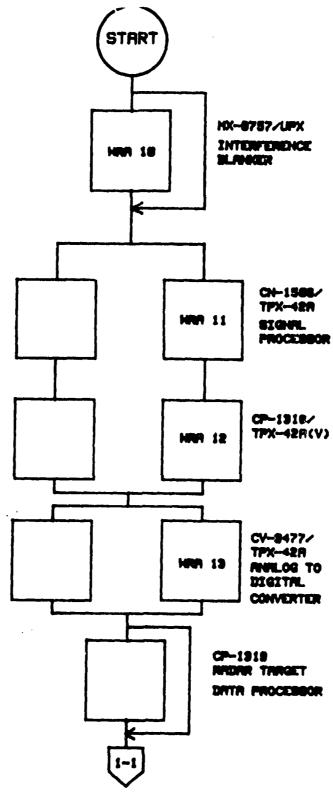


FIGURE 6-1a SYSTEM/WRR-Level Block Diagram for CRTCC-DAIR (AN/TPX-42A(V)8)

4

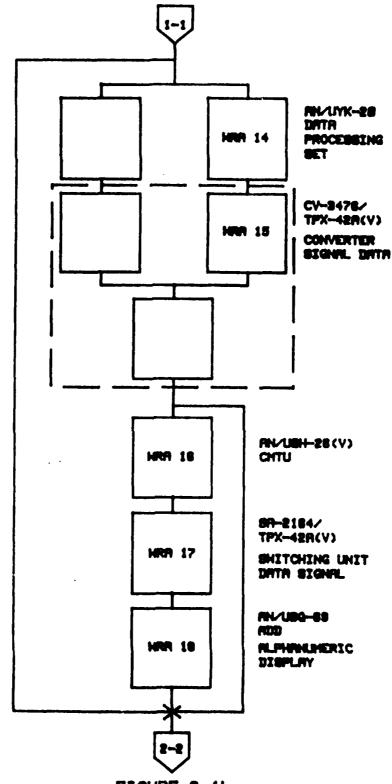


FIGURE 6-1b
CATCC-DAIR SYSTEM Block Diagram (Continued)

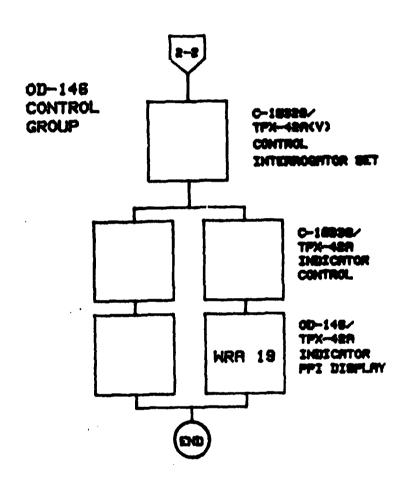


FIGURE 8-1c CATCC-DAIR SYSTEM Block Diagram (Continued)

4.25

### SECTION VII - ANALYSIS

### 7-1 SOFTWARE ANALYSIS

No mechanism exists for the collection of software reliability information. The existing 2 Kilo mechanism does not cover software and despite specifically asking for software problem data, no 2K forms on software were received. This necessitated visits by FRAP personnel to Fleet platforms during the study period, something FRAP would like to avoid since it compromises FRAP's commitment to minimal intrusion into Fleet operations. Even so, the information obtained is subjective in nature and does not lend itself to numerical analysis.

Only a few general observations are possible. At the beginning of the FRAP study, software problems were very severe. As the study progressed, the situation improved. The last contact with the USS KITTA HAWK was in marked contrast to earlier discussions. It was clear that they were pleased with the capabilities CATCC DAIP gave them and the they were eagerly awaiting the delivery of the "Vector Map" upgrade to the TDP software package.

### 7-2 HARDWARE ANALYSIS

The data analysis for CATCC-DAIR is presented in 4 sub-sections, follows:

- (1) All Data. All of the collected data from the participating platfor is selected for analysis. The reliability analysis is conducted all failures or maintenance actions without consideration of sympability loss. No maintainability or availability analysis performed.
- (2) All Data, except USS INDEPENDENCE. All of the collected data for the USS RANGER and the USS KITTYHAWK is selected for analysis maintainability analysis is performed using active repair time reported on the 2K form.
- (3) Equipment Analysis. Data from the USS RANGER and the USS KITTYHAWA is selected to meet the condition of a hardware or a software failure. The reliability analysis is conducted on this data set. The maintainability analysis uses repair time as reported on the 2K form. The availability analysis uses equipment reliability and repair time in hours.
- (4) Parts Replacement. Data from the USS RANGER and the USS KITTYHAWK is selected to meet the condition of requiring a parts replacement. The reliability analysis is performed on this data set. A maintainability analysis is performed using ships force repair man-hours from the 2K form.

SUB-SECTION (1)

CATCC-DAIR ALL DATA

1			<b>u</b> .	LEET RELIABILITY	ASSESSMENT	r DATA					
YSTER	SHIPNAME	DATE	F	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	MR.	٥٦	062	<b>0</b> F3
ATCC DAIR	INDEPENDENCE	8206	1458.	INITIAL	•	•0	000.0	0	•	0	0
ATCC DAIR	INDEPENDENCE	8303	3840.	CENSORED	2382.	2382.	1,023	0	0	0	0
CC DAIR	INDEPENDENCE	8334	3858.	CENSORED	2400•	2400	.781	0	0	0	0
	INDEPENDENCE	1006	3902	CENSORED	5444.	2444.	.636	0	0	0	•
	INDEPENDENCE	9031	3905	CENSORED	2444.	2444.	.536	•	0	0	0
	INDEPENDENCE	8062	4366.	CENSORED	2908.	2908	.548	0	0	0	0
ATCC DAIR	INDEPENDENCE	1606	4778.	FAILURE	3320.	3320.	.553	0	0	0	0
IAIAI ON	FIAL RFCORD-FIRST RECORD USED	RECORD USED									
CATCC DAIR	KITTY HAWK	8588	2650.	FAILURE	•0	•0	00000	14	39	0	0
SATCC DAIR	KITTY HAWK	8321	2658.	INITIAL	•	· 0	00000	0	0	0	0
	KITTY HAWK	8321	2686.	FAILURE	28.	28•	0.000	19	0	0	0
	KITIY HAWK	8321	2688.	FAILURE	30.	.~	00000	11	66	0	0
CATCC DAIR	KITTY HAWK	8348	2794.	FAILURE	136.	106.	.210	18	٣	0	0
CC DAIR	KITTY HAWK	9010	3104.	FAILURE	446.	310.	.344	0	0	0	0
CATCC DAIR	KITTY HAWK	9011	3125.	FAILURE	467.	21.	.354	0	0	0	0
_	KITTY HAWK	6206	3293.	FAILURE	635.	168.	.362	91	66	•	0
_	KITTY HAWK	9135	4085.	FINAL	1427.	792.	.332	•	•	•	0
	PANGER	8164	1904.	INITIAL	•	•	00000	0	0	•	0
	RANGER	8256	2455.	CENSORED	551.	551.	.250	0	0	0	0
CC DAIR	RANGER	8278	2702	CENSORED	798.	798.	262.	0	٥	•	0
	RANGER	8307	3386.	FAILURE	1482.	1482.	.432	19	N.	0	0
_	RANGER	8334	4163.	CENSORED	2259.	777.	.554	0	0	0	0
CATCC DAIR	RANGER	8363	4519.	CENSORED	2615.	1133.	548	0	0	0	0
_	RANGER	6706	5035	FAILURE	3131.	1649.	.522	61	O.	0	0
SATCC DAIR	RANGER	9028	5230.	FAILURE	3326.	195.	.535	19	16	0	•
_	RANGER	72.06	5514.	FAILURE	3610.	284.	.547	61	~	0	0
ATCC DAIR	RANGER	0806	5514.	FAILURE	3610.	•	.535	19	œ	0	0
ATCC DAIR	RANGER	9104	5550.	FAILURE	3646.	36.	867.	61	~	0	0

RELIABILITY

### CATCC DAIRSYSTEM LEVEL

WEIBULL	•106	.263	.291	.318	• 455	• 52₽	775.	• 602	.616		118.	.857	.927
EXPONENTIAL.	•003	• 032	250.	<b>450.</b>	.151	•259	.261	•356	.381		668•	.922	766.
04N	.133	.200	.267	.333	004.	194.	.533	009.	.667		.750	.833	.917
SURVIVORS 14.	13.	12.	11.	10.	•6	• 60	7.	•9	5.		<b>.</b> e	۶.	1:
NO. CENSORED										-			
NO. FALLURES		•	:	-	:	-1	1.	-	-		<b>:</b>	-	-
TIME TO FAIL													
REMAINING SYS. CAP.	100	100.	100	98	100.	100	100.	100.	100.		100	100.	100.

.476 DUTY CYCLE (0.H./C.H.) = CALENDAR HOURS (C.H.) =+ 17616.0 EQUIPMENT OPERATING HOURS (0.H.) = 8393.0

NUMBER OF FAILURES = 13. OBSERVED FAILURE RATE/O.M. = .15489E-02

THE WEIBULL PARAMETERS ARE ALPHA = .837230E-01 BETA = .424563E+00

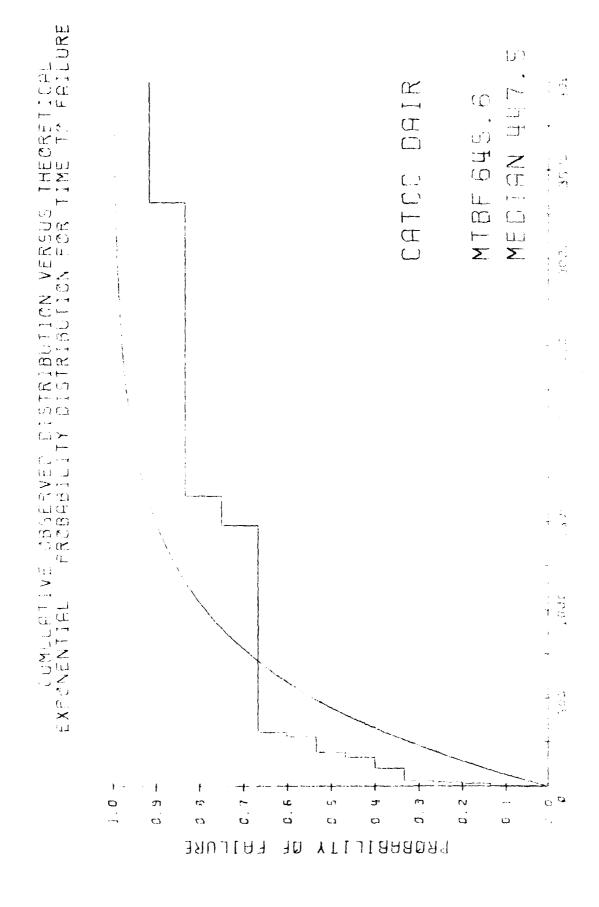
GRATIO OF 4.461 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

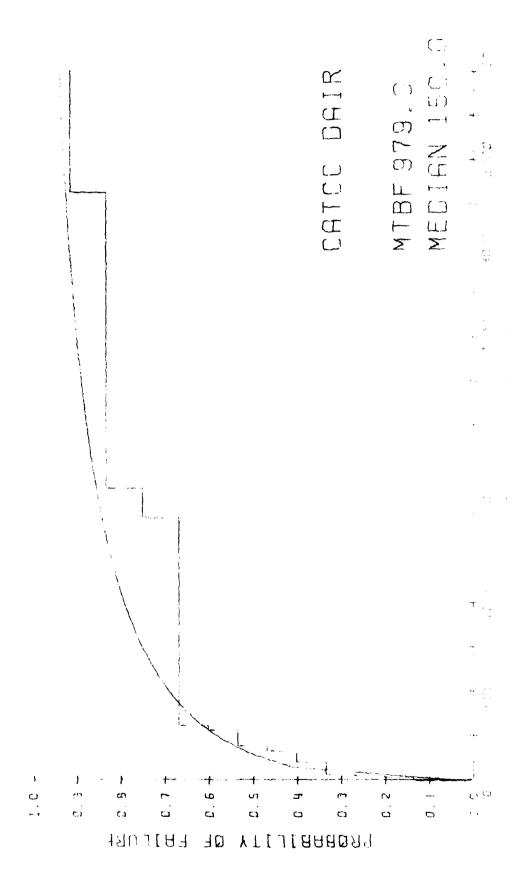
FOR THE ASSUMED DISTRIBUTION

90 PER CENT UCL FOR MEAN = EST. MEAN = 979.263. EST. MEDIAN = 150.000. 90 PER CENT LCL FOR MEAN = 0.000.

2034.941

90 PER CENT LCL FOR BETA = .345781E+00 90 PER CENT UCL FOR BETA # .503345E+00





### PELIABILITY

CATCC DAIR WRA 11 LEVEL

		DUIT CTCLE (0.H./C.H.) = .476				Z15/./. 90 PER CENT UCL FOR MEAN = IT MEETS THE SPECIFICATIONS
TIME TO FAIL FAILURES CENSORED 1397.0 336.0 3320.0 346.0	EQUIPMENT OPERATING HOURS (0.H.) = 8393.0 CALENDAR HOURS(C.H.) = 17616 0 0	NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .11915E-03	LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED	FOR THE ASSUMED DISTRIBUTION		79660.21 IS GREATER THAN 11655.08 HOURS. THEREFORE THE EQUIPMEN
REMAINING SYS. CAP. 100.	EQUIPMENT	NUMBER OF	LESS THAN	FOR THE A:	EST. MEAN	90 PERCENT UCL

79660.213

CATCC DAIR WRA 16 LEVEL

						79660,213
	DITY CYCLE OF A CALL	9/10			6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	CIDIOTO 90 PER CENI UCL FOR MEAN # 79660,213
REMAINING SYS. CAP. TIME TO FAIL FAILUNES CENSORED 100. 635.0 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	EQUIPMENT OPERATING HOURS (0.H.) = 8393.0 CALENDAR HOURS(C.H.) =. 17616.0	NUMBER OF FAILURES # 1. OBSERVED FAILURE RATE/O.H. = .11915E-03	LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMFO	FOR THE ASSUMED DISTRIBUTION	EST. MEAN = 8393.000. EST. MEDIAN = 5817.584. 90 PER CENT LCL FOR MFAN -	90 PERCENT UCL 79660.23 IS GREATER THAN 2000 OF 1000

90 PERCENT UCL 79660.21 IS GREATER THAN

2880.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

### RELIABILITY

## CATCC DAIR WRA 18 LEVEL

	.476			
	CALENDAR HOURS(C.H.) =, 17616.0 DUTY CYCLE (0.H./C.H.) =			
	17616.0			
FAILURES CENSORED  1. 1. 1. 1.	(0.H.) = 8393.0	OBSERVED FAILURE RATE/0.H. = .11915E-03	LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED	ION
TIME TO FAIL 136.0 1291.0 3320.0 3646.0	EQUIPMENT OPERATING HOURS	NUMBER OF FAILURES = 1.	FOUR FAILURES TH	FOR THE ASSUMED DISTRIBUTI
REMAINING SYS. CAP. 100.	EQUIPMENT	NUMBER OF	LESS THAN	FOR THE A

2157.7. 90 PER CENT UCL FOR MEAN = 79660.213

90 PERCENT UCL 79660.21 IS GREATER THAN 5000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

EST. MEAN = 8393.000. EST. MEDIAN = 5817.584. 90 PER CENT LCL FOR MEAN =

RELIABILITY

# CATCC DAIR WRA 19 LEVEL

WEIBULL .012 .276 .276 .295 .454 .495	
EXPONENTIAL .000 .003 .023 .150 .211	
NPD 100 200 300 400 500 625	
SURVIVORS 9. 8. 7. 7. 5. 5.	
CENSORED	
FAILURES 1. 1. 1. 1. 1. 1.	
TIME TO FAIL  28.0 28.0 36.0 195.0 284.0 1399.0 1649.0	FOLLOWENT OPERATION
PEMAINING SYS. CAP. 100. 100. 100. 100. 100.	FOLLPMENT

CALENBAR HOURS(C.H.) =. 17616.0 DUTY CYCLE (0.H./C.H.) = OBSERVED FAILURE RATE/O.H. = .83403E-03 EQUIPMENT OPERATING HOURS (0.H.) = 8393.0 NUMBER OF FAILURES = 7.

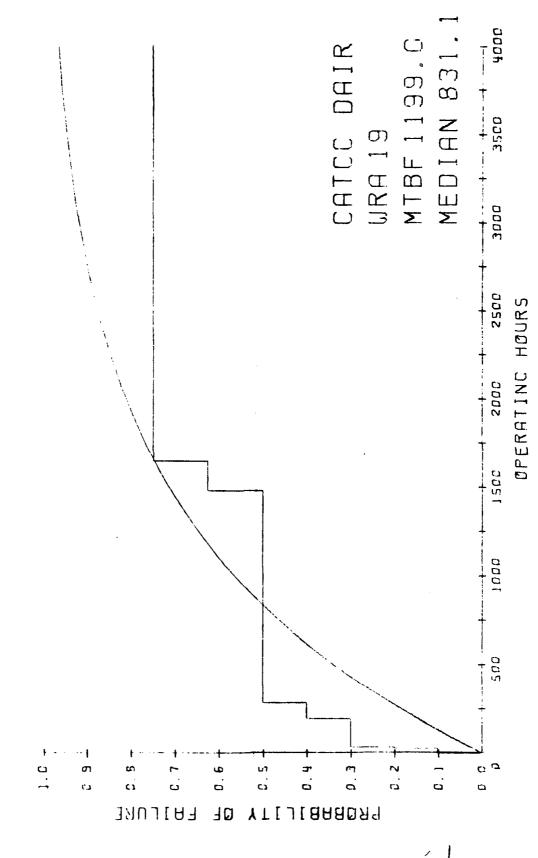
ORATIO OF 4.641 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

THE WEIBULL PARAMETERS ARE ALPHA = .109A99E+00 BETA = .3233B2E+00

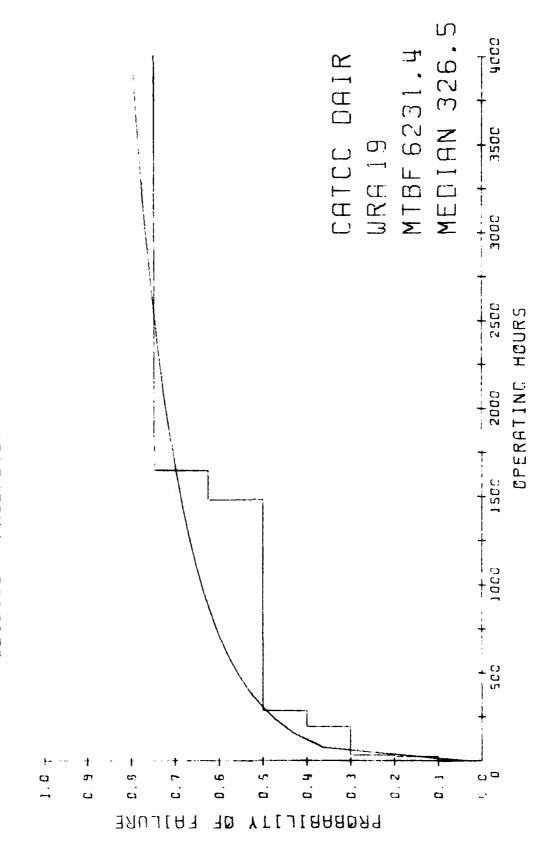
FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 6231.390. EST. MEDIAN = 326.471. 90 PER CENT LCL FOR MEAN = 0.000. 90 PER CENT UCL FOR MEAN = 22319.055 90 PER CENT UCL FOR BETA = .434872E+00 90 PER CENT LCL FOR BETA = .211893E.00

THECRETICAL IME TO FAILURE STRIBUTION VERSUS DISTRIBUTION FOR CBSERVED PROBABILII Ü" CUMULATIVE EXPONENTIAL



TICAL FRILURE THEORET IME TO CBSERVED DISTRIBUTION VERSUS PROBABILITY DISTRIBUTION FOR CUMULATIVE WEIBULL



RELIABILITY

# CATCC DAIR O-LEVEL SUMMARY

₹ 3		O-LEVEL BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER FAILURES	LOWER 90 CONF LIM	MEAN	UPPER 90 CONF LIM	SPEC	OBSERVED FAILURE TIMES		REL I AB
11	66			~	2157.74	8393,00	79660.21	79660.21 1000000.00	00.05		,
16	66			-	2157,74	8393.00	79660.21	79660.21 1000000.00	20.00		ָּבְּי <b>֖</b>
18	m	CPT DA	CRT DRIVER ELECTRONICS	-	2157.74	8393.00	79660.21	00.000001	36.00	90.650	<u>.</u>
19	~	DEFLE	2 DEFLECTION AMPLIFIER	3,	1256,29	2797.67	7615.70		2000	00.00	2
16	<b>c</b>	INTERF	INTERFACE AND LOGIC	-	2157,74	8393.00	79660.21	23702.00	34.10.00	24.00	<u>ن</u> د
61	•	v 10£0	VIDEO AMPLIFIER		2157.74	8393,00	79660.21	54885.00	ייייובנע	מסיופר צ	2 9
<u>•</u>	16	PANEL	PANEL (RIGHT SIDE)	-	2157.74	8393.00	79660.21		3326.00	3326.00	

RELIABILITI

**\** 

2K SUMMARY FOR CATCC DAIRPROBLEM ARFAS

EM AREAS	WHAT HAPPENED ANOTHER AMP FAILURE/SEE 1131/EK EMT REPORTED AS 55054/EK
EN SUMMANT FOR CATCO DAIRPROBLEM AREAS	0-L 0
CATCC	0-1-0
NOT LEADER	WRA 0-L C 19 2 2 19 2 2 19 2
2	#RA 19 19
	JCN 33610E010740 33610E100780 33610E100789

SUB-SECTION (2)

CATCC-DAIR

ALL DATA

EXCEPT INDEPENDENCE

				PLFET MELIABILITY	ASSESSMENT	UATA					
SYSTEM	SHIPNASE	PATE	X L	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	MRA	٥٢.	962	073
CATCC DAIR	AIIIY HAMK	884 G	2650.	FAILURE	0.0	Č	0,00	77	36	0	0
CATCC DAIR	ALTY HALK	6321	2658.	INITIAL	• a	•0	00000	0	0	0	0
CATCC DAIN	ALITY IALK	×321	2646.	FAILURE	28.	24.	00000	19	٥	0	0
CATCC DAIP	KITTY SAMK	6321	26AB.	FAILURE	30.	*	00000	=	66	0	0
CATCC DAIP	XIIIY HALK	8348	2794.	FAILURE	136.	106.	210	18	m	0	0
CATCC DAIR	XITTY INSX	9106	3104.	FAILURE	446.	310.	.344	۵	۵	0	0
CATCC DATA	ANDI YTTA	1106	3125.	FAILURE	457.	21.	.354	Φ	•	0	0
CATCC DATA	ATTEN LAME	うべのテ	3793.	FAILURE	635.	168.	. 362	91	66	9	0
CATCC DAIR	KITTY TANK	9135	4085.	FINAL	1427.	792.	.332	0	0	0	0
CATCC DAIR	PANGFF	4164	1904.	INITIAL	0	• :	00000	0	0	0	0
CATCC DATR	RANGER	8256	2455	CENSORED	551.	551.	.250	0	•	0	0
CATCC DATR	RANGED	827*	2702.	CENSORED	798.	798.	262.	0	0	0	0
CATCC DAIN	749°.45	8307	3386.	FAILURE	1482.	1482.	.432	61	~	0	0
CATCC DAIR	AANGFD	8334	4163.	CENSORED	2259.	777.	.554	9	0	•	0
CATCC DAIR	PANGER	6363	4519.	CENSORED	2615.	1133.	.548	0	•	0	0
CATCC DAIR	MANSEE	Jオ0ケ	5035	FAILURE	3131.	1640.	.522	19	σ	0	c
CATCC DAIR	LANGEL .	9006	5230	FAILURE	3326.	195.	.535	61	16	•	0
CATCC DAIR	4ANGER	706	5514.	FAILURE	3610.	284.	.547	61	~	•	0
CATCC DAIR	DAN(SFU	0H06	5514.	FAILURE	3610.	•0	.535	61	æ	0	0
CATCC DATE	RAPIGER	9104	5550	FAII URF	1666.	36.	867	19	~	0	c

RFITABILITY

## CATCC DATRSYSTEM LEVEL

	WE IBULL	•00•	.115	682.	•320	• 350	864.	.570	.593	<b>•65</b>	.668		.887	868
	EXPONENTIAL	000•	-005	940.	•064	• 082	•225	•328	.370	687.	.520		.970	086.
	OdN	.071	.143	.214	.286	.357	.429	.500	.571	.643	.714		.810	\$06*
	SURVIVORS	13.	12.	11.	10.	•6	·x	7.	•9•	υ. •	•		<b>&gt;</b>	·.
OZ	CENSONED											<b>-</b>		
• <u>3</u> 2	デュート じれいろ	<b>:</b>	• •		-	•-	:	-	-	<b>:</b>				•
	<u>*</u>												14.2.0	_
PERAINING	- ARD - CAK	100.	100.	100.	100.	98.	100.	100.	100.	.06	100.		100.	100.

NUMBER OF FAILURES = 12. OBSERVED FAILURE RATE/0.4. = .23455E-02

EQUIPMENT UPERATING HOURS (0.H.) = 5073.0

.437

CALENDAR HOURS(C.H.) =+ 11516.0 DUTY CYCLE (0.H./C.H.) =

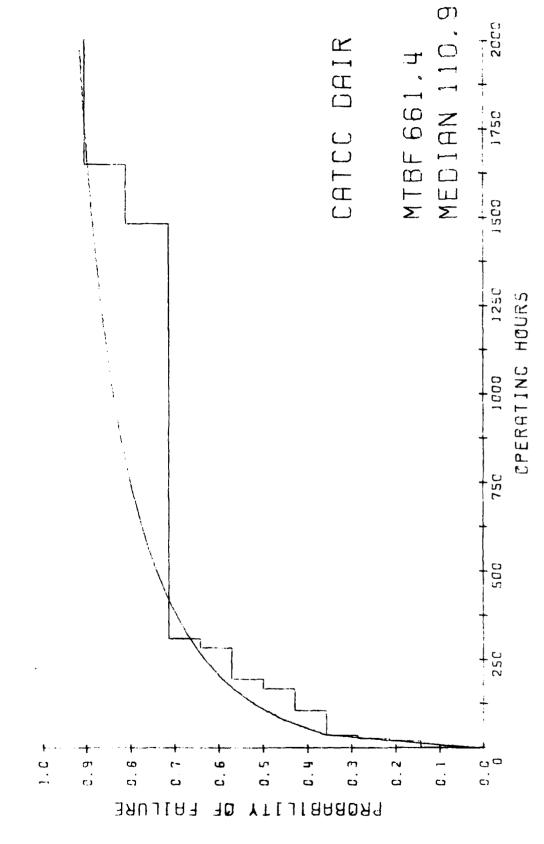
OPATIO OF 3.793 FXCFFNS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

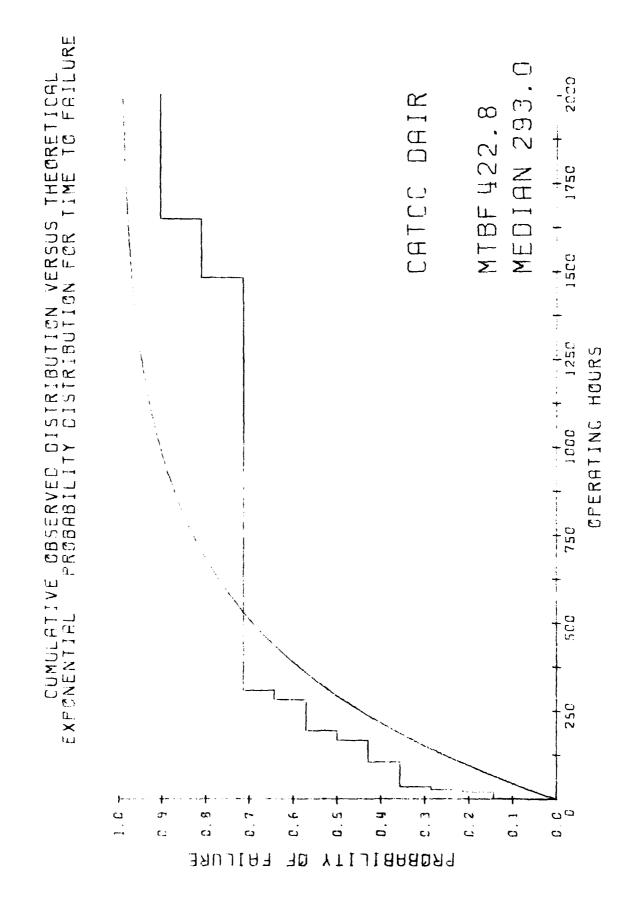
THE WEIBULL PARAMETEMS ARE ALPHA = .902120E-01 BETA = .436198E+00

FOR THE ASSUMED DISTAIGUTION

EST. WEAN = +61.361. EST. MEDIAN = 110.870. 90 PER CENT LCL FOR MEAN = 0.000. 90 PER CENT UCL FOR MEAN = 1377.394 90 PER CENT LCL FOR 9FTA = .348075E+00 90 PER CENT UCL FOR BETA = .524321E+00

OBSERVED DISTRIBUTION VERSUS THEORETICAL PROBABILITY DISTRIBUTION FOR TIME TO FFILURE CUMBLRIVE UE:BULL





#### TITE TITE

# CATCC DAIR WPA 11 LEVEL

	DUTY CYCLE (0.4./C.H.) =		
r D	FOUIDMENT OPFGATING GRASS (N.H.) = 5073.0 CALFNOAR HOURS(C.H.) =. 11616.0 DUTY CYCLE (O.H./C.H.)	E/0.4. = .19712E-03	UTION IS ASSUMED
FAILUNES CENSONED  1. 1.	().H.) = 5073.0	OMSERVED FAILURE HAT	FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED
NING CAP. 1 OF TO FATE 10.0 1397.0 American	Selice Shilksted Indwell	NUMBER OF FAILURES = 1. OMSERVED FAILURE HATEZO.M. # .19712E-03	S THAIL FOUG FAILURFS TH
PFMATNING SYS. CAP. 1.	FOOLINGWEILOUS	NUMBER OF FA	LFSS THAM FOUR

.437

FNT. 4FULAN = 3510.336. 90 PER CENT LCL FOR MEAN = 1304.2, 90 PER CENT UCL FOR MEAN = 48149.203 44144.20 IS GREATER THAN 11655.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS EST. NEAN = 5073.900. 40 PERCENT JOL

FOR THE ASSUMED DISTOLHURA

### PFILABILITY

# CATCC JATH WRA 14 LEVEL

	DUTY CYCLE (0.H./C.H.) =
	11616.0
NO. 4504ED 1.	EQUIPMENT OPERATIONS HOURS (0.8M.) = 5073.0 CALFWIAR HOURS(C.M.) =. 11616.0 DUTY CYCLE (0.M./C.M.) =
FAILURES CENSOMED  1. 1. 1.	5073.0
FAILUME	(O.H.O)
TIME TO FILL #35.0 #35.0 745.0 35.4	OFFRANTING HOUPS
FFMAINING AYS. CAP. 100.	INAMAINDA

CALFWIAR HOURSIC.H.) =. 11616.0 DUTY CYCLE (0.H./C.H.) =

CHSLAVED FAILURE MATEZO.M. = .19712E-03 NUMBER OF FAILURES = 1.

LESS THAN FULLY FATEL OF STANDANFALLAL DISTRIBUTION IS ASSUMED

FOR THE ASSLARD DISTRIBUTION

1304.2. 90 PER CENT UCL FOR MEAN = 48149.203 SAND IS GREATER THAM 2480.30 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS FST. WERN = SN73.000. FST. MEDIAN = 3416.336. 90 PEP CENT LCL FOR MFAN = ON PERCENT OCI

### RELIABILITY

CATCC DATH WRA IN LEVEL

					48149.203	
	DUTY CYCLE (0.H./C.H.) = .437				1304.2. 40 PER CENT UCL FOR MEAN = 4	IT MEETS THE SPECIFICATIONS
1986 FOLESTE FAILURES CENSORED 1986 18 18 18 18 18 18 18 18 18 18 18 18 18	FOUIDMENT OFFRETTING HURES (1. 4.) = SOZ3.0 CALFWOOR HOURS(C.M.) =+ 11615.0	FS = 1. OBSEMVED FAILURE MATEZO.M. = .19712E-03	LESS THAN FOUR ENTERHES THE EXHONENTIAL DISTRIBUTION IS ASSUMED	015T2[40]Tpa	3.000. FST. VEDIAN = 3416.336. 90 PER CENT LCL FOR MEAN =	SPECIFICATIONS OF STEM THAN SOUD SOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS
PF#41V1NG SYS. CaP. 1184 100.	Equipment over	MINAER OF FAILURES = 1.	LESS THAN FOUR	FOR THE ASSUMED DISTALLUTION	EST. WEAN = = =073.000.	90 PERCENT UCL

FFE TABLETY

CATCO DATH WHA 19 LEVEL

WEIBULL .009 .309 .333 .523 .572 .784
F XPONENTIAL • 000 • 038 • 048 • 236 • 324 • 871
NPD 111 .222 .333 .444 .554
SURVIVORS 3. 7. 6. 5. 6. 7.
NO. CENSOALD
FAIL CRAS
11.4. 77. 47.11 0.4.6 0.4.6 1.7.7.7 1.2.4.6 13.39.4 16.2.4
675. CEP. 100. 100. 100. 94. 100. 100.

DUTY CYCLE (0.H./C.H.) = CALE-4DAM MOURS(C.M.) =. 11616.0 NUMBER OF FUTLERS = 7. DESENDED FAILURE HATEZONS = .13794F-02 FOUTPMENT OPERATING HIM-S (A.H.) = 5073.3

.437

OPATIO OF 3.443 EXCFFUS THE CHITICAL VALUE FUR TEST OF EXPONENTIAL

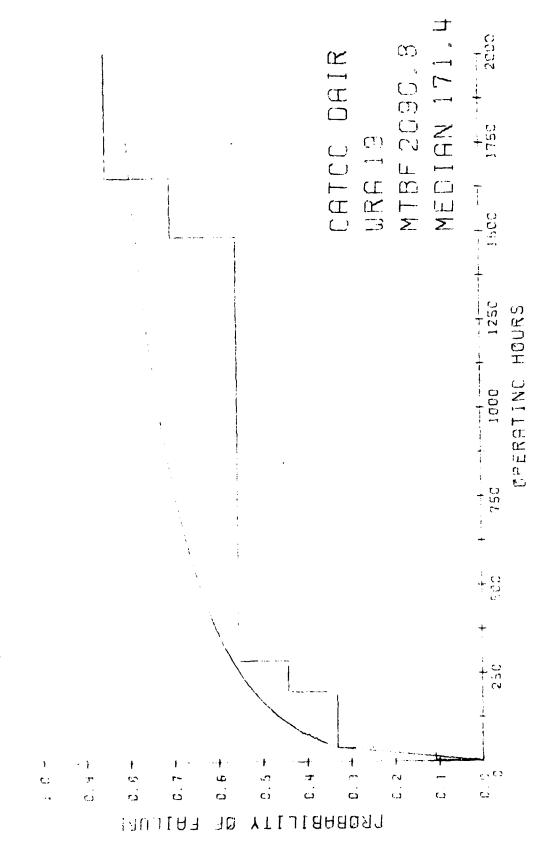
THE WETRULL HEMANFTERS SYE ALPHA = .112102E+00 HETA = .358215F+00

FOR THE ASSUMED DISTATHUTION

6529.923 90 PEP CENT UCL FOR MEAN # FST. MEAN = 2699.424. EST. MEDIAN = 171.429. 90 PER CENT LCL FOR MFAN = 0.000. 90 PEH CENT UCL FOR BETA = .475088E+00 40 PER CENT LCL FOR AFTA = .2413425+00

LURE (7) $\Omega$ DH I ⊢⇒ti. وكانيا 成 で む ZU 日と (:)() MHBH CHI Œ. <u> ال</u> الا 区 二 ليا 1500 **6≤** 11.1 11.1 Σ 3 Z STAIBUTION STSTRIBUTI HOUAS ປາເລ BRATING 1 ---SSERVED BBRBILII S S <u>က</u> ကို ကို Œ CUMBLATIVE EXPONENTIBL - + 250 رع نۍ Į. ų (J  $\alpha^{c_2}$ с: ... (J σ 9  $\Box$ r , د -:: ر.) PROBABILITY OF FATLURE

TOBL TUTCONS LCS THEMBER SA TIME TO (1) أمين (1) أ . (;) CUMULATIVE VEISULL



**PFLIABILITY** 

CATCC DATA OFLEVEL SUMMARY

₹ 1	MEA DELEVE	7F: 0=1 F 4FL 50 • NOWESE ATOM	NUMAFW FATLURES	LUWER 90 CONF LIM	MEAN	UPPER 90 CONF LIM	SPEC	OBSERVED FAILURE TIMES LOW HIGH	ED TIMES High	RELIAB PROBLEM
	8		1.	1304.21	5073.00	48149.20	48149.20 100n000.00	30.00	30.00	YES
č	ő			1304.21	5073.00	48149.20	48149.20 1000000.00	635.00	635.00	YES
<u>«</u>	<b>r</b> ~,	3 CRT DRIVER FLECTANTICS	1.	1304.21	5073.00	48149.20	22769.00	136.00	136.00	0
9	۲3	HELECTION SWOTTELEN	3.	759.34	1691.00	4603.18	92808.00	1482.00	3646.00	YES
3.	x	INTERFACE A 42 LUGIC		1304.21	5073.00	48149.20	23702.00	3610.00	3610.00	0
5.	<b>5</b>	9 VIOEO AMPLIFIED	1.	1304.21	5073.00	48149.20	54885.00	3131.00	3131.00	YES
<u>o</u>	15	In Panel (algar 910e)	•	1304.21	5073.00	48149.20	48149.20 24499.00	3326.00	3326.00	Ç

VellaRILITY

CH SUMMERT FOR CATCO DATERPOOLEM AREAS

	WHAT HAPPENED	ANOTHER AMP FAILURE/SEE 1131/EK
	0-ر د	) <b>)</b> :
•	0-1-0	• • •
	)-0 6	· <b>№</b> ∩
	\$ P P	<u> </u>
	327105017740 337105017740	34105105740

FLEET MAINTAINABILITY ASSESSMENT NATA

SHIPHAME DISCOVERD	715C0	OVERU	Č	REP	REPAIR TIME	TIME DOWN	JWI L 7
ritt	HAH		A321			• 0	ò
		NO MEDATE	TIME FOR THE AROVE RECORD	THE	ROVE	PECORD	
AIII	KITTY HAWK	1268	1639			• 0	•
		NO REPAIN 1	INE FOR	THE A	PUVE	RFCORD	
KITT	KITTY HAWK	4364	שארש			•0	•
		NO WEPAIR 1	LIMF FOR	THE	PUVE	THE APOVE RECORD	
KITTY HAWK	HAKK	0106	9010			• 0	•
		AL PEPATO TIME FOR THE ARC	THE FOR	THE A	POVE	ARUVE RECORD	
KITTY	IDEK	1105	9006			14.	360.
KIIIX	Y P R I	62V6	6006			0.	•
		NO REPAIR	LIME FOR	THF A	APOVE	RECORD	
PANGER			A314			94.	168.
RANGFR	Or		9053			٠. د	96
RANGFR	α		9058			. 4	4
RANGER	æ		9075			-:	24.
RANGER	a		90A7			۶.	168.
RANGER	α		9117			<i>5</i> •	312.

MAINTAINABILITY (REPAIR TIMF)

# CATCC DATR SYSTEM LEVEL

9EPAID TIME 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		FGFOUFNCY 7. 7. 1. 1. 1. 1.	200 MUD	CUM FREQUENCY 1.0 3.0 4.0 5.0 7.0		7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	5	LOGNORMAL .140 .763 .426 .483 .761	EXPONENTIAL . 054 . 105 . 199 . 243 . 589 . 995	WEIBULL 193 282 401 445 707
TOTAL REPAIR HOURS =	5 = 12.	ت • •	NUMBER OF REPATRS =	EPAIRS =	۲.	OBSER	OBSERVED REPAIR BATE/HR	DATE/HR =	.5556F-01	
_	leo la releva		•							
MFAN OF LN#S = 1.47 STO DE K-S CPITICAL VALHE ( .10. 7. ) =	1.67	c >		1.55 MAX DĮFF C	CALC =	.219	IS LESS THAI	-219 IS LESS THAN THE CPITICAL VALUE	L VALIIF	

THEREFORE THE LOGNOPMAL DISTRIBUTION IS ASSUMED

90 PER CENT UCL ON MEDIAN = 12.39

2.30

2.30 IS GREATER THAN MITR. THUS A MAINTAINARILITY PROBLEM EXISTS 90 PER CENT LCL ON MEDIAN = LOWFR CONF LIM 5.33 FST WFOIAN = 2.10 HOURS FST MEAN = 18.00 SPECIFIED MITH =

SEPELS SEPELS ر: در: LY. (11) 111 (c)  $\bigcirc$ U U THECRE  $\alpha$ Z 10 11 11  $\Box$ り り り い  $\Box$ --<u>-</u> N N  $\Box$ נבן ובו  $\overline{\mathcal{C}}$ 5 / \_ (5) TRIBUTION 9  $(\mathbf{I})$ 民 Œ. III (t) mrs . ---**←** L3 SOFFA VED HOURS യല EJ 12  $f_{i_{+}}$ COMPLETIVE CONCAMPL (C) C. 6 . G S C) C.) C 2 **C.3** CJ 2 A1A93A COMPLETION 90 TILLITY

AAINTAINAGILITY (DOWN TIME)

# CATCC DAIP SYSTEM LEVEL

WEIBULL 025 139 449 647	161.71		
FXPONENTIAL .024 .138 .646 .855	PEDAIR (TDT/NR) =		ITICAL VALUF
L.DGMOPMAL 030 219 533 666 792 816	OBSERVED DOWN TIME/PERAIR (TDI/NR) =		.291 IS GREATER THAN THE CRITICAL VALUE
25.0 25.0 25.0 25.0 25.0 25.0 25.0 25.0			166.
C(!M FDF/OUFNCY 1.0 2.0 7.0 5.0 6.0	NUWRER OF REPAIRS (NR)	STO DEV OF LN#S = 1.62	.276 MAX DIFF CALC = N CANNOT RE ASSUMED
PPFUSECT 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	1132.0 N	STD DEV	7. ) = ISTRIBUTIO
004N TIMF. 4.0 24.0 16A.0 312.0 340.0	TOTAL BOWN TIME (TOT) =   PISTFIHUTION DETERMINATION	MFAN OF LN#S # 4.43	K-S CAITICAL VALUE ( .10, 7, ) = .276 MAX DIFF ( THEREFORE THE LOGNORMAL DISTRIBUTION CANNOT RE ASSUMED

OPATIO OF 1.340 DDES NOT FXCFED THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

90 PER CENT LCL ON MEAN = 107.48 FST MEDIAN = 112.09 FST WEAN = 161.71

90 PER CENT HEL ON MEAN = 290.65

ERSUS THEORETICAL FOR SCON TIME # # 0 #  $\Box$ ) K U U I ANB3 <u>(()</u> TCC  $\Box$ Ш Х  $\overset{\cap}{\Pi}$ مرير حرير حدا ر ع CBSERVED DISTRIBUTION ROBABILITY DISTRIBUTI + - + 2sc (H@URS) TIME Z 300 - <u>1</u>20 0\_ CUMBLATIV. 100 1 1 ŧ ۍ. دع က အ . .5 it. Cl G.3 ΓJ f\_3 C 2 C) COMPLETION PROBABILITY OF REPAIR

TECT. √E () ١--- $(\Gamma$ I U U (<u>()</u> S THES <del>|--</del> )で (1) で  $\subset$  $\Sigma$ (iz li Lil (HCURS. TIME PROBABILIT **7**300 N N COMBLATI EXPCNENTIAL 000 1 1 1 ł ىد د: ် က <u>د،</u> ·--£7.5 1.3 ಾ<u>್</u> (1) (1) ۲.) PROBABILITY OF REPAIR COMPLETION

MAINTAINARILITY (REPAIR TIME)
CATCC DAIP WRA 19 LEVEL

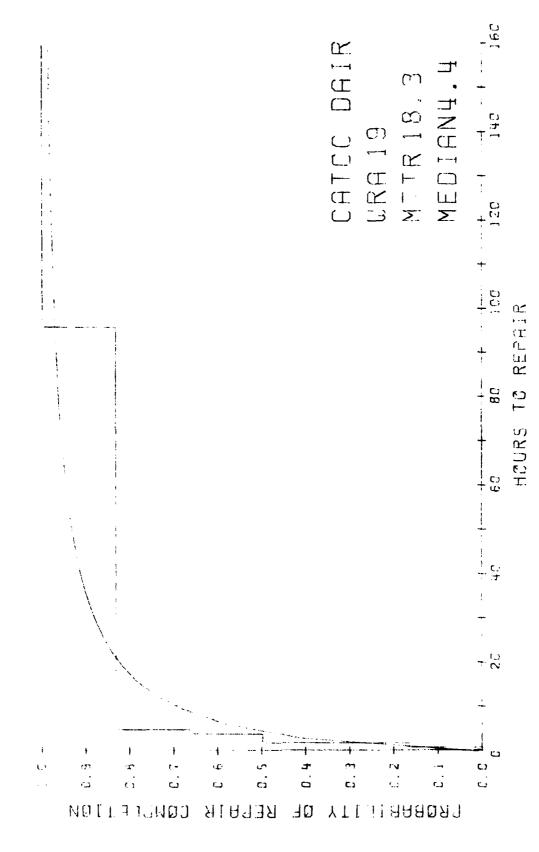
REPAIR TIVE.	FAFGUENCY	CIM FREDUFNCY	N P P	LOGNORMAL	EXPONENT I AL	WE I BULL
<b>1.</b> 0	-	0.1	.147	.177	.053	.231
∪ <b>•</b> ∠	ζ.	0*6	624.	014.	.103	.325
0.4		0.4	.571	7/7.	961.	777.
5.0	-	5.0	217.	.529	.239	.487
9 <b>%</b> .n	<b>:</b>	٨•0	.857	216.	\$66.	. 975
TOTAL REPAIR HOUPS =	110.0	NIJMBER OF REPAIRS =	6. ORSERVED	ORSERVED RFPAIR PATF/HR =	.5455F-01	
DISTRIBUTION DETERMINATION	MCITA					
MEAN OF LV#5 = 1.49		STO DEV OF LN#S = 1.61				
K-S C91TICAL VALUF ( .10. 6. ) =	10. 6. ) =	.294 MAX DIFF CALC =		.258 IS LESS THAN THE CRITICAL VALUE	AL VALUE	
THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED	AL OTSTRIBUTION	ON IS ASSUMED				
EST 4FAN = 19.73	FST MFDIAN	# 4.44 90 PER	90 PER CENT LCL ON MEDIAN =	1.68	90 PER CENT UCL ON MEDIAN	JIAN = 11.72

SPECIFIED MITH =

1.69 IS LESS THAN MITP. THUS THE EQUIPMENT MEETS THE SPECIFICATIONS

LOWFR CONF ! IM

2.11 HOURS



MAINTAINAHILITY (REPAIR TIME) CATCC DAIR O-LEVEL SUMMARY

MAINT	# 3 Tan # 1	2			
TIMES		0.04	٥.٥	5.0	4.0
ORSERVED REGAIR 1	93.00	1		2.00	0.00
ORSFRV			0.7	5.0	4.0
SPFC MTTR	0.0		•	٥•٥	7.0
UPPER 90 CONF LIM	84.00	0 T T T T		LIMITS	LIMITS
LOWFR 90 U	07.			NO CONF	NO CONF
NIMMED REPATAS	3.			•	• •
O-LFVEL NowEnce, ATURE	2 DEFLECTION ANDLIFTED	INTERFACE AND LOGIC			in Parel (Right Sine)
WRA O-LFVFL 9LOCK NO.	2 DEFLEC	A INTERE	9 41050	1 4 5 5	
3 4	2	13	6	9	<u>.</u>

MAINTAINABILITY (REPAIR TIME) 2K SUMMARY FOR CATCC DAIR PROBLEM AREAS

W4A 0-L 0-L 0-L

WHAT HAPPENFO

2

49

SUB-SECTION (3)

CATCC-DAIR

**EQUIPMENT** 

RELIABILITY

DATA

			_	FLEET RELIABILITY	ASSESSMENT	DATA					
	SHIPNAME	DATE		FAILURE TYPE	_	FAILURE TIME	0U1 <b>∀</b>	<b>ERA</b>	011	962	013
DAIR	KITTY HAWK	8588		FAILURE		0	00000	14	39	0	0
DAIR	KITTY HAWK	8321		INITIAL		0	00000	0	0	0	0
DAIR	KITTY HAWK	8321		FAILURE		28.	00000	19	0	0	0
DAIR	KITTY HAWK	8321		FAILURE		2•	0000	11	66	0	0
DAIR	KITTY HAWK	8348		FAILURE		106.	.210	18	m	0	•
DAIR	KITTY HAWK	90106		CENSORED		310.	344	0	0	•	0
DAIR	KITTY HAWK	106		CENSORED		331.	.354	0	0	0	0
DAIR	KITTY HAWK	9029		FAILURE		499	362	91	66	0	c
DAIF	KITTY HAWK	9135		FINAL		192.	.332	0	0	0	C
DAIF	RANGER	8164		INITIAL		•	0000	0	0	0	0
DAIR	RANGER	8256		CENSORED		551.	.250	0	0	0	0
DAIR	RANGER	8278		CENSORED		798.	562.	0	0	0	0
DAIF	RANGER	8307		FAILURE		1482.	.432	61	2	0	0
DAIR	RANGER	8334		CENSORED		777	.554	0	0	0	0
CATCC DAIR	RANGER	8363	4519.	CENSORED	2615.	1133.	.548	•	0	•	0
DAIR	RANGER	6706		FAILURE		1649.	.522	19	•	0	0
DA 16	RANGER	9028		FAILURE		195.	.535	19	16	0	•
DAIR	RANGER	44.06		FAILURE		284.	.547	61	2	0	0
DAIR	RANGER	9080		FAILURE		C	.535	61	<b>Ø</b>	0	0
DAIR	RANGER	<b>7016</b>		FAILURE		36.	867.	19	~	0	•
							,				,

RELIABILITY

# CATCC DAIRSYSTEM LEVEL

WEIBULL	•000	.123	.317	446.	.480	.567	•623	• 106		.851	.863
EXPONENTIAL	000.	<b>*00*</b>	•054	.069	.189	.319	624.	•626		976.	.961
OBN	.083	.167	.250	, 333	.417	.500	.583	.667		.778	.889
SURVIVORS	11.	10.	•6	.60	7.	•		;		-2	:
NO. CENSORED									-:		
NO. FAILURES	-,	-	<b>:</b>			<b>:</b>		-		-	1.
7 IME										1482.0	
REMAINING SYS. CAP.	100	100.	100.	98•	100.	100.	100.	100.		100.	100.

DUTY CYCLE (0.H./C.H.) = CALENDAR HOURS(C.H.) =. 11616.0 EQUIPMENT OPERATING HOURS (0.H.) = 5073.0

.437

NUMBER OF FAILURES = 10. OBSERVED FAILURE RATE/0.H. = .19712E-02

GRATIO OF 4.399 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

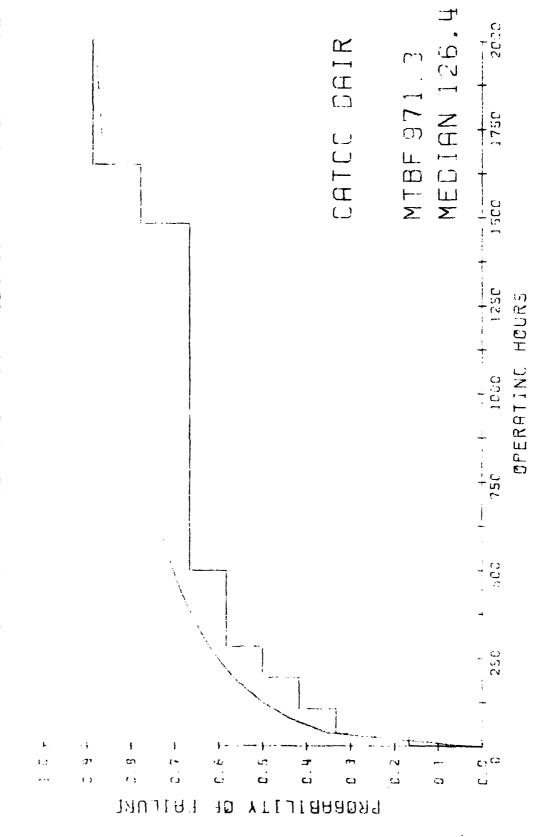
THE WEIBULL PARAMETERS ARE ALPHA = .989034E-01 BETA = .405053E+00

FOR THE ASSUMED DISTRIBUTION

2291.286 90 PER CENT UCL FOR MEAN = 90 PER CENT LCL FOR MEAN = 0.000. 90 PER CENT LCL FOR BETA = .308808E.00 90 PER CENT UCL FOR BETA = .501298E.00 EST. MEAN = 971.268, EST. MEDIAN = 126.364,

TICAL FRILURE  $\Box$ 2000 DAIR MEDIGN 351 MTBF 507, 3 TRIBUTION VERSUS THEORE CATCC HOURS 出切 CPERATING GBSERVED D PROSABILITY 750 CUMDLATIVE EXFCNENTIAL 1 -- 1 200 + 25C -• ري . - .  $\omega^{\oplus}$ . . . . . D. . J <u>ر:</u> Ġ CZ) ن . <u>.</u> . د: . ت **aau 11 A a** QE YTIJIAAADA9

ICAL PILURE SUS THECRETI CBSERVED DISTRIBUTION VER ROBERTLIN DISTRIBUTION F ĩ١, CONCLETIVE LEISULE



#### ELIABILITY

# CATCC DAIR WRA 11 LEVEL

REMAINING SYS. CAP. 100.	TIME TO FAIL 30.0 1397.0 3645.0	NO. FAILURES	CENSORED  1. 1.	
EQUIPMENT	EQUIPMENT OPERATING HOURS (0.H.) =	5073.	.0 CALENDAR HOURS(C.H.) =. 11616.0 DUTY CYCLE (0.H./C.H.) =	.437
NUMBER OF	NUMBER OF FAILURES = 1. OBSERVED FAILE	OBSERVED FAILU	URE RATE/0.H. = .19712E-03	
LESS THAN	LESS THAN FOUR FAILURES THE EXPONENTIAL	_	DISTRIBUTION IS ASSUMED	
FOR THE AS	FOR THE ASSUMED DISTRIBUTION	NO		
EST. MEAN	EST. WEAN = 5073.000.	EST. MEDIAN = 3	3516.336. 90 PER CENT LCL FOR MEAN # 1304.2. 90 PER CENT UCL FOR MEAN =	FOR MEAN = 48149.203
90 PERCENT UCL		48149.20 IS GREATER THAN	N 11655.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS	

## RELIABILITY

CATCC DAIR WRA 16 LEVEL

NO. CENSORED		-:	_
NO. FATLURES	-		
TIME TO FAIL	635.0	792.0	0 777
REMAINING SYS. CAP.	100.		

.437 DUTY CYCLE (0.H./C.H.) = CALENDAR HOURS(C.H.) =. 11616.0 EQUIPMENT OPERATING HOURS (0.H.) = 5073.0

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/0.H. = .19712E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 5073.000. EST. MEDIAN = 3516.336. 90 PER CENT LCL FOR MEAN = 1304.2. 90 PER CENT UCL FOR MEAN = 48149.203 90 PERCENT UCL 48149.20 IS GREATER THAN 2880.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

### RELIABILITY

CATCC DAIR WRA 18 LEVEL

	DUTY CYCLE (0.H./C.H.) =	
	11616.0	
NO. 450RED 1. 1.	ING HOURS (0.H.) = 5073.0 CALENDAR HOURS(C.H.) =, 11616.0 DUTY CYCLE (0.H./C.H.) =	ES # 1. OBSERVED FAILURE RATE/O.H. # .19712E-03
NO. NO. FAILURES CENSORED  1. 1. 1.	(0.H.) = 5073.0	OBSERVED FAILURE
TIME TO FAIL 136.0 1291.0 3646.0	OPERATING HOURS	FAILURES = 1.
REMAINING SYS. CAP. 100.	EQUIPMENT OPERAT	NUMBER OF FAILURE

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

.437

1304.2. 90 PER CENT UCL FOR MEAN = 48149.203 90 PERCENT UCL 48149.20 IS GREATER THAN 5000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS EST. MEAN = 5073.000. EST. MEDIAN = 3516.336, 90 PER CENT LCL FOR MEAN =

R E L I A B I L I T Y
CATCC DAIR WRA 19 LEVEL

REMAINING		• ON	0N					
SYS. CAP.	TIME TO FAIL	FAILURES	CENSORED	SURVIVORS	Ž		EXPONENT I AL	WEIBULL
100	0.			•	7		000	500
.00	28.0	-		7.	.2.	2	800	90
<b>.8</b> 6	36.0	:		•9	· ·		640	e e
100.	195.0	-:		ů,	777	4	.236	.523
100.	284.0	<b>1</b>		4	, is		400	472
	1399.0		7	1		•	,	,
100.	1482.0	-:	•	2.	7.	4	.871	784
100.	1649.0	:		-1	.852	.2	.897	161.
EOUIPMENT	EQUIPMENT OPERATING MOURS (0.H.)	(0.H.) = 5073.0		CALENDAR HOURS(C.H.) =.	11616.0	DUTY CYCLE	DUTY CYCLE (0.44./C.H.) =	.437
NUMBER OF	NUMBER OF FAILURES = 7. OBSERV	OBSERVED FAILU	RE RATE/0.H	/ED FAILURE RATE/0.H. = .13799E-02				
ORATIO OF	3.883 EXCEEDS THE CRI	THE CRITICAL VA	LUE FOR TES	TICAL VALUE FOR TEST OF EXPONENTIAL				

90 PER CENT UCL FOR MEAN = EST. WEAN = 2090.828. EST. MEDIAN = 171.429. 90 PER CENT LCL FOR MEAN = 0.000. 90 PER CENT LCL FOR BETA = .241342E+00 90 PER CENT UCL FOR BETA . .47508E+00

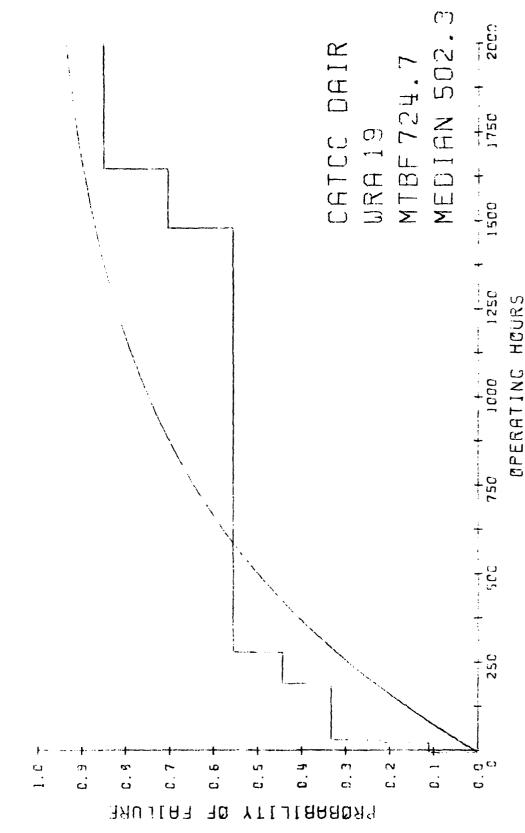
BETA = .358215E+00

THE WEIBULL PARAMETERS ARE ALPHA = .112102E+00

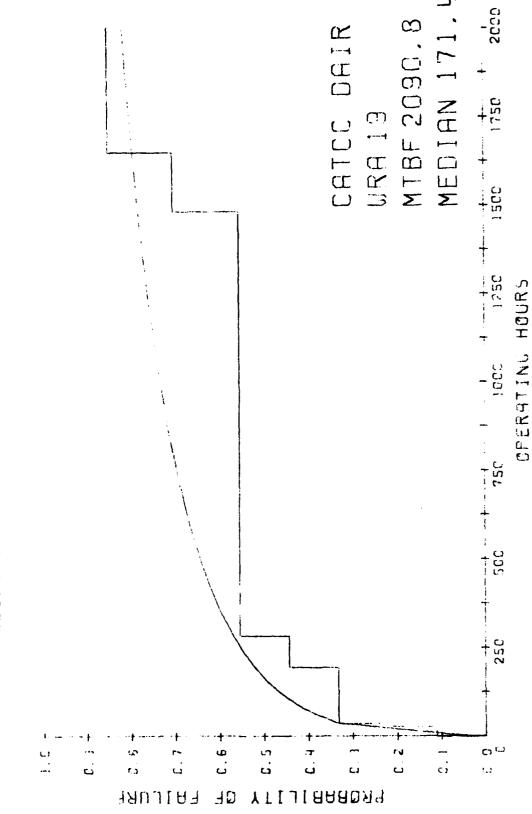
FOR THE ASSUMED DISTRIBUTION

6529.923

 $\{1,1\}$ r rus R ICAL TIME TO TO TRIBUTION VERSUS ISTRIBUTION FOR CUMULATIVE CBSERVED DEXPONENTIAL PROBABILITY



THECRETICAL TIME TO FAILURE CBSERVEC DISTRIBUTION VERSUS PROBABILITY DISTRIBUTION FOR CUMULATIVE WEIBULL



RELIABILITY

CATCC DAIR O-LEVEL SUMMARY

4			O-I EVE		000		00000		OBSERVED FATTURE TIMES	03	951 7 40
!	BLOCK NO.		NOMENCL ATURE	FAILURES	CONF LIM	MEAN	CONF LIM	MT8F	10A		PROBLEM
=	66			:	1304.21	5073.00	48149.20	48149.20 1000000.00	30.00	30.00	YES
9	66				1304.21	5073.00	48149.20	48149.20 1000000.00	635.00	635.00	YES
18	m	CRT DRIVES	CRT DRIVER ELECTRONICS	-	1304.21	5073.00	48149.20	22769.00	136.00	136.00	<b>Q</b>
61	8	2 DEFLECTION AMPLIFIER	N AMPLIFIER	3.	759.34	1691.00	4603.18	92808.00	1482.00	3646.00	YES
67	60	INTERFACE	INTERFACE AND LOGIC		1304.21	5073.00	48149.20	23702.00	3610.00	3610.00	ON
2	•	VIDEO AMPLIFIER	LIFIER	:	1304.21	5073.00	48149.20	54885.00	3131.00	3131.00	YES
19	16	16 PANEL (RIGHT SIDE)	6HT S10E)	1.	1304.21	5073.00	48149.20	24499.00	3326.00	3326.00	9

RELIABLE TY

2K SUMMARY FOR CATCC DAIRPROBLEM AREAS

WHAT HAPPENED	ANOTHER AMP FAILURE/SEE 1131/EK EMT REPORTED AS 55054/EK
7°°	• • •
0	
7-0	· ~ ~
WRA 19	161
JCN 33610F010740 33610F010763	33610£100780 33610£100789

# FLEET MAINTAINABILITY ASSESSMENT DATA

DISCOVERD COMPL AZAA B2AB
A321 A321 0.
NO REPAIR TIME FO
4321 A32
NO REPAID TIME FO
6348
NO REPAIR TIME F
J6 6206
NO REPAID TIME
8307 A
6 6 9 0 6
905A
9074
6 0806
7016

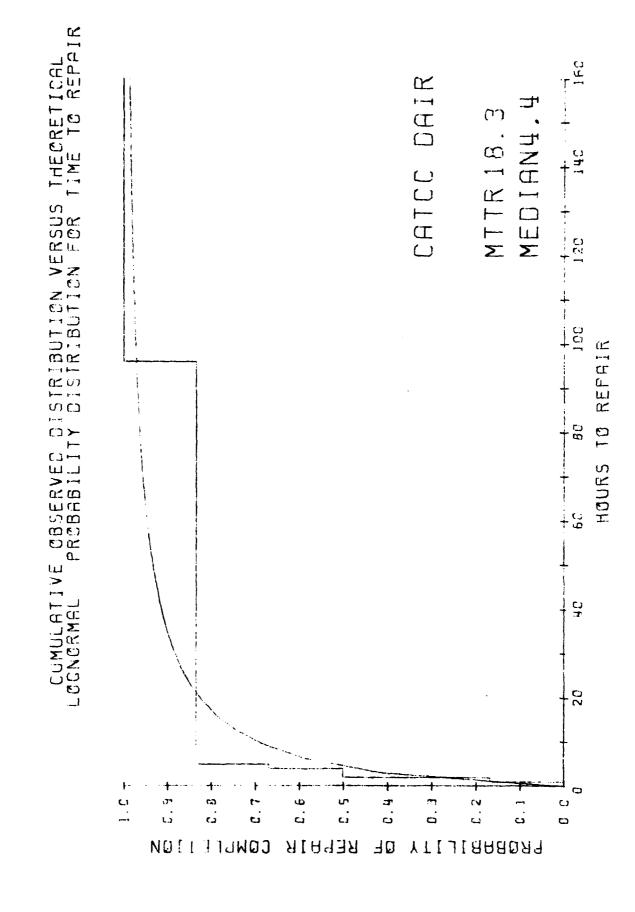
MAINTAINABILITY (REPAIR TIME)
CATC DAIR SYSTEM LEVEL

WEIBULL 231 325 444 687		
EXPONENTIAL .053 .103 .196 .239	.5455F-01	
LOGNORMAL 177 -110 -474 -529	DBSERVED REPAIR RATE/HR =	
N	6. OBSERVE	
CUM FPFOUENCY 1.0 1.0 4.0 5.0 6.0	NUMPER OF BEPAIRS =	
FPFOUENCY	110.0	<b>~01</b> 1
9EPATR TIMF. 1.0 2.0 4.0 5.0	TOTAL REPAIR HOURS =	DISTRIBUTION UFTERMINATION

.258 IS LESS THAN THE CRITICAL VALUE MAX DIFF CALC = 1.61 STO DEV OF LN#S = K-5 CRITICAL VALUE ( .10. 6. ) = .254 MEAN OF LNES = 1.49

THEREFORE THE LOGNORMAL DISTRIGUTION IS ASSUMED

LOWER CONF LIM 1.68 IS LESS THAN MTTR. THUS THE EQUIPMENT MEETS THE SPECIFICATIONS 90 PER CENT UCL ON MEDIAN = 11.72 4.44 90 PER CENT LCL ON MEDIAN = 1.68 FST MEDIAN = 2.00 HOUPS EST WEAN = 14.73 SPECIFIED MITR =



MAINTAINABILITY (DOWN TIME)

## CATCC DATR SYSTEM LEVEL

<b>4ۥ</b>	FPFGUENCY	COM FREQUENCY	NP.	LOGNORMAL	EXPONENT I AL	WEIBULL
c. 4	-	1.0	.141	240.	.031	*E0.
24.0	<u>-</u>	0.4	286	.267	0.170	179
0.46	٦.	٥•٤	624.	265	526	532
168.0	ζ.	5.0	.714	718	.729	730
312.0	<u>.</u>	٧٠٥	.857	. 431	-915	906
TOTAL DOWN TIME (TOT) =	772.0	NUMBER OF REPAIRS (NR)	IR) = 6•	OBSERVED DOWN TIME/REPAIR (TDI/NR)	PAIR (TOT/NR) =	128.67
DISTRIBUTION DETFRMINATION	N.C					
MEAN OF LN#5 = 4.19	STO DEV	DEV OF LN#S = 1.62				
K-S CRITICAL VALUE ( .10. 6. )	. 6. ) .	.294 MAX DIFF CALC =	•306	IS GREATER THAN THE CRITICAL VALUE	ICAL VALUE	
THEREFORE THE LOGNORMAL DISTRIBUTION CANNOT RE ASSUMED	DISTRIBUTIO	4 CANNOT RE ASSUMED				

66

ORATIO OF

90 PER CENT UCL ON MEAN # 244.93

90 PER CENT LCL ON MEAN = 83.24

3.360 DOES NOT EXCEED THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FST MEDIAN = 89.18

EST MEAN # 128.67

THEBRETICAL DOWN TIME 100 to 1  $\infty$ 128. C C C AN65  $\Box$ **--**4 **|--**E U . Σ ZZ [T] 300 ISTRIBUTION DISTRIBUTE HOURSI 250 III Z III CBSERVED RESABILIT 23 33 33 33 33 n\_ CUMULATIVE LOGNORMAL - DD: O <del>ن</del> د. ca in ت. ت ري س C. C C) u, ີ່ C) . دے REPA1R COMPLETION OF PROBABILITY

FROBASILITY DISTRIBUTION VERSUS THEORETICAL H R C C . 00 17 MEDIEN89 CATCE 1 --- --- --- --- 25C (HGURS DOWN TIME 150 150 CUMULATIVE EXPONENTIAL 001 ۲۰ ز) U7 رع د : 64 63 ပ ် . C .; -: C) œ Œ r, C COMBLE LINN REPAIR ЯØ PROBABILITY

MAINTAINABILITY (REPAIR TIME)

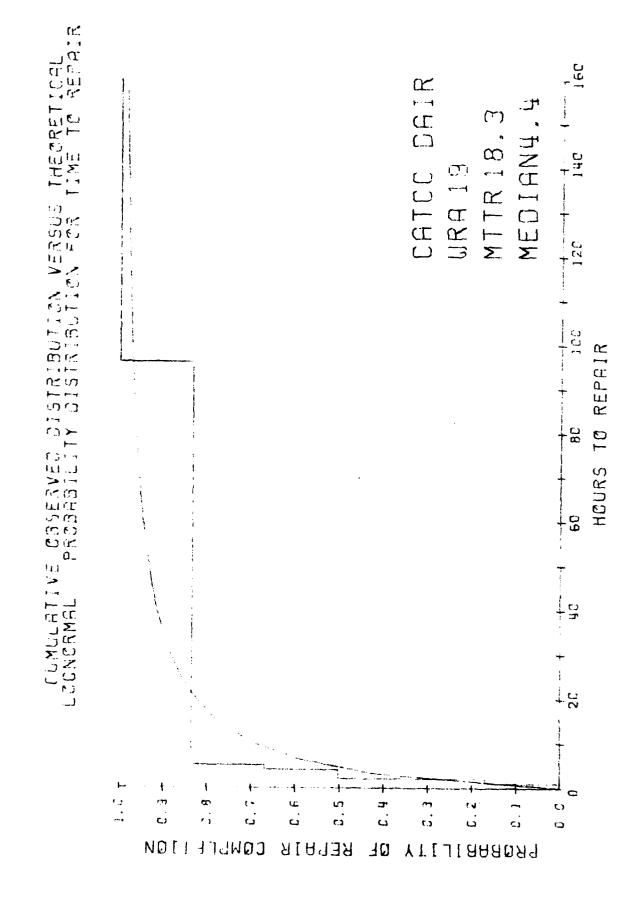
# CATCC DATR WRA 19 LEVEL

EXPONENTIAL WEIGULL .231 .231 .325 .325 .325 .444 .239		.5455F-01	
LOGNORMAL 177 310 474 529	276*	JOSENNEO REPAIR RAIE/MR =	
NPF 143 479 571 714	30		
CUM FREDUENCY 1.0 3.0 4.0 5.0 6.0	NUMBER OF REPAIRS =		
FRFQUENCY 1. 2. 1. 1.	110.0	TON	
REPAIR TIME. 1.0 2.0 4.0 5.0 96.0	TOTAL REPAIR HOURS =	DISTRIBUTION DETERMINATION	

1.61 STO DEV OF LNZS = WEAN OF LN#S = 1.49

.258 IS LESS THAN THE CRITICAL VALUE MAX OIFF CALC = THEREFORE THE LOGNOPHAL DISTRIBUTION IS ASSUMED K-S CRITICAL VALUE ( . 10. 4. ) = .294

LOWER CONF LIM 1.68 IS LESS THAN MTTR. THUS THE EQUIPMENT MEETS THE SPECIFICATIONS 90 PER CENT UCL ON MEDIAN = 11.72 1.68 4.44 90 PER CENT LCL ON MEDIAN = EST MEDIAN = 2.10 HOURS SPECIFIED MITR =



WAINTAINABILITY (REPAIR TIME)
CATCC DAIR O-LEVEL SUMMARY

Ø 3	WPA 0-LEVEL PLOCK NO.	O-LEVEL ROWFNCLATIBE	NUMBER	LOWER 90 CONF LIM	UPPER 90 CONF LIM	SPFC	ORSFPV	ORSFRVED REPAIR Low Mean	TIMES HIGH	MAINT PROBLEM
19	2 DEFLE	2 DEFLECTION AMPLIFIEM	3.	04.	84.00	0°2	1.0	33.00	96.0	O 2
61	8 INTER	INTERFACE AND LOGIC	1.	NO CONF LIMITS	LIMITS	7.0	2.0	2.00	2.0	
19	9 VIDEC	VIDEO AMPLIFIFF		NO CONF LIMITS	LIMITS	0.5	5.0		5.0	
19	16 PANFL	16 PANFL (RICHT SINF)	-:	NO CONF LIMITS	LIMITS	0.0	0.4	00.0	0.4	

MAINTAINABILITY (REPAIR TIME) 2K SUMMARY FOR CATCC DAIR PROBLEM AREAS

#PA 0-L 0-L n-L

WHAT HAPPENED

ڻ ت

# AMA SUMMADY CATCC DAIP EQUIP. RELIABILITYSYSTEM LFVFL

971.27 .40500 MFAN = .09890 AND BETA = TTF DISTRIBUTION IS WEIRULL WITH ALPHA =

ET DISTRIBUTION IS EXPONENTIAL WITH MEAN = 128.67

1,61000 LT DISTRIBUTION IS LOGNORMAL WITH MEAN OF LNS = 1.49000 AND STANDARD DEVIATION OF LNS =

INHEGENT AVAILABILITY = MTRF/(MTRF+MTTR)

WEAN TIME TO FAILURE = 971.27

MEAN CFDAIN TIME = 14.08

INHERFNT AVAILAGILITY = .9857

ORSERVED AVAILABILITY (SIMULATION OF RATIOS TTF/(TTF+DT))

90 PERCENT LCL ON INDIVIDUALS = .0017

ON PERCENT UCL ON INDIVIDUALS = .9793

MEAN = .5245

MEDIAN ==

.5773

SUB-SECTION (4)

CATCC-DAIR

PARTS

REPLACEMENT

	OL3	0	0	0	0	•	0	0	0	0	0	0	•	0	0	•	0	0	0	0	0
	0L2	0	0	•	•	0	•	•	0	0	0	0	0	0	•	0	0	•	•	0	•
	0 <b>L</b> 1	39	0	0	66	٣	0	0	66	•	0	0	0	~	•	•	Φ	16	~	10	8
	MK A	14	0	19	11	18	0	0	91	•	0	0	•	19	•	•	61	61	61	61	61
	DUTY	00000	000.0	00000	00000	.210	.344	, 354	.362	,332	00000	•250	262.	.432	.554	.548	.522	.535	.547	.535	967.
DATA	FAILURE TIME	• C	•0	28.	<b>~</b>	106.	310.	331.	*667	1291	•0	551.	798.	1482.	777	1133.	1649.	195.	284.	0	36.
/ ASSESSMENT	OPERATE	•	• 0	28.	30.	136.	446.	467.	635.	1427.	•	551.	798.	1482.	2259.	2615.	3131.	3326.	3610.	3610.	3646.
LEET MELIABILITY	FAILURE TYPE	FAILURE	LAITIAL	+ AILURE	FAILURE	FAILURE	CENSORED	CENSORED	CENSORED	FINAL	INITIAL	CENSORED	CENSORED	FAILURE	CENSORED	CENSOMED	FAILURE	FAILURE	FAILURE	FAILURE	FAILURE
•	M T	2650.	2658	2646.	2688.	2794.	3104.	3125.	3243.	40A5.	1904.	2425.	2702.	3786.	4163.	4519.	5035.	5230	5514.	5514.	5550
	DATE	TIVE	1564	9321	6321	436B	0106	1105	6206	9135	n]64	8256	8278	6307	H334	6363	6406	9605	4206	7080	9104
	BEVENTER	KITTY HANG	RITIV TALE	KIIIV LANK	KITTY HANG	KITIT TABE	KITIY HANK	AITIY HAJA	KITIY HAMA	KITTY HAWK	HANGER	APSOFE.	AANGFU	RANGER	RAPIGEN	MANGER	KANGHA	KANGER	KANGEK	RANGER	KANGER
	SYSTFM							-						CATCC DAIR		_				_	

RELIABILITY

CATCC DAINSYSTEM LEVEL

3 3 3 4 3	.010	151	.347	.373	664.	.578	.628	•	.835	.846
A T TARROCK	• 000	400	640.	• 062	.171	-292	• 396		.928	976.
C	160	.182	273	.364	455	.545	636		.758	618.
SURVIVORS	10.	•	10	7.	•	δ.	• •		2.	:
NO. CENSORED								-		
NO. FAILURES	•	• 7	7	•	-1	-	-		1.	
=		0.€								
MEMAINING SYS. CAP.	109.	100.	100.	94.	100.	700-	100.		100.	100.

CALENDAR HOURS(C.M.) =, 11616.0 DUTY CYCLE (0.H./C.M.) = NUMBER OF FAILUPES = 4. ORSENVED FAILURE KATEZO.M. = .17741E-02

EGUIPMENT OPERATING HOUMS (U.H.) = 5073.0

.437

6.226 EXCEFUS THE CHITICAL VALUE FOR TEST OF EXPONENTIAL GRATIO OF

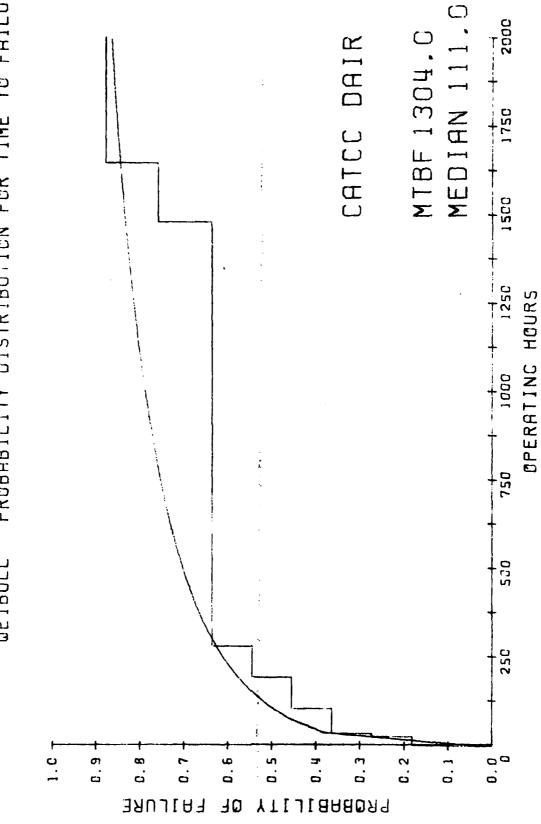
BETA = .362814E+00 THE WEIRULL PAKAMETERS AME ALPHA = .127400E+00

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 1304.031. EST. MEDIAN = 111.000. 90 PER CENT LCL FOR MEAN = 0.000. 90 PER CENT UCL FOR MEAN = 90 PER CENT LCL FOR BETA = .261647E+00 40 PER CENT UCL FOR BETA = .463980E+00

ICAL FAILURE 2000 DAIR 18N 390 MTBF 563. THECRET 1750 CATCC MED DBSERVED DISTRIBUTION VERSUS PROBABILITY DISTRIBUTION FOR 1500 HOURS OPERATING 750 CUMULATIVE EXPCNENTIAL 250 00 9.0 0.5 . C 0.1 (L) Ø 5 <u>ပ</u> c; ن . O PROBABILITY OF **FAILURE** 

PROBABILITY DISTRIBUTION VERSUS THEORETICAL CUMULATIVE WEIBULL



#### RELIABILITY

#### CATCC UAIR WRA 11 LEVEL

ZEMAINING		02	OZ						
SYS. CAP.	TIME TO FAIL 30.0 1397.0 3646.0	10	CENSORED						
EQUIPMENT	UPERATING HOURS	EQUIPMENT UPERATING HOURS (0.H.) = 5073.	0 CALENDAR	CALENDAR HOURS(C.H.) =+ 11616.0 DUTY CYCLE (0.H./C.H.) =	11616.0	DUTY CYCLE	(0.H./C.H.) =	.437	
NUMBER OF	NUMBER OF FAILURES = 1.	UBSERVED FAILURE RATE/0.4. = .19712E-03	PE RATE/0.H.	= .19712E-03					
LESS THAN	FOUR FAILURES 1	LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED	ISTRIBUTION	IS ASSUMED					
FOR THE A	FOR THE ASSUMED DISTRIBUTION	10N							
EST. MEAN	EST. MEAN = 5073.000.	EST. MEDIAN = 3	516.336. 9	3516.336. 90 PER CENT LCL FOR MEAN	OR MEAN =	1304.2.	90 PER CENT UCL FOR MEAN = 48149.203	FOR MEAN =	48149.203
90 PERCENT UCI		48149.20 IS GREATER THAN		19655,00 HOURS, THEREFORE THE FOURDMENT MEETS THE SPECIFICATIONS	THE FOLLTPME	TAL MEETS TH	A SPECIFICATIONS		

#### ELIABILITY

CATCC VAIR WRA 18 LEVEL

REMAINING		• OV	• CN					
SYS. CAP. 100.	TIME TO FAIL 136.0	FAILURES 1.	CENSORED					
	1241.0		::					
EQUIPMENT	EQUIPMENT OPERATING HOURS (0.H.) = 5073.0 CALENDAR HOURS(C.H.) =, 11616.0 DUTY CYCLE (0.H./C.H.) =	(0.H.) = 5073,	O CALENDAR	HOURS(C.H.) =+	11616.0	DUTY CYCLE (0.	* (*H*)/*H*	.437
NUMBER OF	NUMBER OF FAILURES = 1.	OBSERVED FAIL	OBSERVED FAILURE RATE/0.4. = .19712E-03	.197126-03				
LESS THAN	LESS THAN FOUR FAILURES TH	THE EXPONENTIAL DISTRIBUTION IS ASSUMED	MISTRIBUTION IS	ASSUMED				
FOR THE AS	FOR THE ASSUNED DISTRIBUTION	NOI						

EST. MEAN = 5073.000. EST. MEDIAN = 3516.336. 90 PER CENT LCL FOR MEAN = 1304.2. 90 PER CENT UCL FOR MEAN = 48149.203

90 PERCENT UCL 48149.20 IS GREATER THAN 5000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY

#### CATCC DAIR WRA 19 LEVEL

<b>د</b> ۔									6529.923	
WE IBULL	900°	.578	.784	.437					FOR MEAN =	
EXPONENT IAL	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	.324	.871	DUTY CYCLE (0.H./C.H.) =					90 PER CENT UCL FOR MEAN =	
NPD E	333	556	.704 .852						0.000.	
•	• • (	•	• •	. 11616.0			E+00		FOR MEAN =	
SURVIVORS 8.	. ¢ ()	•	2. 1.	CALENDAR HOURS(C.H.) =.	H. = .13799E-02	VALUE FOR TEST OF EXPONENTIAL	BETA = .358215E+00		90 PER CENT LCL FOR MEAN =	
NO. CENSOMED		•	•	3.0 CALEN	LURE RATE/O.H. =	LUE FOR TE	112102E+00		171-429.	
NO. FAILURES 1.	••	١.	-:-	(0.H.) = 5073	OBSERVED FAI		•	NOI	EST. MEDIAN =	
TIME TO FAIL	36.0 195.0	284.0 1399.0	1482.0	EQUIPMENT OPERATING HOURS (0.H.) = 507	NUMBER OF FAILURES = 7.	3.883 EXCEEDS THE CRITICAL	THE WEIBULL PARAMFTERS ARE ALPHA =	FOR THE ASSUMED DISTRIBUTION	2090.828.	On DED CENT LOS CONTRACTOR
REMAINING SYS. CAP. 100.	900	• • • • • • • • • • • • • • • • • • • •	100.	EQUIPMENT	NUMBER OF	GRATIO OF	THE WEIBUL	FOR THE AS	EST. MEAN =	משם שם

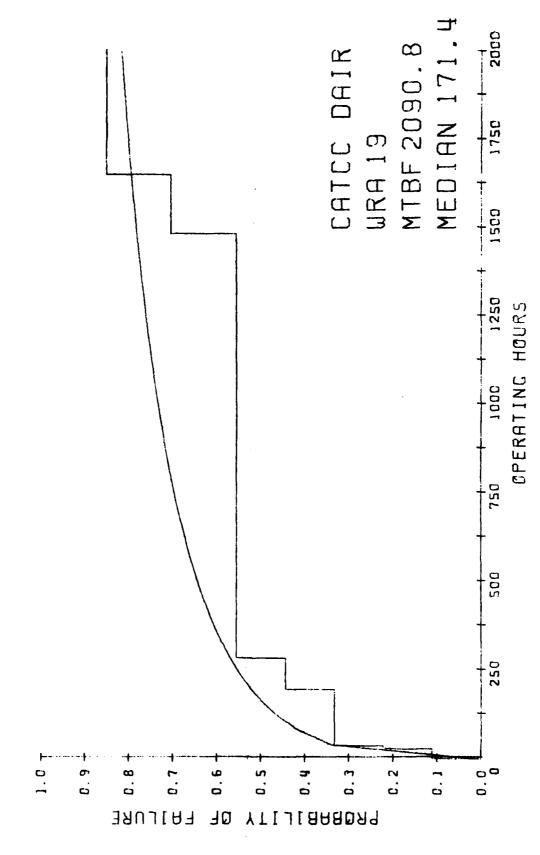
.241342E+00 90 PER CENT UCL FOR BETA = .475088E+00

90 PER CENT LCL FOR BETA =

CBSERVED DISTRIBUTION VERSUS THEORETICAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE MEDIAN 502.3 2000 DAIR MTBF 724.7 1750 CATCC WRH 19 1500 OPERATING HOURS 1000 CUMULATIVE EXPONENTIAL 500 250 0.0 0 0.2 0.1 C . 9 0.6 . S J . C D. 9 PROBABILITY FA1LURE 70

Walter Land

CBSERVED DISTRIBUTION VERSUS THEORETICAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE CUMULATIVE WEIBULL



RELIABILITY

# CATCC DAIM O-LEVEL SUMMARY

<b>4</b>	A O-LEVEL BLOCK NO.	NO. NOMENCLATURE	NUMBER FAILURES	LOWER 90 CONF LIM	MEAN	UPPER 90 CONF LIM	SPEC MTBF	OBSERVED FAILURE TIMES LOW HIGH	ED TIMES HIGH	RELIAB Problem
11	66			1304.21	5073.00	48149.20	48149.20 1000000.00	30.00	30.00	YES
8	m	CRT DRIVER ELECTHUNICS	1.	1304.21	5073.00	48149.20	48149.20 22769.00	136.00	136.00	2
19	~	2 DEFLECTION AMPLIFIER	3.	759.34	1691.00	4603.18	92808.00	1482.00	3646.00	YES
19	60	INTERFACE AND LUGIC	. II.	1304.21	5073.00	48149.20	23702,00	3610.00	3610.00	9
16	σ	VIDEO AMPLIFIER	1.	1304.21	5073.00	48149.20	54885.00	3131.00	3131.00	YES
19	16	16 PANEL (RIGHT SIDE)	:	1. 1304.21 5073.00	5073.00	48149.20	54494.00	3326.00	3326.00	2

2K SUMMARY FOR CATCC DAIRPROBLEM AREAS

70

WHAT HAPPENED

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# FLEET MAINTAINABILITY ASSESSMENT DATA

SYSTEM		DISCOVERU	COMPL		
CATCC DAIR	KITTY HANK	8538	8288	•	•
CATCC DAIR		8321	8321		•
CATCC DAIR		6321	8321		7.
CATCC DAIR		8348	8348		•
		NO KEPAIK I	IME FOR	Ê	
CATCC DAIR		6307	8314		168.
CATCC DAIR		A+0A	9053		96
CATCC DAIR		8506	9058		80
CATCC DAIR		4106	9075		54.
CATCC DAIR		0906	9087		168.
CATCC DAIR		7016	4116		312.

MAINTAINABILITY (KEPAIR TIME)

## CATCC DAIR SYSTEM LEVEL

REPAIN TIME.	FHEUCENCY	CUM FREGUENCY		NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
O • •	•,		•	555	.163	•056	.219
6.5			•	***	•596	.108	.312
O.9	-		•	556	.566	.290	•516
ن م	-	D.9	•	667	.637	.367	.578
0.9	<b>.</b> :	2.6	•	7/8	484.	.435	.627
116.0	<b>:</b>	O•6.	•	864	626.	866.	<b>586</b> *
TOTAL MEPAIR HOURS = 140.0	140.0	NUMBER OF REPAIRS =	<b>3</b>	OBSERVED RE	JUSERVED KEPAIR RATE/HR =	.5714E-01	
DISTRIBUTION DETERMINATION	ATIUN						

MAX DIFF CALC = .201 IS LESS THAN THE CRITICAL VALUE 1.56 THEREFORE THE LUGNORMAL DISTAIBUTION IS ASSUMED STD DEV OF LN#S = .261 u ... K-S CRITICAL VALUE ( .10. 1.53 MEAN OF LN#S =

90 PER CENT UCL ON MEDIAN = 10-12 2.12 IS GREATER THAN MITR. THUS A MAINTAINABILITY PROBLEM EXISTS 21.5 90 PER CENT LCL ON MEDIAN = LOWER CONF LIM 4.63 EST MEDIAN = 2.00 HOURS EST MEAN = 17.50 SPECIFIED MITH =

THECRETICAL TIME TO REPAIR DAIR 9 MTTR 17.5 MEDIANY 140 CATCC CBSERVED DISTRIBUTION VERSUS PROBABILITY DISTRIBUTION FOR 120 100 REPAIR 10 HOURS CUMULRTIVE LGGNCRMAL ი . 9 .. .. က အ C. 3 0.6 0.5 ٠ ت C. 3 £.2 0,0 0.1 COMPLETION REPA1R 40 YTIJIAAABAA

MAINTAINABILITY (DOWN TIME)

## CATCC DAIR SYSTEM LEVEL

#EI&UL. .052 .164 .196 .366 .366 .815	97.88
EXPONENTIAL • 010 • 059 • 078 • 017 • 625 • 820 • 959	TIME/REPAIR (TOT/NR) =
LOGNOKMAL .044 .206 .249 .446 .709 .796	OBSERVED DOWN TIME
222 222 333 344 556 556 689	(NK) = B.
	CALES OF RETAINS (
FREGUENCY 10 10 10 10 10 10 10 10 10 10 10 10 10	
DOWN IIME, F 1.0 6.0 6.0 24.0 96.0 108.0 312.0	DISTRIBUTION DETERMINATION

MEAN OF LN#S = 3.45 STU UEV OF LN#S # 2.03

.264 IS GREATER THAN THE CRITICAL VALUE MAX DIFF CALC = THENEFORE THE LUGNORMAL DISTRIBUTION CANNUT RE ASSUMED K-S CRITICAL VALUE ( .10. 8. ) = .401

GRATIO OF 9.064 EXCEEDS THE CHITICAL VALUE FOR TEST OF EXPONENTIAL

THEREFORE THE EXPONENTIAL DISTRIBUTION CANNOT BE ASSUMED

90 PER CENT UCL ON MEAN # 179.545 BETA = .67239E+00 +88245441E+00 ESI HEAN = 101.636 90 PER CENT LCL ON MEAN \* 23.727 WEIGULL DISTRIBUTION ASSUMED. ESTIMATEU PARAMETERS ARE ALPHA = .53828E-01 \*\*62323E+00 90 PER CENI UCL FOR BETA = 90 PER CENT LCL FOR BETA = EST MEDIAN # 46.066

ı`

S THEORETICAL COUN TIME DAIR 97.9 MEDIAN31 350 CATCC PROBABILITY DISTRIBUTION VERSUS  $\mathbf{\Sigma}$ 300 (HØURS) T I ME NMOO CUMULATIVE LGGNCRMAL 10C 50 .. ני G. O YTIJIBABBA9 REPA1R COMPLETION 40

THEORETICAL DOWN TIME DAIR  $\infty$ മ MEDIAN67 97. 350 CATCC CBSERVED DISTRIBUTION VERSUS PROBABILITY DISTRIBUTION FOR MOT 38 (HØURS) 250 TIME 200 DOWN 150 CUMULATIVE EXPCNENTIAL 100 . . 0.5 0.2 0.0 **Я**[คๆ<sub>3</sub>Я COMPLET 10N 40 PROBABILITY

THEORETICAL DOWN TIME DAIR MEDIAN46.1 350 CATCC CBSERVED DISTRIBUTION VERSUS PROBABILITY DISTRIBUTION FOR I 300 (HØURS) 250 TIME 200 NBOO 150 CUMULATIVE WEIBULL 100 50 0 · C رع دع ය . G. 6 0.5 0.3 C. 2 <u>.</u> C. 7 Я[АЧЭЯ ۵F PROBABILITY COMPLETION , / (

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MAINTAINABILITY (REPAIR TIME)
CATCC DAIR WRA 11 LEVEL

LESS THAN FOUR DISTINCT MEPAIN TIMES

THENEFORE THE LUGNORMAL DISTRIBUTION IS ASSUMED

ONLY ONE DISTINCT PEPAIR TIME -- NO CUNFIDENCE LIMITS

# MAINTAINABILITY (REPAIR TIME)

## CATCC DAJR WRA 19 LEVEL

					NOIT	DISTRIBUTION DETERMINATION
	.5036E-01	OBSERVED REPAIR RATE/HR =	7. OBSERVED	NUMBER OF REPAIRS =	139.0	TOTAL REPASR HOURS =
.980	.996	.971	.8/5	7.0		
.581	.396	.639	.750	٥.0		, e . c
.531	.332	•584	•625	5.0	-	, a
.469	.261	.510	.500		:	
.273	.096	.247	•3/5		•	• • • • • • • • • • • • • • • • • • • •
.187	.049	.129	125		•	
AE I BULL	EXPONENTIAL	LOGNORMAL	N. T	CUM FREQUENCY	FREQUENCY	REPAIR TIME.

MEAN OF LN#S = 1.75 STU DEV OF LN#S = 1.55

K-S CRITICAL VALUE ( .10. 7. ) = .276 MAX DIFF CALC = .221 IS LESS THAN THE CRITICAL VALUE

SPECIFIED MITH = EST MEAN = 14.86

2.00 HOURS

EST MEDIAN =

5.76

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

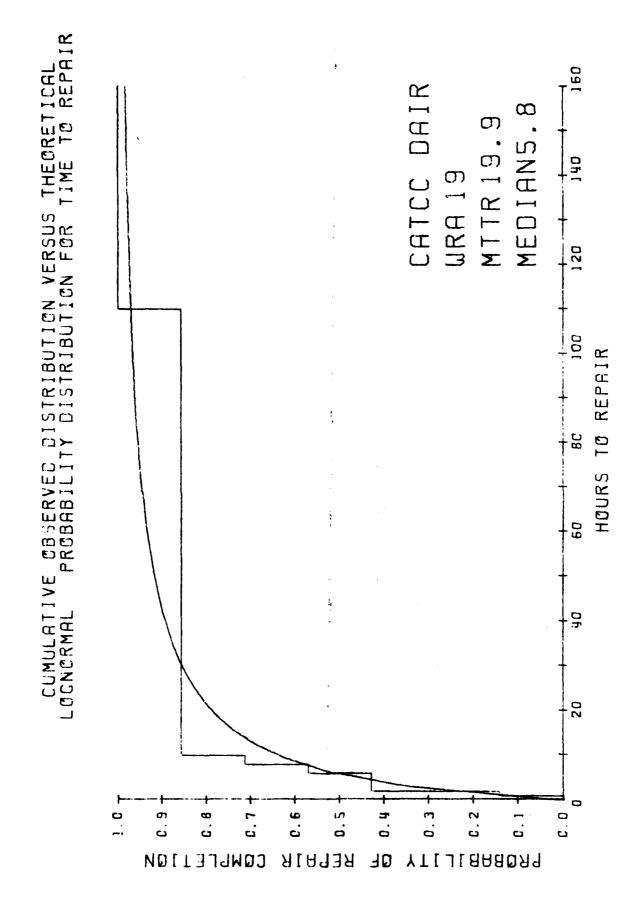
90 PER CENT LCL ON MEDIAN =

LOWER CONF LIM 2.48 IS GREATER THAN MITR. THUS A MAINTAINABILITY PROBLEM EXISTS

2.48

90 PER CENT UCL ON HEDIAN =

13.40



#### MAINTAINABILITY (REPAIR TIME) CATCC DAIM O-LEVEL SUMMARY

<b>Š</b> :	BLOCK NO.	WEL NO.	O-LEVEL Nomënclaturë	NUMBER	LOWER 90 CONF LIM	CONF LIM CONF LIM	SPEC	OBSERVE LOW	D REPAIR MEAN	TIMES	MAINT PROBLEM
=	\$			•	NO CONF LIM	LIMITS	2.0	1.0	1.00	-	
61	~	DEFLE	2 DEFLECTION AMPLIFIER	۳,	38	19-56	0		, ,		;
19	•	INTER	INTERFACE AND LOGIC	7	NO CONF	STIMIT?		• •	10.10	0-011	<b>⊋</b>
61	σ	VIUEO	VIDEO AMPLIFIFR	-	CON	LIMITS	) (	0 4	00.2	2.0	
61	16	PANEL	16 PANEL (RIGHT SIDE)	.1	NO CONF	LIMITS	2 0 2	9 9	10.01 10.00 10.01 8.0 0.00 8.0	0 0	
								•		•	

# MAINTAINABILITY (REPAIR TIME)

AREAS
PROBLEM
DAIR
CATCC
FOR
SUMMARY
¥

CELLE TALL	/EK WHAT HAPPENED	ANOTHER AMP FAILURE/SEE 1131/EK ETM REPURTED AS 45014/CORRECTED/EK EMT REPORTEU AS 55054/EK
	) - -	999
	3000	000
	7070	N 30 N
	**************************************	222
	JCN 33630E02M125 33610E010740 33610E010763 33610E010777 33610E100780	33610E10078u 33610E10078u

