AD-A237 164

[RE]PORT DOCUMEN]TATION PAGE

Form Approved
OMB No. 0704-0188

...s estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, ...ewing the collection of information. Send comments regarding this burden estimate or any other aspect of this ...den, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson ...ice of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE: 14 Aug 89

3. REPORT TYPE AND DATES COVERED: Aug 88 - Aug 89

4. TITLE AND SUBTITLE: Technology Insertion (TI)/Industrial Process Improvement (IPI) Task Order No. 1 Data Base Documentation Book for WR-ALC/MANPGB (Gyroscopic Repair)

5. FUNDING NUMBERS: Contract

6. AUTHOR(S): McDonnell Douglas Missile Systems Company

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES): McDonnell Douglas Missile Systems Company, St. Louis, Missouri 63166

8. PERFORMING ORGANIZATION REPORT NUMBER: F33600-88-D-0567

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES): HQ AFLC/LGME, WPAFB OH 45433

10. SPONSORING/MONITORING AGENCY REPORT NUMBER: F33600-88-D-0567

11. SUPPLEMENTARY NOTES: Prepared in cooperation with WR-ALC & HQ AFLC

12a. DISTRIBUTION/AVAILABILITY STATEMENT: Distribution Statement A

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

Technology Insertion (TI)/Industrial Process Improvement (IPI) Data Base Documentation Book Volume, for WR-ALC/MANPGB (Gyroscopic Repair).
This document contains detailed information about layouts equipment and processes for this RCC.

14. SUBJECT TERMS: TECHNOLOGY INSERTION, DATABASE, AFLC, AF, MAINTENANCE, GRYOSCOPIC, REPAIR, AIRCRAFT, AF MANPGB

15. NUMBER OF PAGES: 159

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT: Unclassified

18. SECURITY CLASSIFICATION OF THIS PAGE: Unclassified

19. SECURITY CLASSIFICATION OF ABSTRACT: Unclassified

20. LIMITATION OF ABSTRACT: Unclassified

TECHNOLOGY INSERTION-ENGINEERING SERVICES
PROCESS CHARACTERIZATION
TASK ORDER NO. 1
(BLOCK 1)

DATABASE DOCUMENTATION BOOK

WR-ALC

MANPGB

CONTRACT SUMMARY REPORT
14 AUGUST 1989

CONTRACT NO. F33600-88-D-0567
CDRL SEQUENCE NO. B008

MCDONNELL DOUGLAS
McDonnell Douglas Missile Systems Company
St. Louis, Missouri 63166-0516 (314) 232-0232

WR-ALC (MANPGB)

1.0 Identification of RCC

RCC MANPGB has been identified by the statement of work of the contract F33600-88-D-0567 for process characterization.

2.0 General Information

MANPGB is a Resource Control Center under the MANPG section of the Industrial Products Division (MAN) at WR-ALC. MANPGB is located in Building 158 in the center portion of the building. The area is maintained as a 300,000 class clean room though the common air locks, work restrictions, and clean room garb is not required. Observation of the area has established that the MANPGB cleanliness level exceeds both MANPGA and MANPGC.

The workload is primarily MISTR work. It consists of various vertical, two axis displacement gyro repair, and flight data instruments. The area also has responsibility for operation of the automatic gyroscope test stations and support computer systems that service all three RCCs (MANPGA, MANPGB, and MANPGC). Most product in the area is of 1955 to 1970 design. Because of this aging product mix, the workload has been decreasing for some time.

MANPGB will be discussed in more detail in the following Section 2.1 through 2.8.

2.1 Facility Layout Drawing

The accompanying facility drawing represents MANPGB's part of Building 158. The area includes workbench areas, ATE areas, depaint, unsealing, resealing, and paint area. The area appears to be the most stable of Building 158.

2.2 Equipment

MANPGB equipment is individual workbench stations, a small machine shop support area. The depaint and unsealing area, a filling, resealing and painting area and the automatic test station area. The area also contains many manual test stands and two axis manual tables. The automatic stands consist of computer and switching panels with large three axis or single axis rate stands. The tooling is standard precision hand tools furnished to the operators in complete kit sets plus some amount of special tooling for each model but little is complex enough to require much concern. The test sets, except for the ATE and contractor manual test stands, are of a design age consistent with the product design. It is doubtful that it can be properly supported much longer.

2.3 Workforce

MANPGA has a stable workforce with little variance. The workforce is comprised of instrument mechanics, three supervisors, a clerk, and a senior supervisor. The following is a breakdown of the mechanics within MANPGB.

Skill Code	Skill Level	Quantity	Experience
WG 3359	G-10	13	19.3 yrs.
WG 3359	G-09	36	17.1 yrs.
WG 3359	G-07	8	6.4 yrs.
WG 7009	G-04	1	10.0 yrs.

It is to be noted that the workforce is shared between the gyro RCCs as workloads vary. A major concern is availability of trained instrument mechanics if increased workload was demanded. The age of the workforce should also be of a concern. Experience is very high but natural attrition is reducing the numbers faster than training is furnishing younger mechanics. Surge conditions would be gated by this constraint.

2.4 Repair Process Technologies

The repair process technologies within MANPGB consist of defining the malfunction causes of gyroscopes, repairing as required, and retesting to verify the completeness of the repair. The gyros are pretested to identify malfunctions, torn down and repaired as required to technical overhaul manuals. Repair is generally accomplished through replacement of worn and/or defective piece parts. The rebuild and acceptance testing is also directed by Technical Orders and test specifications. Some mandatory replacement of high failure items are directed by Technical Orders to extend MTBF. Precision bearing and miniature slip rings/brushes are examples of some 100% replacement parts.

2.5 Workload Volume and Mix

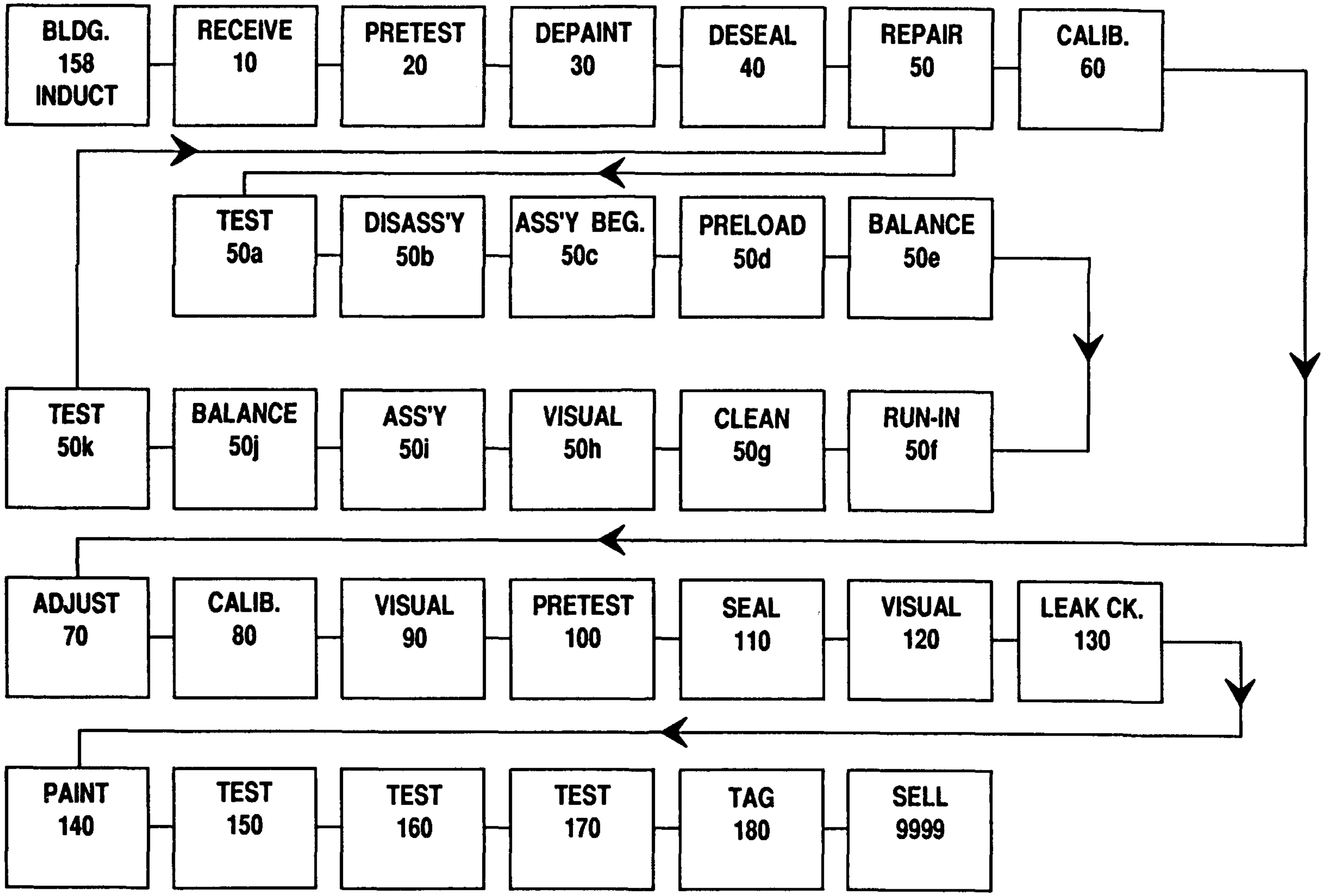
The workload within MANPGB consists of Management of Item Subject To Repair (MISTR) and exchangeables. MISTR represents greater than 98% of the workload. The RCC repairs and tests in excess of 6000 units annually.

2.6 Material Handling

Material handling in MANPGB is mostly accomplished by the repair operator hand carrying the items between stations. The gyroscopes are small, weighing from ounces to a few pounds. Units are repaired by a single mechanic rather than by line flow process. The one exception of this method is rotor repair, which are repaired in groups rather than one at a time. The repair is still accomplished by a mechanic, not a line, but an operation is completed on multi assemblies before moving to the next operation.

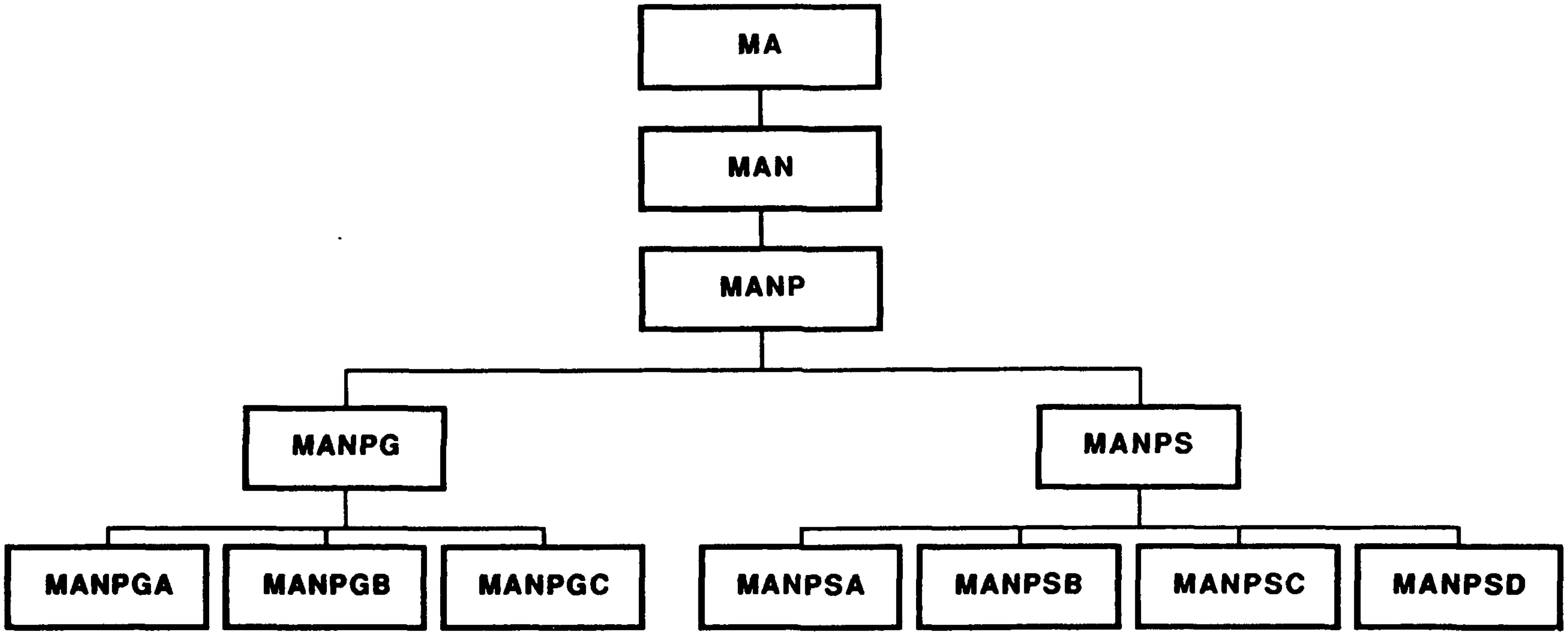
2.7 Storage

Storage is on line in MANPGB. It is accomplished on shelved hand trucks between aisles on the repair floor. The items for repair are received, logged in, and placed on the storage trucks for pretest. After pretest, the items are returned to the truck to wait the availability of a mechanic. The item is repaired and calibrated then returned to the truck or another truck for test and ship.



WR-ALC MANPGB PROCESS FLOWCHART
FIGURE

LSC-20237



LEGEND:

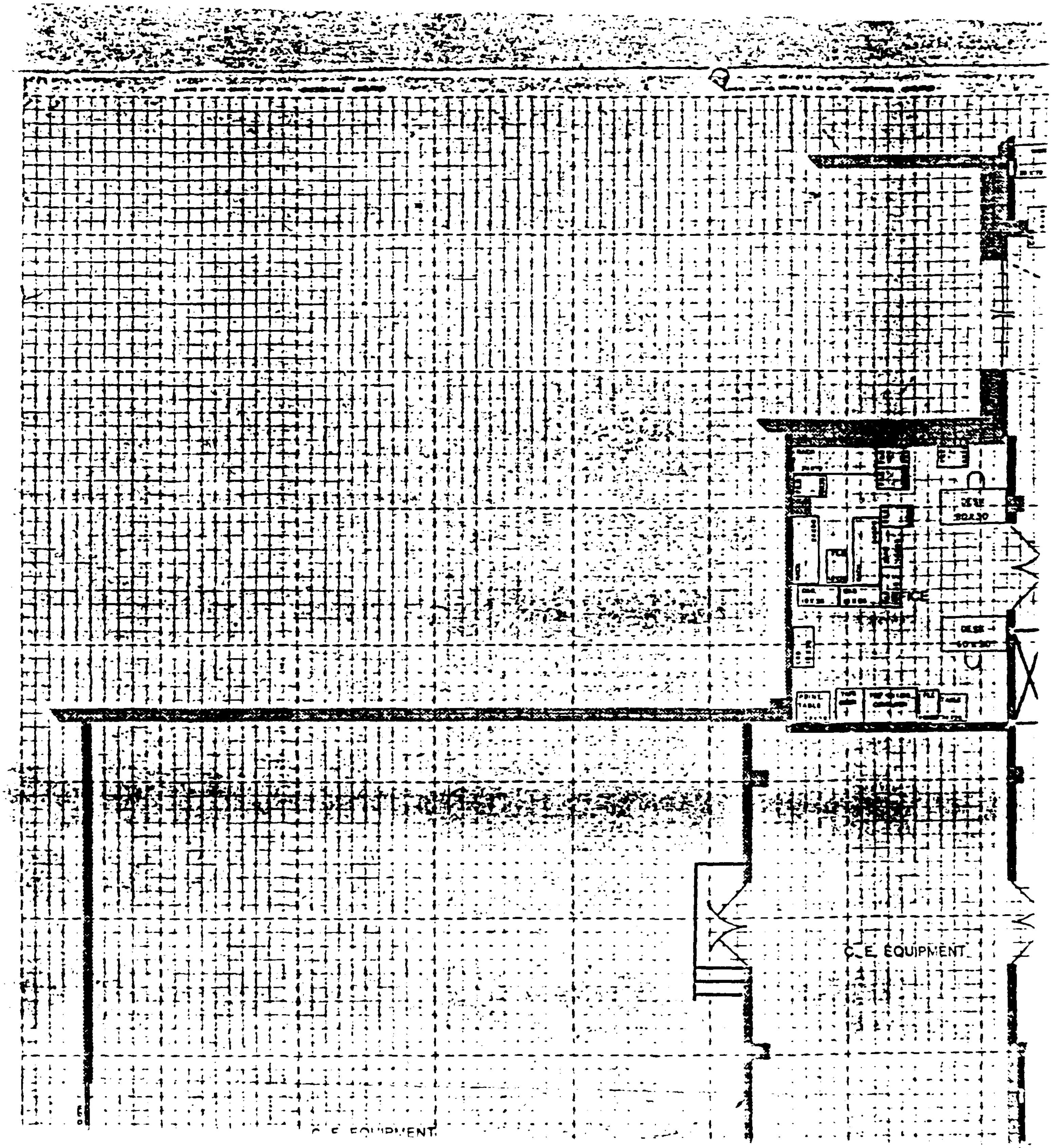
MA = DIR. OF MAINT.
MAN = INDUSTRIAL PRODUCTS DIVISION
MANP = PRODUCTION BRANCH
MANPG = GYRO SECTION
MANPGA = GYRO REPAIR UNIT NO. 1
MANPGB = GYRO REPAIR UNIT NO. 2
MANPGC = GYRO REPAIR UNIT NO. 3

MANPS = SHEET METAL SECTION
MANPSA = ADHESIVE BONDING UNIT
MANPSB = SHEET METAL MANUFACTURING UNIT
MANPSC = SHEET METAL REPAIR UNIT
MANPSD = PLASTIC & MISC. SHEET METAL UNIT

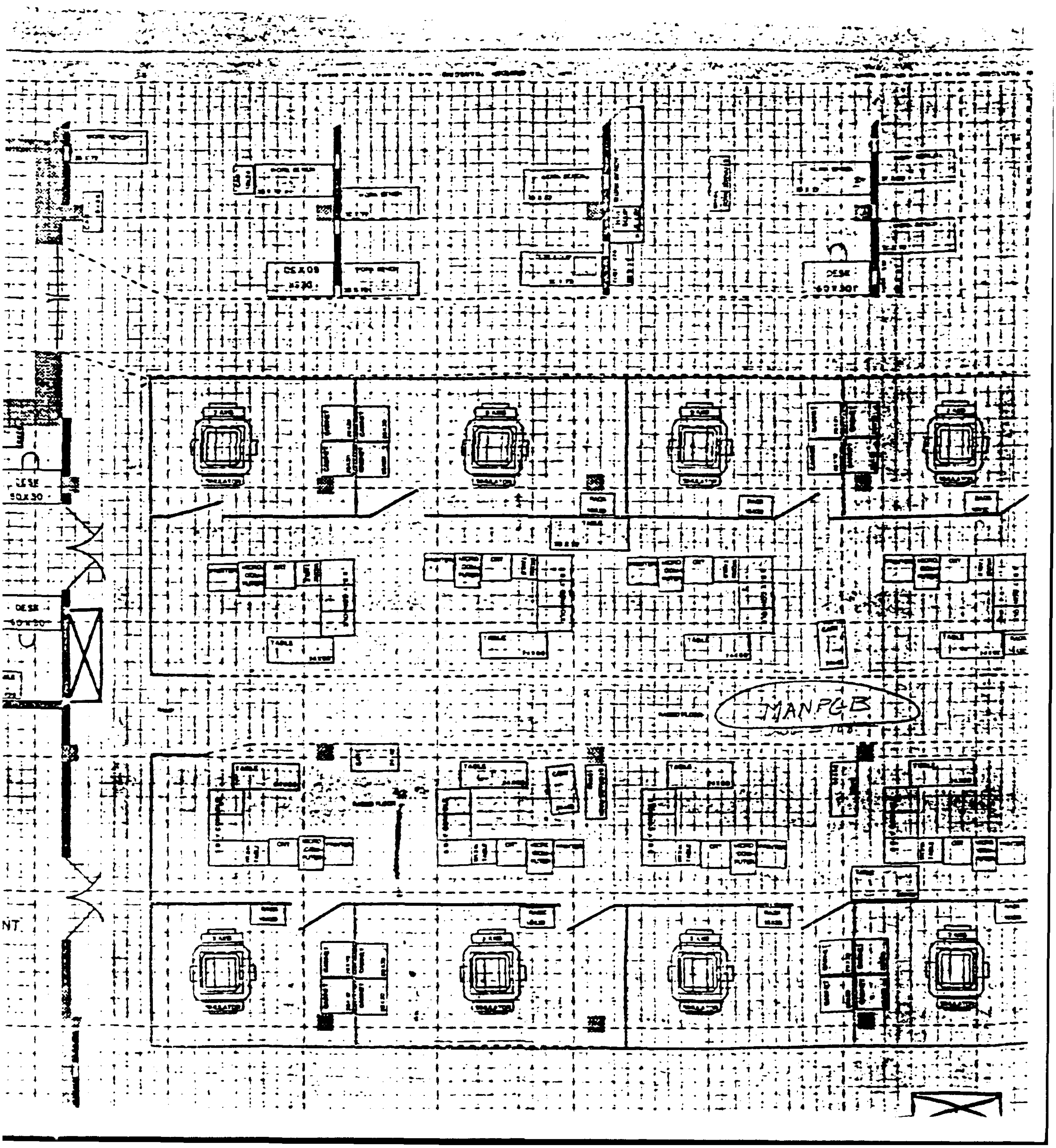
LSC-20282

WR-ALC RCC PROCESS CHARACTERIZATION COVERAGE
FIGURE 9.0-1

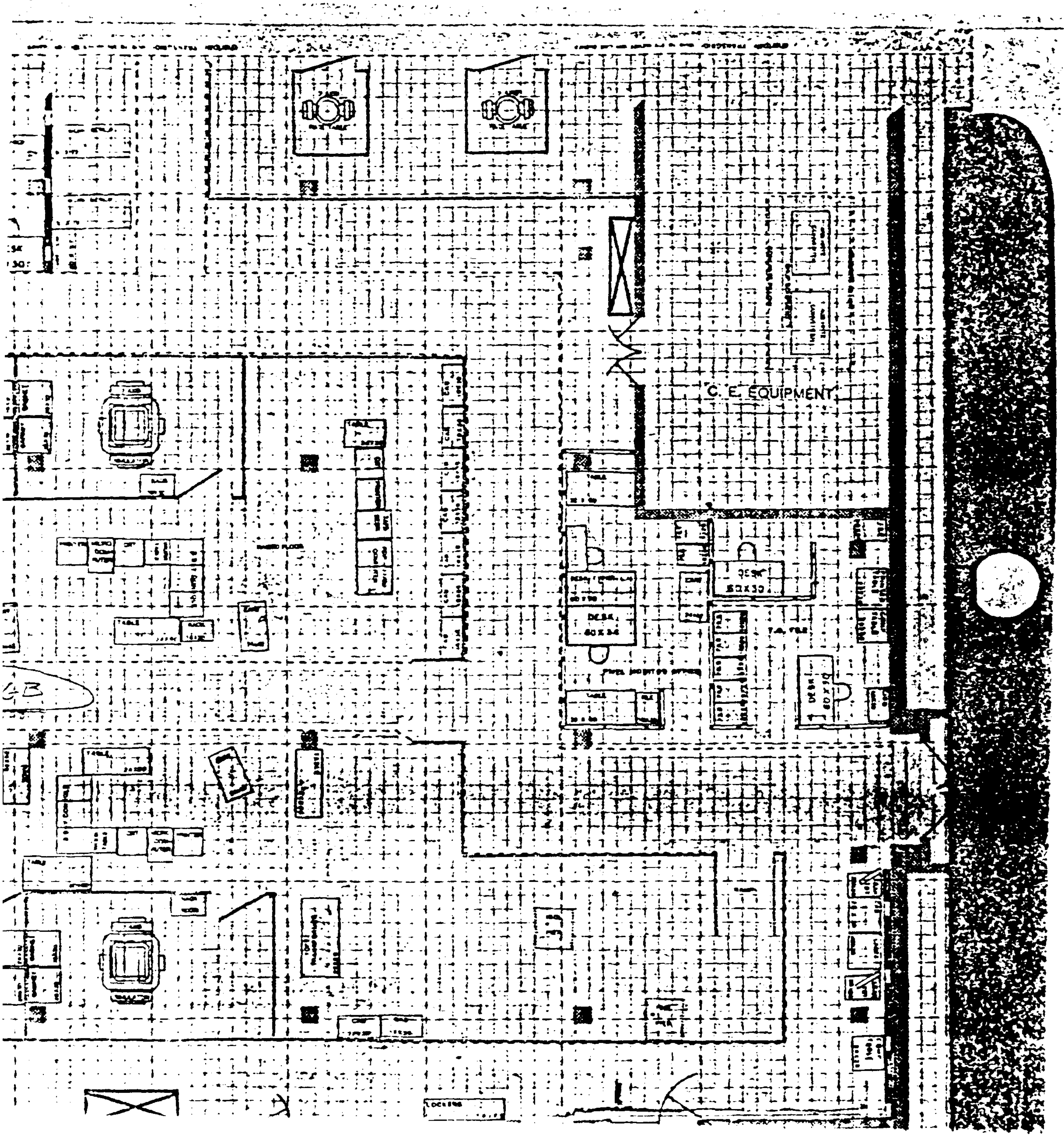
A

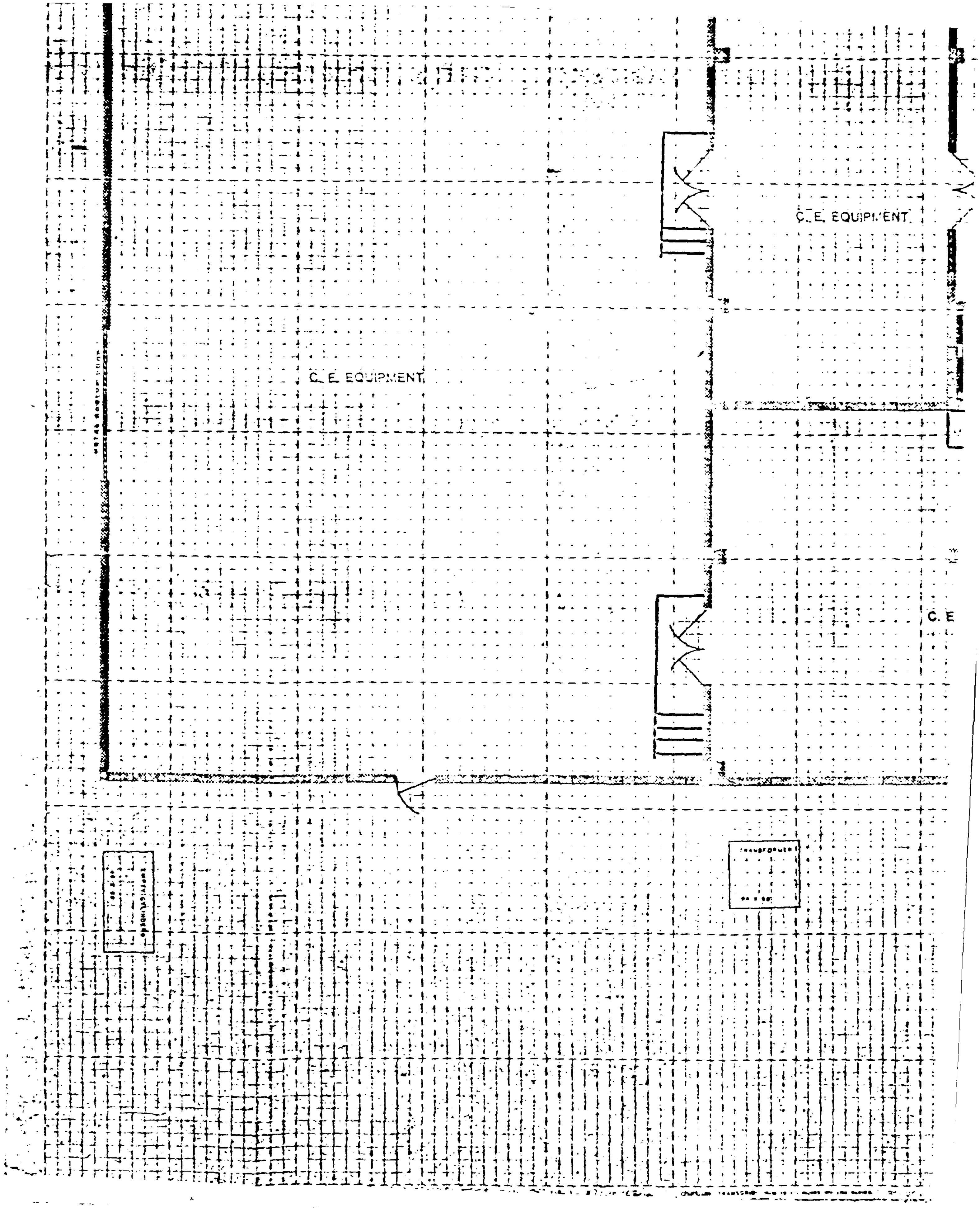


B

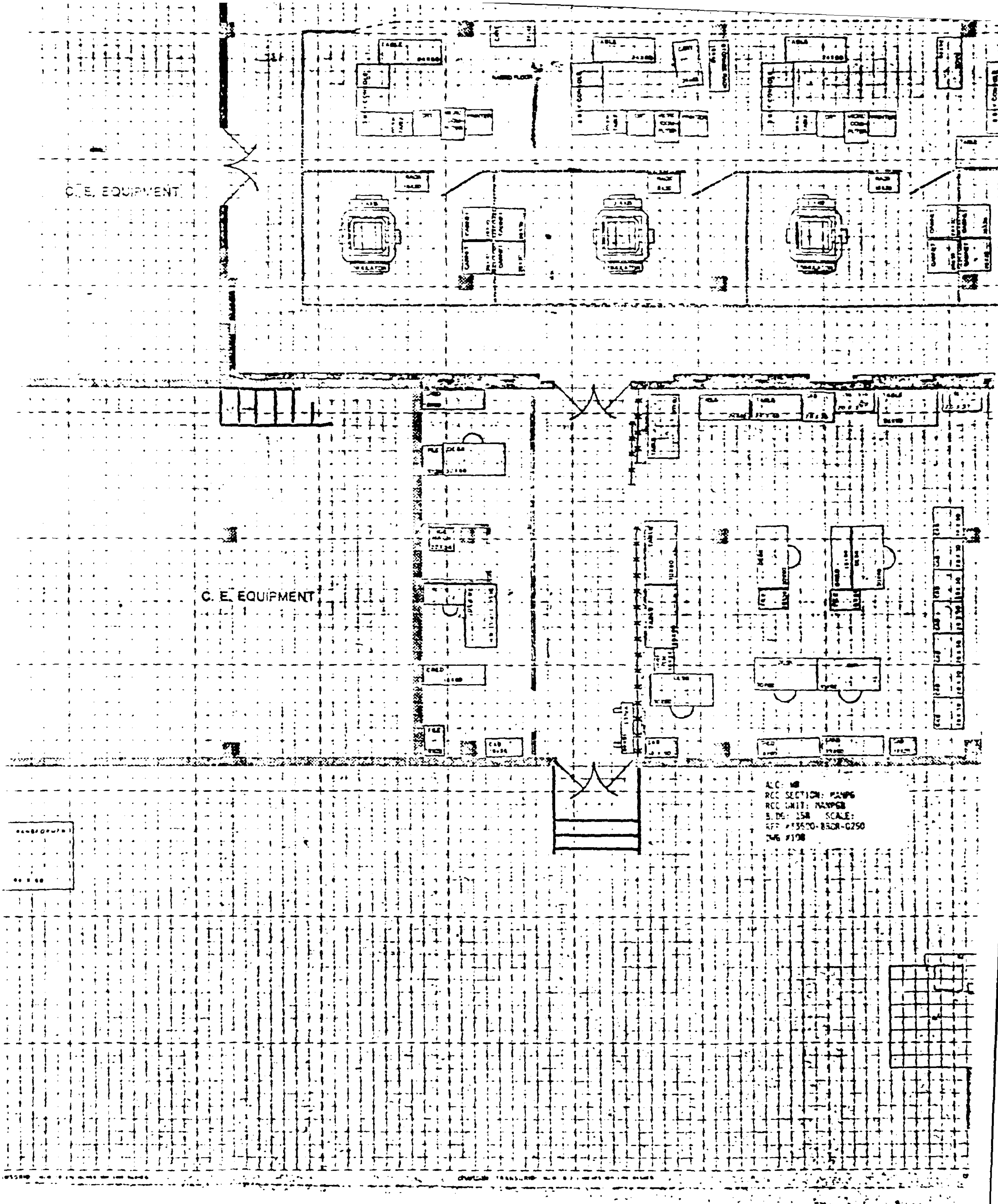


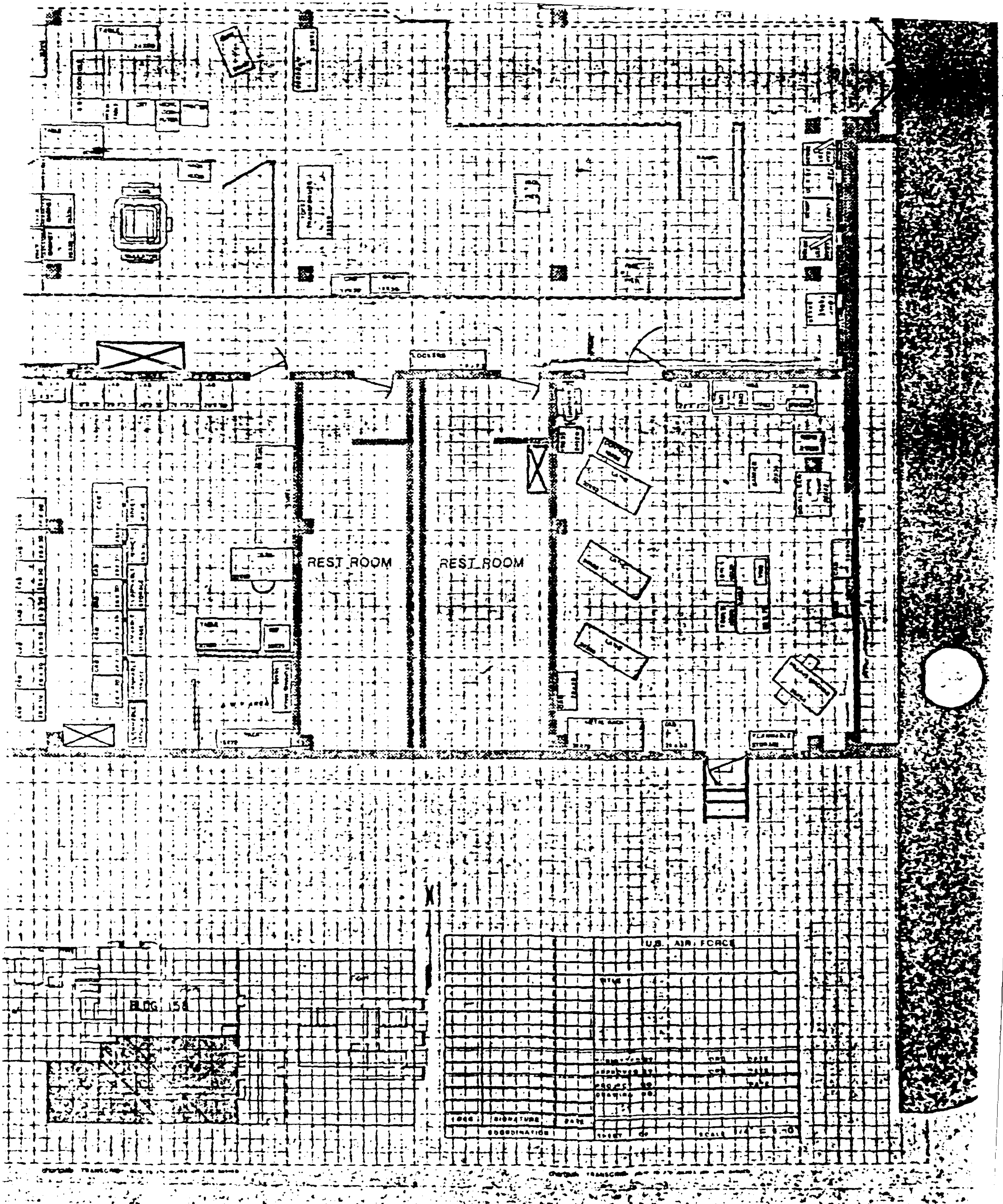
C





C. E. EQUIPMENT
C. E. EQUIPMENT
C. E
TRANSFORMER


C. E. EQUIPMENT
C. E. EQUIPMENT
RAISED FLOOR
ALC:
RCC SECTION:
RCC UNIT:
SCALE:


REST ROOM
REST ROOM
U.S. AIR FORCE

** ALC - WR RCC - MANPGB MODEL WORKLOAD FILE 6/30/1989

74051A	7187	0	4	975	966	921	927		12.28		16.20	0A
VAR.	396.2	322.2		567		5.5771		1.0264	750		.746	B
20012A	8120	0	4	333	322	330	314		8.45		10.80	0A
VAR.	87.0	70.9		8		4.1464		0.7920	750		.171	B
74051ASUB1	7215	50	4	0	0	0	0	0.85	.00		1.80	0A
	48.0	24.0		2		3.7280		0.5490	750	S	.083	B

MANPG WORKLOAD

INDEX.

RDO 4/6/89

METHODOLOGY FOR MANPG WORKLOAD

ANALYSIS of 80/20

a. GYRO WORKLOAD HAS BEEN DETERMINED TO BE 98% MISTR GENERATED. THEREFORE ONLY MISTR WORK WAS CONSIDERED

b. ALL LIKE GYRO HOURS WERE GATHERED UNDER A CONTROL GYRO PCN TO ESTABLISH FAMILIES of GYROS FOR CHARACTERIZATION

c. TOTAL HOURS FOR EACH FAMILY of GYROS WAS OBTAINED FROM THE 31, OCT, 88 ISSUE of THE A-G019C-CAA-CA-MCE REPORT, PAGE 2145 THRU 2212

d. THE PCN HOURS WERE SEPERATED BY RCC & COMPARED TO THE TOTAL HOURS FOR THE RCC TO VERIFY THE 80% WORKLOAD.

THE METHODOLOGY YIELDED THE RESULTS THAT THE PCNs PICKED FOR CHARACTERIZATIO[N] REPRESENTED 84.5% OF MANPGA WORKLOAD, 78.5% OF MANPGB & 82.9% of MANPGC. A COMBINED CHARACTERIZATION OF 82.3% OF THE MANPG WORKLOAD

NG3

FY88

INDUSTRIAL PRODUCTS DIVISION
WORK LOAD HISTORY DPSH
MNPG

WORK CAT	BOY NET AVAIL	FALLOUT	ADJ BOY NET AVAIL	YTD IND	TOTAL WKLD	YTD PROD	EOY NET AVAIL
A/C	0	0	0	0	0	0	0
MISTR	24765	264	24501	266,656	291,157	256,856	34,301
EXCH	1666	111	1555	6,465	8,020	4,043	3,977
MFG	0	0	0	0	0	0	0
OTHER	8	0	8	635	643	639	4
DME	0	0	0	0	0	0	0
TOTAL	26439	375	26064	273,756	299,820	261,538	38,282

FY89

INDUSTRIAL PRODUCTS DIVISION
ANNUAL WORKLOAD VS CAPABILITY DPSH
MNPG

WORK CAT	BOY MOS AVAIL	BOY NET AVAIL	NEG INPUT	TOTAL WKLD	BUDG CAP	EOY NET AVAIL	EOY MOS AVAIL
A/C	0	0	0	0	0	0	0
MISTR	2	34,301	281,292	315,593	210,147	105,446	6
EXCH	16	3,977	3,763	7,740	3,000	4,740	19
MFG	0	0	0	0	0	0	0
OTHER	0	0	0	0	0	0	0
DME	0	0	0	0	0	0	0
TOTAL	2.2	38,282	285,055	323,337	213,147	110,190	6.2

DATASET: I7S150ED.ALC.WRMANPGB.WORKLD

DATE: 89/03/29
TIME: 07:22
PAGE: 1

```
START
 COL   ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

  1    PART                WCD     INV-  T Q1- Q2- Q3- Q4-
  1    74051A              7187     .    4  975 966 921 927
  1    20012A              6120     .    4  333 322 330 314
  1    74051ASUB1          7215     0    4
```

MANPG WORKLOAD [STUDIED vs FORECAST] 3.0

RCC	C/N FAMILY	STUDIED HOURS	RCC HOURS	% OF RCC
MANPGA	C/N 74010A			
	C/N 74074A			
	C/N 74103A			
	C/N 74126A			
RCC TOTAL		118,380	140,020	84.5%
MANPGB	C/N 20012A			
	C/N 74051A			
RCC TOTAL		59,449	76,728	78.5%
MANPGC	C/N 06121A			
	C/N 74061A			
	C/N 74063A			
	C/N 74146A			
	C/N 74148A			
	C/N 74149A			
RCC TOTAL		82,723	99,827	82.9%
MANPG TOTAL		260,552	316,575	82.3%

RDS 11/27/95

C/Ns INCLUDED IN MANPG STUDY

RCC CONTROL C/N		INCLUDED C/Ns
MANPGA		
C/N 74074A		02006A 02007A 74076A 74073A 74075A
C/N 74010A		74002A
C/N 74029A		74034A 74103A
C/N 74126A		
MANPGB		
C/N 20012A	Comp	04791A 20019A 26651A 26700A 30832A 30833A 30834A
C/N 74051A	Comp	01720A 02634A 03614A 03620A 03621A 03641A 03611A 03649A 74017A 74035A 74043A 74044A 74048A 74049A
MANPGC		
C/N 06121A	Comp	01970A 03696A 08023A
C/N 74061A	Comp	02387A 02382A 74065A
C/N 74063A	Comp	74000A 74053A 74058A 74059A 74067A
C/N 74146A	Comp	74282A
C/N 74148A	Comp	
C/N 74149A	Comp	

R.J.V. 10/28

MANPOWER PROFILE

NAME: R Vanderwood ALC: WR DATE: 4/10/89 RCC: MANPGB SHEET 1 OF 1

SK CODE	DESCRIPTN	QTR	QUANTITY AVAILABLE WORK WEEK 1	WORK WEEK 2	WORK WEEK 3	WEEK END 1	WEEK END 2	WEEK END 3	HOLIDAY 1	HOLIDAY 2	HOLIDAY 3	AVAILABLE HRS (PER SHIFT) WORK WEEK 1	WORK WEEK 2	WORK WEEK 3	WEEK END 1	WEEK END 2	WEEK END 3	HOLIDAY 1	HOLIDAY 2	HOLIDAY 3	ALTERNATE SKILL CD/LVL	NOTES
IG07		1	8	.	.	.	.	.	.	.	.	5.3	.	.	.	.	.	.	.	.		
IG07		4	8	.	.	.	.	.	.	.	.	4.5	.	.	.	.	.	.	.	.		
IG09		1	36	.	.	.	.	.	.	.	.	5.3	.	.	.	.	.	.	.	.		
IG09		4	36	.	.	.	.	.	.	.	.	4.5	.	.	.	.	.	.	.	.		
IG10		1	12	3	.	.	.	.	.	.	.	5.3	5.3	.	.	.	.	.	.	.		
IG10		4	10	3	.	.	.	.	.	.	.	4.5	4.5	.	.	.	.	.	.	.		

SAS
ASSEMBLY/DISASSEMBLY PROFILE

NAME ________ ALC WR DATE ________ RCC MANPGB SHEET ___ OF ___

ITEM CODE	WCD	WCD DT	DSOP	ASOP	REMOV ITEM CODE	WCD	WCD DT	INSTALL SAME	NOTES
PCN 74051A		7187	50	60	PCN 74051ASUB1	N/A	7215	N	

EQUIPMENT PROFILE

NAME R Vander Voord ALC WR DATE 4-14-89 RCC MANPGB SHEET 1 OF 3

EQUIPMENT CODE	EQUIPMENT TYPE/DESCRIPTION	QUANTITY PER SHIFT 1st	2nd	3rd	DOWNTIME: PREVENTIVE MAINT. FREQ.	SHIFT	DOWN TIME	UNSCHEDULED BREAKDOWN REPAIR TIME MTBF	MTTR	PERCENT USED FOR OTHER RCCs (e.g. TIME NOT AVAILABLE)	ENVELOP UNITS MIN	MAX	ALTERNATE EQUIPMENT CODE	SOURCE
6849	CONSOLE 705084	4	4	4	180	1st	10.5	180	83		2	4		Mary Ann Purser Panel Recorder
3957	ROCKTABLE LT3957	3	3	3	NCR	1st	∅	∅	∅		1	1		PN#6-4123 Willard Winne
2440	[illegible] 13703-1B	7	7	7	90	1st	5.1	90	78		1	1		T.E. Supervisor PN#6-5413 Danny Pate
3860	INDICATOR J2298ARN/14	14	14	14	180	1st	4.8	180	77		1	1		ATE Supervisor PN#6-9098
2314	FILLSTAND & BAKE	1	1	1	NCR	1st	∅	200	110		1	1 25	ck	Various operators Personal observation
3346	LEAKDETEC MASS SPEC	10	10	10	90	1st	16.6	90	102		1	1		Gov't Reports WG 004 I 098
5139	SCHENBAL MACHINE	3	3	3	999	1st	10.5	999	83		1	1		Rcs-Lvl-MA(M)7118 G0041 AMC05P
8556	CONSOLE 705007	4	4	4	180	1st	10.5	180	83		1	4		
0450	CONSOLE 705830	2	2	2	180	1st	13.5	180	86		1	2		
6219	RUNIN SET LT3740	2	2	2	180	1st	4.9	180	77		1	10		
5610	TEST SET B-96072	1	1	1	120	1st	18.1	120	86		1	1		
5690	INSULTEST 13700-1A	1	1	1	270	1st	1.1	270	74		1	1		

EQUIPMENT PROFILE

NAME R VANDER VOORD ALC ·/R DATE 4-14-89 RCC MANRGB SHEET 2 OF 3

EQUIPMENT CODE	EQUIPMENT TYPE/DESCRIPTION	QUANTITY PER SHIFT 1st	2nd	3rd	DOWNTIME PREVENTIVE MAINT. FREQ.	SHIFT	DOWN TIME	UNSCHEDULED BREAKDOWN REPAIR TIME MTBF	MTTR	PERCENT USED FOR OTHER RCCs (e.g. TIME NOT AVAILABLE)	ENVELOP UNITS MIN	MAX	ALTERNATE EQUIPMENT CODE	SOURCE
4850	CIRCANALZ R00BR	1	1	1	999	1st	4.4	999	87		1	1		
0009	STRLPTANK	1	1	1	NCR			300	72		1	10		
0002	VAC OVEN	3	3	3	NCR			300	72		1	4		
0004	PT BOOTH	1	1	1	NCR			300	120		1	1		
0005	INDUCT HR TALYOR WINFIELD	1	1	1	NCR						1	1		
0001	CIRL OVEN	3	3	3	NCR			300	72		1	4		
5724	TST PRESSZ LOCMFG	2	2	2	999	1st	4.9	999	77		1	1		
1665	BOMRELSTS LJ4742-01-01	2	2	2	180	1st	7.0	180	80		1	1		
1708	ELTDIR TS LT4740-01-01	2	2	2	180	1st	4.9	180	77		1	1		
04/21	TESTSYNCH H38037	1	1	1	999	1st	4.9	999	77		1	1		
9950	INSUL TS KT426598	1	1	1	999	1st	5.0	999	78		1	1		
7362	INDICATTS KT419829	1	1	1	180	1st	4.9	180	77		1	1		

LSC-20094B

EQUIPMENT PROFILE

NAME R VANDERVOORD ALC WR DATE 4-14-89 RCC MANPGB SHEET 3 OF 3

EQUIPMENT CODE	EQUIPMENT TYPE/DESCRIPTION	QUANTITY PER SHIFT 1st	2nd	3rd	DOWNTIME: PREVENTIVE MAINT. FREQ.	SHIFT	DOWN TIME	UNSCHEDULED BREAKDOWN REPAIR TIME MTBF	MTTR	PERCENT USED FOR OTHER RCCs (e.g. TIME NOT AVAILABLE)	ENVELOP UNITS MIN	MAX	ALTERNATE EQUIPMENT CODE	SOURCE
2047	SCORESBY 2366266	2	2	2	Nce	1st	7.3	999	80		1	1		
2090	DISPL TS LT3470A	2	2	2	90	1st	3.0	90	75		1	1		
6900	SCORESBY TS 1460R	3	3	3	Nce	1st	Ø	J	Ø		1	1		
3114	TESTPANEL 250ARN	1	1	1	Nce	1st	4.9	999	77		1	1		
9856	LNSLLTEST 60B4-1A	1	1	1	180	1st	Ø	180	72		1	1		
3434	TESTSCOMP T3 2569ANB	2	2	2	180	1st	4.9	180	77		1	1		
9548	CONSOLE 704907-1	~~6~~ 9	~~6~~ 9	~~6~~ 9	180	1st	5.1	180	78		~~1~~ 1	1.4	?	
8793	CONSOLE 704831-1	4	4	4	180	1st	13.5	180	86		1	4		

LSC-20094B

WORK CONTROL DOCUMENT

1. DATE	PAGE	OF	PAGES
6120	1	1	

JOB ORDER NUMBER	3. QUANTITY	4. PRODUCTION SECTION/RCC	5. DATE SCHED	6. DATE COMP
See Block 12	1	MNPGB		

7. PART NUMBER	8. TECH DATA	9. ITEM SERIAL NUMBER
See Block 12	See Block 12	

10. MODEL-DESIGN-SERIES	11. STOCK NUMBER	12. OPTIONAL
See Block 12	See Block 12	SEE BELOW
13. SERIAL NUMBER	14. NOUN	

15. DISPATCH STATION	16. PON/OP NO.	17. WORK TO BE ACCOMPLISHED			18. MECHANIC	19. "P"	20. "Q"
TO		NSN	PIN	TYPE	AF	NAVY	
12 R5-2A	RN-203 & 204	5826-00-557-5818	140700	ID-351B	20012A	30832A	
12 R5-2A	RN-203 & 204	5826-00-505-3140	140314	ID-341A	20019A	04791A	
12 R5-2A	RN-203 & 204	5826-00-505-3141	140313	ID-351	26700A		
12 R5-2A	RN-203 & 204	5826-00-505-2219	140192	ID-249B	26747A		
12 R5-2A	RN-313 & 314	5826-00-833-8110	PAJ1000	ID-351B	26753A	30830A	
12 R5-2A	RN-193 & 194	5826-00-505-2221	7202-1A-1-A2	ID-249A	26749A		
12 R5-2A	RN-193 & 194	5826-00-505-3092	7204-1A-4-A1	ID-387	26751A		
12 R5-2A	RN-193 & 194	5826-00-505-3096	7204-1A-4-D1	ID-387	26651A	08722A	
12 R5-2A	RN-193 & 194	5826-00-505-2947	7204-1A-1-A2	ID-387	07274A	30834A	
	12	Circle appropriate control number					
	01	Receive (Check S/N on WCD & AFTO Form 349. Clean indicator external surfaces.)			M		
	02	Functional analysis			B		
	03	Deseal			M		
	04	Internal cleaning & visual.			M		
	05	Failure analysis & repair (on P/N 7204-1A-4D1 items assure resistance between P/Ns J & K is 150+ 50 ohms.)			B		
	06	Functional test and calibration prior to sealing/			B		

ABG/DAP (JUN.86) (DLM)

APPROV

FINAL DESTINATION		22. COORDINATION/INITIATING RCC SIGNATURE-DATE		23. DOCUMENT S/N
DISPATCH	FUNCTIONAL CODE	a. MANEG [signature]	c. MAQNG [signature] 29 APR 86	
		b. MANPGB [signature]	d. MANSAA [signature]	

AFLC FORM MAR 81 959 PREVIOUS EDITION WILL BE USED. WR-ALC/MANSAA "OVERPRINT"

WORK CONTROL DOCUMENT (CONT'D)

WORK CONTROL DOCUMENT (CONT'D)			1. DATE	PAGE OF PAGES	
15. DISPATCH STATION	16. POH/OP NO.	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19.	20.
	07	Visually inspect & Certify that this item does not contain any foreign objects such as tools or unattached components.	B		
	08	Seal, purge and fill	M		
	09	Final functional test. Connect to J 229 box for alignment.	B		
	10	Final visual, tag and check decal application IAW WR-ALC/MAOI 66.40. Complete AFTO Form 349 ..Check for foreign objects inside.	B		

A.D.

WORK CONTROL DOCUMENT

1. DATE: 7187	PAGE 1 OF 2 PAGES			
2. JOB ORDER NUMBER: See Block 12	3. QUANTITY: 1	4. PRODUCTION SECTION/RCC: MNPGB	5. DATE SCHED: 9081	6. DATE COMP: 9109
PART NUMBER: See Block 12	8. TECH DATA: See Block 12 92A	9. ITEM SERIAL NUMBER: 59-532		
10. MODEL-DESIGN-SERIES:	11. STOCK NUMBER: See Block 12	12. OPTIONAL: See Below. Circle appropriate control number.		
13. SERIAL NUMBER:	14. NOUN:			

15. DISPATCH STATION	16. PDN/OP NO.	17. WORK TO BE ACCOMPLISHED			18. MECHANIC	19.	20. "Q"
TO		NSN	P/N	TYPE	AF	NAVY	
12R5-2ARN-193		5826-00-505-2221	7202-1A-1-A2	ID-249A	26749A		
12R5-2ARN-193		5826-00-505-3092	7204-1A-4-A1	ID-387	26751A		
12R5-2ARN-193		5826-00-505-3096	7204-1A-4-D1	ID-387	26651A	08722A	
12R5-2ARN-193		5826-00-505-2947	7204-1A-1-A2	ID-387	07274A	30834A	
12R5-2ARN-203		5826-00-373-1926NA	ID-351	ID-351		30833A	
12R5-2ARN-203		5826-00-557-5818	1400700	ID-351B	20012A ✓	30832A	
12R5-2ARN-203		5826-00-505-3140	140314	ID-351A	20019A	04791A	
12R5-2ARN-203		5826-00-505-3141	140313	ID-351	26700A		
12R5-2ARN-203		5826-00-505-2219	140192	ID-249B	26747A		
12R5-2ARN-313		5826-00-833-8110	PAG1000	ID-351B	26753A	30830A	
12R5-2ARN-193		5826-00-505-2218FZ	7202-1A-4-B1	ID-249A		30831A	
	010	Receive (Check S/N on WCD & AFTO Form 349. Clean Indicator external surfaces.) APR 19 87			WR PA 6124		
	020	Functional analysis APR 19 87			WR PA 6124		
	030	Deseal APR 19 87			WR PA 6124		
	040	Internal cleaning and visual. APR 19 87			WR PA 6124		
	050	Failure analysis & repair (on P/N 7204-1A-4-D1 items; Assure resistance between Pins J & K is 150 ± 50 ohms.) APR 19 87			WR PA 6124		
	060	Functional test and calibration prior to sealing. APR 19 87			WR PA 6124		

21. FINAL DESTINATION		22. COORDINATION/INITIATING RCC SIGNATURE/DATE		23. DOCUMENT S/N
DISPATCH	FUNCTIONAL CODE	a. MANERG [signature] 8 Jul 87	c. MAQNG Alice Perry 8Jul87	
		b. MANPGE [signature] 7/6/87	d. MANSAA [signature] 7/6/87	

AFLC FORM MAR 81 959 PREVIOUS EDITION WILL BE USED. WR-ALC/MANSAA "OVERPRINT"

WORK CONTROL DOCUMENT (CONT'D)

1. DATE 7187

15. DISPATCH STATION	16. PON/OP NO.	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19.	20.
	070	Visually inspect and certify that this item does not contain any foreign objects such as tools or unattached components. APR 19 89	WR PA 6124		B
	080	Seal, purge and fill. APR 19 89	WR PA 6124		
	090	Final functional test. Connect to J229 box for alignment. Attach completed serviceable tag. APR 19 89	WR PA 6124		B
	100	Final visual, check decal application, complete AFTO Form 349. Check for foreign objects inside. APR 19 89	WR PA 6124		B

WR-ALC/MANSAA "OVERPRINT"

OPERATION PROFILE

NAME R. VANDERVOORD ALC WR DATE 4-6-89 RCC MANPG SHEET 1 OF 1

PCN/NSN/PIN R001ZA WCD N/A WCD DATE 61R0

OPERATION NUMBER	RCC	OPERATION DESCRIPTION	MANDATORY OCCURRENCE FACTOR	OPERATION TYPE	MANDATORY FLOW HOURS %	MANDATORY FLOW HOURS HRS.	MANPOWER SKILL CODE/LEVEL	MANPOWER QTY.	MANPOWER TIME REQUIRED %	MANPOWER TIME REQUIRED HRS.	EQUIPMENT CODE	EQUIPMENT QTY.	EQUIPMENT TIME REQUIRED %	EQUIPMENT TIME REQUIRED HRS.	DATA SOURCE COMMENTS
IN	MANPG	REC	1	TRANSIT											C. DRIVER PLANNER MAC MILLER OPER. & A SCHEDULER
				SETUP											
				PROCESS		1	IG09	1		0.1	STD				
		↑		TRANSIT											
				SETUP											
				PROCESS											
ALL WCD OPERATIONS LISTED IN CN OPER PROFILE				TRANSIT											
				SETUP											
				PROCESS											
		↓		TRANSIT											
				SETUP											
				PROCESS											
9999	MANPG	SELL	1	TRANSIT											D. HARRELSON SUPERV. MANPG MAC MILLER OPERATOR & A SCHEDULER
				SETUP											
				PROCESS		.1	IG09	1		0.1	STD				

OPERATION PROFILE SAS

NAME [signature] ALC WR DATE 4/20/89 RCC MANPGB SHEET 1 OF 3

ITEM CD PCN 20012A WCD WCDDATE 6120

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
01	MANPGB	REC	0.99	.	T	.		.	.	.		.	.	.	
01	MANPGB	REC	.	.	S	.		.	.	.		.	.	.	
01	MANPGB	REC	.	1.00	P	0.1	IG09	1	.	0.1		.	.	.	
02	MANPGB	REC	1.00	.	T	.		.	.	.		.	.	.	
02	MANPGB	REC	.	.	S	~~0.1~~ 0.6		.	.	.		.	.	.	
02	MANPGB	REC	.	1.00	P	[illegible]	IG09	1	.	~~0.1~~ 0.6		.	.	.	
02	MANPGB	NDI	.	1.00	P	[illegible]	~~IG09~~	1	.	~~0.5~~	2440	1	.	0.5	
03	MANPGB	DIS	0.99	.	T	.		.	.	.		.	.	.	
03	MANPGB	DIS	.	.	S	.		.	.	.		.	.	.	
03	MANPGB	DIS	.	1.00	P	0.2	IG07	1	.	0.2	0005	1	.	0.2	
04	MANPGB	DIS	0.99	.	T	.		.	.	.		.	.	.	
04	MANPGB	DIS	.	.	S	.		.	.	.		.	.	.	
04	MANPGB	DIS	.	1.00	P	1.0	IG09	1	.	1.0		.	.	.	

OPERATION PROFILE

NAME [signature] ALC WR DATE [handwritten date] RCC MANPGB SHEET 2 OF 3

ITEM CD PCN 20012A WCD WCDDATE 6120

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
05	MANPGB	REP	0.99	.	T	.		.	.	.		.	.	.	
05	MANPGB	REP	.	.	S	.		.	.	.		.	.	.	
05	MANPGB	REP	.	1.00	P	6.0	IG09	1	.	~~4.0~~ 3.5		.	.	.	
06	MANPGB	REP	0.99	.	T	.		.	.	.		.	.	.	
06	MANPGB	REP	.	.	S	.		.	.	.		.	.	.	
06	MANPGB	REP	.	1.00	P	3.0	IG09	1	.	~~3.0~~ 2.0	2440	1	.	3.0	
07	MANPGB	NDI	1.00	.	T	.		.	.	.		.	.	.	
07	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
07	MANPGB	NDI	.	1.00	P	0.5	IG09	1	.	0.5		.	.	.	
08	MANPGB	ASSY	1.00	.	T	.		.	.	.		.	.	.	
08	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
08	MANPGB	ASSY	.	1.00	P	4.0	IG07	1	.	0.3	2314	1	.	2.8	

OPERATION PROFILE

NAME [signature] ALC WR DATE 4/20/89 RCC MANPGB SHEET 3 OF 3

ITEM CD PCN 20012A WCD WCDDATE 6120

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
09	MANPGB	NDI	0.99	.	T	.		.	.	.		.	.	.	
09	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
09	MANPGB	NDI	.	1.00	P	2.0	IG09	1	.	2.0	2440	1	.	2.0	
10	MANPGB	ASSY	0.98	.	T	.		.	.	.		.	.	.	
10	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
10	MANPGB	ASSY	.	1.00	P	1.0	IG09	1	.	1.0		.	.	.	

PART OPERATION SUMMARY

ALC: WARNER ROBBINS   RCC: MANPGB   GYRO SHOP, UNIT 2

PN: 1470700   NSN: PCN: 20012A   WCD: WCD DATE: 6120

OPERATION: ZPRT   PRIMARY   OPERATION TYPE: ASSY   MATERIAL TYPE:
SAMPLE SIZE: 417   MISSING FLOWTIMES: 0   END ITEMS: .   OUTLIERS DELETED: 1

MANPOWER REQUIRED				EQUIPMENT REQUIRED					
SKILL	QTY	TIME FRACTION	TIME HOURS	CODE	CATEGORY	QTY	TIME FRACTION	TIME HOURS	BATCH MIN MAX

HISTORICAL DATA

	ACTUAL FREQ	RELATIVE FREQUENCY 0 10 20 30 40 50 60 70 80 90 100
0	4	**
1	19	*******
2	20	********
3	11	*****
4	11	****
5	9	****
6	8	***
7	6	**
8	2	*
9	2	*
>=10	9	****

DISTRIBUTION	PARAMETERS	D VALUE	D ALPHA
UNIFORM	0.0 173.0	0.882	.
TRIANGULAR	0.0 2.0173.0	0.821	.
NORMAL	5.5 13.0	0.308	.
LOGNORMAL	5.5 13.0	0.019	1.00
EXPONENTIAL	6.0	0.134	.

OCCURRANCE FACTOR: .   OCCURRANCES: 418

DISTRIBUTION OF CHOICE: LOGNORMAL

SHOP FLOW DAY COMPUTATION FOR PRODUCTION NO: 20012A

AFLCR 66-4 Shop Flow Day Formula was used to establish this flow day standard as follows: Flow Days = A [(B ÷ C) + D + E] where A = 1.45; B = End Item Labor Standard; C = Direct Labor Hours Per Person Per Day adjusted for indirect categories and labor efficiency; D = Routine Delays; E = Unique Delays; Repair is being accomplished as a responsible shop.

DESCRIPTION	DAYS
B = Labor Standard of 8.45 Hrs C = 7.58 Daily Labor Hrs Value "C" is calculated as follows: MANPG 6 .24 +.25 + .26 + .29 Indirect Average = .1 Hours MANPG 6 Labor Efficiency = 96 % C = 8 Hours Minus Indirect Average Times Labor Efficiency	B ÷ C 1.11
Routine Delays a. Awaiting Maintenance (AWM) = 3.8 days b. One days supply at station awaiting maintenance = 4 days (average 4 stations for each C/N). This is necessary to maintain uninterrupted flow of items. TOTAL	 7.80
E = Unique Delays a. Machine processing - Day(s) b. Machine processing delays - Day(s) c. Routing to support shops - Day(s) d. Others (See Reverse Side) 2 Day(s) TOTAL	14.4 Hrs 2 Hrs 4 2.00
Total flow days this shop (1 + 2 + 3)	10.91
Work Shift Adjustment (Item 4 ÷ number of shifts).	10.91
... of flow days for all shops (Item 5 x 1.45) (...nal result to be rounded up to next whole day.)	16.00

...IPUTED BY: [signature] DATE: 6 May 86

WORK CONTROL DOCUMENT

1. DATE	PAGE 1 OF 2 PAGES
7187	

2. ORDER NUMBER	3. QUANTITY	4. PRODUCTION SECTION/RCC	5. DATE SCHED	6. DATE COMP
See Block 17	1	MNPGB		

7. PART NUMBER	8. TECH DATA	9. ITEM SERIAL NUMBER
See Block 17	5F6-3-5-3; 5F6-3-5-3-1	

10. MODEL-DESIGN-SERIES	11. STOCK NUMBER	12. OPTIONAL
	See Block 17	

13. SERIAL NUMBER	14. NOUN
	Gyro, Displacement

15. DISPATCH STATION	16. PDN/OP NO.	17. WORK TO BE ACCOMPLISHED		18. MECHANIC	19.	20.
		NSN	P/N	AF	NAVY	ARMY
		6615-00-531-2265	124623-01		02636A	
		6615-00-852-1611	124623-01-09		02637A	
		6615-00-951-9140	124623-01-10		02639A	
		6615-00-994-8940	124623-01-12		02640A	
		6615-00-943-2218	121672-01-15	74051A	05807A	03621A
		6615-00-074-4036	121672-01-16	74017A	05812A	
		6615-00-900-5959	121672-01-17	74044A	05805A	03611A
	010 00100	Receive and perform functional analysis (Pretest). Ascertain data correctness on 959 and 349. If serviceable, stamp serviceable tag and proceed to steps 140-180.				B
	020 00200	Receive and perform functional analysis (Pretest). Ascertain data correctness on 959 and 349. If serviceable, stamp serviceable tag and proceed to steps 140-180.				B
	030	Clean and depaint gyro.				
	040	Deseal gyro.				
	050	Repair gyro. Enter serial number of inner axis gimbal assy, if replaced ______________				
	060	Set null and verticality.				
	070	Recheck end play and balance. Adjust as necessary.				
	080	Free drift test (calibration) and erection rate test.				

21. FINAL DESTINATION		22. COORDINATION INITIATING MIC SIGNATURE DATE		23. DOCUMENT S/N
DISPATCH	FUNCTIONAL CODE	a. MANGEG	MAONG	
		b. MANGEG	c. NSAA	

AFLC FORM 959 PREVIOUS EDITION WILL BE USED. WR-ALC/NSAA "OVERPRINT"

WORK CONTROL DOCUMENT (CONT'D)			1. DATE 7197		PAGE 2 OF 2 PAGES
DISPATCH STATION	15. PDN/OP NO.	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19.	20.
	090	Inside visual inspection. Certify this item does not contain foreign objects such as tools or loose components.			B
	100	Perform preseal test.			
	110	Seal, purge and fill.			
	120	Manually manipulate gyro and listen for loose objects.			B
	130	Leak test.			B
	140	Prepare for final test (includes painting).			
	150	Perform dielectric test.			
	160 00100	Perform functional analysis (final test). Stamp serviceable tag.			B
	170 00200	Perform functional analysis (final test). Stamp serviceable tag.			B
	180	Complete AFLC Form 959 and AFTO 349. Install decals and attach completed serviceable tag.			

WORK CONTROL DOCUMENT

1. DATE	PAGE
7215	1 OF 2 PAGES

2. JOB ORDER NUMBER	3. QUANTITY	4. PRODUCTION SECTION/RCC	5. DATE SCHED	6. DATE COMP
See Block 12		MNPGB		

7. PART NUMBER	8. TECH DATA	9. ITEM SERIAL NUMBER
114634-08 114634-10-01	5F6-3-5-3	

10. MODEL-DESIGN-SERIES	11. STOCK NUMBER	12. OPTIONAL
	NSL	AF: 74017A, 74044A, 74051A NAVY: 02636A, 02637A, 02639A, 02640A, 05805A, 05807A, 05812A ARMY: 03621A, 03611A

13. SERIAL NUMBER	14. NOUN
	Inner Axis Gimbal Assy

15. DISPATCH STATION	16. PCN/OP NO.	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19. "P"	20. "Q"
	050a	Determine condition. If serviceable, proceed to Block 050k			
	050b	Diassemble. Establish serial number on stator and rotor assembly			
	050c	Replace bearings			
	050d	Set preload			
	050e	Dynamic balance rotor			
	050f	Perform run-in test			
	050g	Clean housing assembly			
	050h	Visually inspect. Certify this item does not contain any foreign objects such as tools or unattached components.			
	050i	Reassemble housing and rotor.			
	050j	Perform initial static balance			

21. FINAL DESTINATION		22. COORDINATION/INITIATING RCC SIGNATURE/DATE		23. DOCUMENT S/N
DISPATCH	FUNCTIONAL CODE	a. 3 Aug 87 MANERG [signature]	c. 3 Aug 87 MAQNG A Perry	
		b. 3 Aug 87 MANPCB E [signature]	d. J. T. Powell 3 Aug 87 SANSAA	

AFLC FORM MAR 81 959 PREVIOUS EDITION WILL BE USED.

WORK CONTROL DOCUMENT (CONT'D)

1. DATE 7215

15. DISPATCH STATION	16. PON/OP NO.	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19. "P"	20. "Q"
	050k	Final visual and current test			

WORK CONTROL DOCUMENT

1. DATE 7288	PAGE 1 OF 2 PAGES		
2. JOB ORDER NUMBER See Block 17	3. QUANTITY 1	4. PRODUCTION SECTION/RCC MNPGB	5. DATE SCHED 8 2 4 9
6. DATE COMP 5-72			
7. PART NUMBER See Block 17	8. TECH DATA 5F6-3-5-3; 5F6-3-5-3-1	9. ITEM SERIAL NUMBER 1589	
10. MODEL-DESIGN-SERIES	11. STOCK NUMBER See Block 17	12. OPTIONAL 84 A	
13. SERIAL NUMBER	14. NOUN Gyro, Displacement		

15. DISPATCH STATION	16. PDN/OP NO.	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19.	20.
		NSN / P/N	AF	NAVY	ARMY
		6615-00-581-2265 / 124623-01		02636A	
		6615-00-852-1611 / 124623-01-09		02637A	
		6615-00-951-9140 / 124623-01-10		02639A	
		6615-00-994-8940 / 124623-01-12		02640A	
		6615-00-973-2218 / 121672-01-15	74051A ✓	05807A	03621A
		6615-00-074-4036 / 121672-01-16	74017A	05812A	
		6615-00-900-5959 / 121672-01-17	74044A	05805A	03611A
	010 00100	Receive and perform functional analysis (Pretest). Ascertain data correctness on 959 and 349. If serviceable, stamp serviceable tag and proceed to steps 140-180. N/R 06 Sept 88	WR PA 6002	CHECK. & VISUAL	B
	020 00200	Receive and perform functional analysis (Pretest). Ascertain data correctness on 959 and 349. If serviceable, stamp serviceable tag and proceed to steps 140-180. 06 Sept 88	WR PA 6002	ATP	B
	030	Clean and depaint gyro.	PA 6121 SEP 8 1988		
	040	Deseal gyro.	WR PA 6121 SEP 8 1988		
	050	Repair gyro. Enter serial number of inner axis gimbal assy, if replaced ________.	WR PA 6116 9-23-88		
	060	Set null and verticality. #14	WR PA 6116 9-23-88		
	070	Recheck end play and balance. Adjust as necessary.	WR PA 6116 9-23-88		
	080	Free drift test (calibration) and erection rate test. #14	WR PA 6116 9-23-88		

21. FINAL DESTINATION DISPATCH	FUNCTIONAL CODE	22. COORDINATION/INITIATING RCC SIGNATURE/DATE		23. DOCUMENT S/N
		a. 14 Oct 87 MANERG [signature]	a. 14 Oct 87 MAQNG [signature]	
		b. 14 Oct 87 MANPGB [signature]	d. MANSAA [signature] 14 Oct 87	

AFLC FORM MAR 81 959 PREVIOUS EDITION WILL BE USED.

WORK CONTROL DOCUMENT (CONT'D)

1. DATE: [illegible]88 — PAGE 2 OF 2 PAGES

15. DISPATCH STATION	16. PDK/OP NO.	17. WORK TO BE ACCOMPLISHED	18. MECHANIC	19.	20.
	090	Inside visual inspection. Certify this item does not contain foreign objects such as tools or loose components.	WR PA 6115 9-23-8		B
	100	Perform preseal test. # 5	WR PA 6115 9-23-88		
	110	Seal, purge and fill.	SEP 26 1988 6121		
	120	Manually manipulate gyro and listen for loose objects.	SEP 26 1988 WR PA 6121		B
	130	Leak test.	WR 5606	SEP [illegible] 1988	B
	140	Prepare for final test (includes painting).	WR PA 6115	SEP [illegible] 1988	
	150	Perform dielectric test.	[illegible]	SEP	
	160 00100	Perform functional analysis (final test). Stamp serviceable tag. 27058 N/A	WR PA 8031		B
	170 00200	Perform functional analysis (final test). Stamp serviceable tag. 27058	WR PA 8031		B
	180	Complete AFLC Form 959 and AFTO 349. Install decals and attach completed serviceable tag.	WR MI 05158		

OPERATION PROFILE

NAME R. VANDER VOORD ALC WR DATE 4-6-89 RCC MANPGB SHEET 1 OF 1

PCN ~~NGN~~ ~~PIN~~ 74051A WCD N/A WCD DATE 7187

OPERATION NUMBER	RCC	OPERATION DESCRIPTION	MANDATORY OCCURRENCE FACTOR	OPERATION TYPE	MANDATORY FLOW HOURS %	MANDATORY FLOW HOURS HRS.	MANPOWER SKILL CODE/LEVEL	MANPOWER QTY.	MANPOWER TIME REQUIRED %	MANPOWER TIME REQUIRED HRS.	EQUIPMENT CODE	EQUIPMENT QTY.	EQUIPMENT TIME REQUIRED %	EQUIPMENT TIME REQUIRED HRS.	DATA SOURCE COMMENTS
0000 ~~+N~~	MANPGB	REC	1	TRANSIT											C. DRIVER PLANNER MAC MILLER OPER. & A SCHEDULER.
				SETUP											
				PROCESS		1	IG09	1		0.1	STD				
		↑		TRANSIT											
				SETUP											
				PROCESS											
ALL WCD OPERATIONS LISTED IN ON OPER. PROFILE				TRANSIT											
				SETUP											
				PROCESS											
		↓		TRANSIT											
				SETUP											
				PROCESS											
9999	MANPGB	SELL	1	TRANSIT											D. HARRELSON SUPERV. MANPGC MAC MILLER OPERATOR & A SCHEDULER.
				SETUP											
				PROCESS		.1	IG09	1		0.1	STD				

LSC-20092C

OPERATION PROFILE

NAME [signature] ALC WR DATE 1/20/87 SAS RCC MANPGB SHEET 1 OF 5

ITEM CD PCN 74051A WCD WCDDATE 7187

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
10	MANPGB	NDI	0.98	.	T	.		.	.	.		.	.	.	
10	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
10	MANPGB	NDI	.	~~1.00~~ 0.1	P	4.0	IG09	1	. (AJT)	3.5	~~9548~~	1	.	~~3.5~~	.5 OUT MANUAL
20	MANPGB	NDI	0.98	.	T	.		.	.	.		.	.	.	
20	MANPGB	NDI	.	1.00	S	.		.	.	.		.	.	.	
20	MANPGB	NDI	.	.	P	4.0	IG10	1	.	3.5	6849	1	.	3.5	
30	MANPGB	PROC	1.00	.	T	.		.	.	.		.	.	.	
30	MANPGB	PROC	.	.	S	.		.	.	.		.	.	.	
30	MANPGB	PROC	.	~~1.00~~ .35	P	4.0	IG09	1	.	0.2	0009	1	.	4.0	
40	MANPGB	DIS	1.00	.	T	.		.	.	.		.	.	.	
40	MANPGB	DIS	.	.	S	.		.	.	.		.	.	.	
40	MANPGB	DIS	.	.85	P	0.1	IG09	1	.	0.1		.	.	.	
50	MANPGB	REP	1.00	.	T	.		.	.	.		.	.	.	

OPERATION PROFILE

SAS

NAME [signature] ALC WR DATE 4/26/89 RCC MANPGB SHEET 2 OF 5

ITEM CD PCN 74051A WCD WCDDATE 7187

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
50	MANPGB	REP	.	.	S	.		.	.	.		.	.	.	.85 of WHEELS ARE REPAIRED
50	MANPGB	REP	.	~~1.00~~ .85	P	6.0	IG09	1	.	6.0		.	.	.	
60	MANPGB	ASSY	0.99	.	T	.		.	.	.		.	.	.	
60	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
60	MANPGB	ASSY	.	~~1.00~~ .85	P	1.0	IG09	1	.	1.0	9548	1	.	~~1.0~~ .5	
70	MANPGB	ASSY	0.99	.	T	.		.	.	.		.	.	.	
70	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
70	MANPGB	ASSY	.	~~1.00~~ .80	P	0.5	IG09	1	.	0.5	3957	1	.	0.5	
80	MANPGB	ASSY	0.99	.	T	.		.	.	.		.	.	.	
80	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
80	MANPGB	ASSY	.	~~1.00~~ .80	P	2.0	IG09	1	.	1.5	9548	1	.	1.5	
90	MANPGB	NDI	0.98	.	T	.		.	.	.		.	.	.	

SAS

OPERATION PROFILE

NAME [signature] ALC WR DATE 4/20/89 RCC MANPGB SHEET 3 OF 5

ITEM CD PCN 74051A WCD WCDDATE 7187

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
90	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
90	MANPGB	NDI	.	~~1.00~~ .85	P	0.1	IG09	1	.	0.1		.	.	.	
100	MANPGB	ASSY	0.99	.	T	.		.	.	.		.	.	.	
100	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
100	MANPGB	ASSY	.	~~1.00~~ .85	P	4.5	IG09	1	.	0.5	0002	1	.	4.0	
110	MANPGB	ASSY	0.99	.	T	.		.	.	.		.	.	.	
110	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
110	MANPGB	ASSY	.	~~1.00~~ .85	P	3.0	IG09	1	.	0.5	~~9548~~	~~1~~	~~.~~	~~1.0~~	OUT
120	MANPGB	NDI	0.99	.	T	.		.	.	.		.	.	.	
120	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
120	MANPGB	NDI	.	~~1.00~~ .85	P	0.1	IG09	1	.	0.1		.	.	.	
130	MANPGB	NDI	0.98	.	T	.		.	.	.		.	.	.	
130	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	

OPERATION PROFILE SAS

NAME [illegible] ALC WR DATE 4/20/89 RCC MANPGB SHEET 4 OF 5

ITEM CD PCN 74051A WCD WCDDATE 7187

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
130	MANPGB	NDI	.	~~1.00~~ .85	P	0.2	IG09	1	.	0.2	3346	1	.	0.2	
140	MANPGB	PROC	0.97	.	T	.		.	.	.		.	.	.	
140	MANPGB	PROC	.	.	S	.		.	.	.		.	.	.	
140	MANPGB	PROC	.	~~1.00~~ .85	P	3.0	IG09	1	.	0.2	0004	1	.	0.2	
150	MANPGB	NDI	0.97	.	T	.		.	.	.		.	.	.	
150	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
150	MANPGB	NDI	.	~~1.00~~ .35	P	0.1	IG09	1	.	0.1	4850	1	.	0.1	
160	MANPGB	NDI	0.83	.	T	.		.	.	.		.	.	.	
160	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
160	MANPGB	NDI	.	~~[illegible]~~ .00	P	4.0	IG09	1	.	3.5	9548	1	.	3.5	
170	MANPGB	NDI	0.83	.	T	.		.	.	.		.	.	.	
170	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	

OPERATION PROFILE SAS

NAME [signature] ALC WR DATE 4/20/89 RCC MANPGB SHEET 5 OF 5

ITEM CD PCN 74051A WCD WCDDATE 7187

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
170	MANPGB	NDI	.	1.00	P	4.0	IG10	1	.	3.5	6849	1	.	3.5	
180	MANPGB	ASSY	0.84	.	T	.		.	.	.		.	.	.	
180	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
180	MANPGB	ASSY	.	1.00	P	0.1	IG09	1	.	0.1		.	.	.	

.85 WHEELS ARE REPAIRED. 100% of WHEELS REPAIRED GO THRU ALL OPS.

OPERATION PROFILE

NAME [illegible signature] ALC WR DATE SAS [illegible]/20/89 RCC MANPGB SHEET 1 OF 3

ITEM CD PCN 74051ASUB1 WCD WCDDATE 7215

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
50A	MANPGB	NDI	1.00	.	T	.		.	.	.		.	.	.	
50A	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
50A	MANPGB	NDI	.	1.00	P	0.2	IG07	1	.	0.2		.	.	.	
50B	MANPGB	DIS	1.00	.	T	.		.	.	.		.	.	.	
50B	MANPGB	DIS	.	.	S	.		.	.	.		.	.	.	
50B	MANPGB	DIS	.	1.00	P	0.2	IG07	1	.	0.2		.	.	.	
50C	MANPGB	ASSY	1.00	.	T	.		.	.	.		.	.	.	
50C	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
50C	MANPGB	ASSY	.	1.00	P	0.3	IG07	1	.	0.3		.	.	.	
50D	MANPGB	ASSY	1.00	.	T	.		.	.	.		.	.	.	
50D	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
50D	MANPGB	ASSY	.	1.00	P	1.2	IG07	1	.	0.2		.	.	.	
50E	MANPGB	ASSY	1.00	.	T	.		.	.	.		.	.	.	

OPERATION PROFILE

NAME [signature] ALC WR DATE 4/20/89 RCC MANPGB SHEET 2 OF 3

ITEM CD PCN 74051ASUB1 WCD WCDDATE 7215

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
50E	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
50E	MANPGB	ASSY	.	1.00	P	0.2	IG07	1	.	0.2	5139	1	.	0.2	
50F	MANPGB	ASSY	1.00	.	T	.		.	.	.		.	.	.	
50F	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
50F	MANPGB	ASSY	.	1.00	P	4.0	IG07	1	.	0.1	~~8219~~ 6219	1	.	4.0	ADD 1 @ 4.0 [illegible]
50G	MANPGB	ASSY	0.98	.	T	.		.	.	.		.	.	.	
50G	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
50G	MANPGB	ASSY	.	1.00	P	0.2	IG07	1	.	0.2		.	.	.	
50H	MANPGB	NDI	0.98	.	T	.		.	.	.		.	.	.	
50H	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
50H	MANPGB	NDI	.	1.00	P	0.1	IG07	1	.	0.1		.	.	.	
50I	MANPGB	ASSY	0.98	.	T	.		.	.	.		.	.	.	

OPERATION PROFILE

NAME [signature] ALC WR DATE 5/20/89 SAS RCC MANPGB SHEET 3 OF 3

ITEM CD PCN 74051ASUB1 WCD WCDDATE 7215

OPER NUMB	RCC	OPER DESC	HIST OCCR	MAND OCCR	OPER TYPE	MAND F HRS	SKILL CD/LVL	QTY	%	HRS	EQUIP CODE	QTY	%	HRS	NOTES
50I	MANPGB	ASSY	.	.	S	.		.	.	.		.	.	.	
50I	MANPGB	ASSY	.	1.00	P	1.5	IG07	1	.	0.2		.	.	.	
50J	MANPGB	NDI	0.98	.	T	.		.	.	.		.	.	.	
50J	MANPGB	NDI	.	.	S	.		.	.	.		.	.	.	
50J	MANPGB	NDI	.	1.00	P	1.0	IG07	1	.	0.1		.	.	.	
50K	MANPGB	NDI	.	.	~~P~~	.	~~IG07~~	~~1~~	.	~~0.1~~		.	.	.	
50K	MANPGB	NDI			S	'									
50K	MANPGB	NDI			P	0.1	IG07	1		0.1					

```
                                  PART OPERATION SUMMARY

                         ALC: WARNER ROBBINS    RCC: MANPGB    GYRO SHOP, UNIT 2

    PN: 121672-               NSN: 01-15               PCN: 74051A        WCD:          WCD DATE: 7187

    OPERATION: ZPRT                          PRIMARY    OPERATION TYPE: ASSY   MATERIAL TYPE:
    SAMPLE SIZE: 1676 MISSING FLOWTIMES: 4     END ITEMS: .          OUTLIERS DELETED: 1

    -------- MANPOWER REQUIRED --------       -------------------- EQUIPMENT REQUIRED --------------------
                         --- TIME ---                                             --- TIME ---     BATCH
    SKILL      QTY      FRACTION    HOURS          CODE       CATEGORY    QTY    FRACTION  HOURS    MIN MAX

   HISTORICAL DATA                                                                     D          D
     ACTUAL               RELATIVE FREQUENCY                DISTRIBUTION     PARAMETERS      VALUE      ALPHA
       FREQ  0  10  20  30  40  50  60  70  80  90 100
    0   36   **************                                 UNIFORM          0.0      265.0   0.713        .
   10   19   *******                                        TRIANGULAR       0.0  0.0265.0   0.558        .
   20   17   *******                                        NORMAL          23.6 27.6         0.135        .
   30   11   ****                                           LOGNORMAL       23.6 27.6         0.119        .
   40    7   ***                                            EXPONENTIAL     24.1              0.063        .
   50    3   *
   60    2   *
   70    1
   80    1                                               OCCURRANCE FACTOR:  .      OCCURRANCES: 1681
   90    0
 >=100   3   *                                           DISTRIBUTION OF CHOICE: HISTORICAL DISCRETE
```

PART OPERATION SUMMARY

ALC: WARNER ROBBINS RCC: MANPGB GYRO SHOP, UNIT 2

PN: 114634-08 NSN: PCN: 74051ASUB1 WCD: WCD DATE: 7215

OPERATION: ZPRT PRIMARY OPERATION TYPE: NDI MATERIAL TYPE:
SAMPLE SIZE: 241 MISSING FLOWTIMES: 0 END ITEMS: . OUTLIERS DELETED: 0

-------- MANPOWER REQUIRED --------				-------------------- EQUIPMENT REQUIRED --------------------					
		--- TIME ---					--- TIME ---		BATCH
SKILL	QTY	FRACTION	HOURS	CODE	CATEGORY	QTY	FRACTION	HOURS	MIN MAX

HISTORICAL DATA

	ACTUAL FREQ	RELATIVE FREQUENCY 0 10 20 30 40 50 60 70 80 90 100
0	89	************************************
1	1	
2	1	
3	1	
4	0	
5	0	
6	0	
7	0	
8	0	
9	0	
>=10	7	***

DISTRIBUTION	PARAMETERS			D VALUE	D ALPHA
UNIFORM	0.0		83.0	0.881	.
TRIANGULAR	0.0	0.0	83.0	0.868	.
NORMAL	3.6	13.8		0.482	.
LOGNORMAL	3.6	13.8		0.166	.
EXPONENTIAL	4.1			0.677	.

OCCURRANCE FACTOR: . OCCURRANCES: 241

DISTRIBUTION OF CHOICE: HISTORICAL DISCRETE

LABOR STANDARD OPERATION RESOURCE STANDARD AND METHOD ANALYSIS 09/22/88 A-E046B-MM1-DY-M45 PAGE 0001

74051A MD-1 GYRO RCC MNPGB Y 5F6-3-5-3

OPER SUB	TECH STEP	S T D	S K L	W #R K	F A C	PF FA DC	A/R REV SUPPORT ELEMENT	OCC FACT	DESCRIPTION STORED		DESCRIPTION SUPPLEMENTAL	BASE HOURS	PFD TIME	STD HOURS	DLY	PCT	A C
00100	W	E	GA	EA	A		K 82049	1.00	PERCENT ENGR 99.1		MD-1 GYRO DEPOT MAINT	10.87		10.87		86	
0010			GA	01		07		1.00			MD-1 GYRO DEPOT MAINTENANCE	7.489	.524	8.013		87	
	0020	E						.95	9558 .01		DEPAINT GYRO	.11000		.111			A
	0030	E						.95	9558 .01		DESEAL GYRO	.12300		.125			A
	0040	E						.90	9558 .36		REPAIR GYRO	4.50900		4.342			A
	0050	E						.90	2198 .09		NULL&VERTCALITY TEST & AD.	.66600		.641			A
	0060	E						.96	2198 .22		CALBRATION	1.61100		1.654			A
	0070	E						.96	9558 .03		REASSEMBLE MAJOR COMPONENTS	.42200		.433			A
	0080	E						.95	9558 .02		PRESEAS TEST	.28300		.287			A
	0090	E						.95	9558 .02		SEAL / FILL	.21100		.214			A
	0095	E						.95	6	2.79	LEAK CK USING LK DETECTOR	.06233		.063			
	0100	E						.95	9558 .01		PAINT GYRO	.13700		.139			A
0020			GA	01		07		1.00			INNER AXIS GIMBAL REPAIR	1.896	.133	2.029		87	
	0010	E						.86	8558 .05		MOTOR REPAIR	1.82600		1.680			A
	0020	E						.86	9558 .01		MOTOR ROTOR BALANCE	.37800		.348			A
0030			GA	01		07		1.00			CHASSIS ASSEMBLY REPAIR	.694	.049	.743		88	
	0010	E						.86	9558 .09		REPAIR POWER PACK	.80700		.742			A
0040			GA	01		00		1.00			MISCELLANEOUS ESTIMATE	.084	.000	.084		88	
	0010	N						1.00			MACHINE-WELD ESTIMATE	.08400		.084			
8998			GA	01		00		1.00			HISTORICAL DATA	.000	.000	.000		89	

```
0380 STANDARD WAS REDUCED AS A RESULT OF SUGGESTION
0390 NUMBER WR75-278 WHICH REDUCED THE AMOUNT OF
0400 TIME TO CHECK CONTINUITY FROM CONNECTOR J141
0410 TO CONNECTOR P141 AND P142.
0420 OLD STANDARD 9.89 M/H
0430 NEW STANDARD 9.68 M/H
0440 NET DECREASE .21 M/H
0450 DATE 26 APRIL 78 U. NORWOOD
0460
0470 STANDARD WAS RAISED DUE TO INCREASE
0480 IN THE NUMBER OF ITEMS REQUIRING
0490 MAJOR REPAIR IAW TIME STUDY
0500 PERFORMED FOR LSIP
0510 OLD STANDARD 9.67 M/H
0520 NEW STANDARD 12.40 M/H
0530 NET INCREASE 2.73 M/H
0540 DATE 23 AUG. 1978 U. NORWOOD
0550
0560
0570 LABOR STD. PR&D INCREASE DUE TO CHANGE FROM
0580 NON-CLEANROOM TO A CLEANROOM WORK ENVIROMENT
0590 NEW STD. 12.80 M/H
0600 OLD STD. 12.40 M/H
0610 NET CHG. .40 M/H
0620 9 MAY 1980 U.NORWOOD
0630
0840 TWO YEAR REVIEW CONDUCTED. NO CHANGES MADE AS NEW
0650 AUTOMATIC TEST EQUIPMENT WILL SOON CHANGE FLOW
0660 PROCESS. 22 AUG 1980 JOE HASTINGS.
0670
0680 LABOR STANDARD BACKUP DATA DOES NOT SUPPORT
0690 ENGINEERED STANDARD CRITERIA THEREFORE STANDARD
0700 IS CHANGED TO NON-ENGINEERED 2FEB81 D BRIDGES
0710
0720 LABOR STANDARD CHANGE DUE TO WORK SAMPLING STUDY
0730 BEING PERFORMED AND PF&D CHANGE FROM 11 TO 7.
0740 GYRO MOVED FROM CLEAN ROOM TO NON-CLEANROOM.
0750 OLD STD. 12.80 HRS. NEW STD. 10.91 HRS.
0760 NET DECREASE 1.89 HRS. J.HASTINGS 18 JAN 82.
```

SHOP FLOW DAY COMPUTATION FOR PRODUCTION NO: 74051A

AFLCR 66-4 Shop Flow Day Formula was used to establish this flow day standard as follows: Flow Days = A [(B ÷ C) + D + E] where A = 1.45; B = End Item Labor Standard; C = Direct Labor Hours Per Person Per Day adjusted for indirect categories and labor efficiency; D = Routine Delays; E = Unique Delays. Repair is being accomplished as a responsible shop.

STEP	DESCRIPTION	DAYS
1	B = Labor Standard of 12.28 Hrs C = 7.66 Daily Labor Hrs Value "C" is calculated as follows: MANFG B .24 +.25 + .26 + .29 Indirect Average = .1 Hours MANFG B Labor Efficiency = 97 % C = 8 Hours Minus Indirect Average Times Labor Efficiency	B ÷ 1.603
	D = Routine Delays a. Awaiting Maintenance (AWM) = 3.8 days b. One days supply at station awaiting maintenance = 4 days (average 4 stations for each C/N). This is necessary to maintain uninterrupted flow of items. TOTAL	7.80
3	E = Unique Delays a. Machine processing ____ Day(s) b. Machine processing delays ____ Day(s) c. Routing to support shops ____ Day(s) d. Others (See Reverse Side) 1.8125 Day(s) TOTAL	1.8125
4	Total flow days this shop (1 + 2 + 3)	11.2155
	Work Shift Adjustment (Item 4 ÷ number of shifts). 11.2155 ÷ 1	11.2155
	Sum of flow days for all shops (Item 5 x 1.45) 11.2155 x 1.45 (Final result to be rounded up to next whole day.)	17

COMPUTED BY: SYLVIA H. BLACK DATE: 4 SEP 85

(OVER)

PAINT/DEPAINT 3 Hours

Para 2-49, 2	1.5 Hrs	Bake Time	Page 2-16
Para 2-49, 11	.25 Hr	Cure Time	Page 2-16
Para 2-49, 13	1.5 Hrs	Bake Time	Page 2-16
Para 2-49, 14	1.0 Hrs	Bake Time	Page 2-16
Para 2-49, 15	1.0 Hrs	Bake Time	Page 2-16
Para 2-49, 37	.25 Hr	Bake Time	Page 2-19
Para 2-67, 2	2.0 Hrs	Bake Time	Page 2-25
Para 2-67, 4	1.5 Hrs	Bake Time	Page 2-25
Para 2-67, 13	2.0 Hrs	Bake Time	Page 2-26
Para 2-67, 31	1.5 Hrs	Bake Timem	Page 2-27
Para 2-78, 12	.5 Hrs	Cure Time	Page 2-32
Para 2-78, 12	.5 Hrs	Bake Time	Page 2-32
Para 2-78, 34	8.0 Hrs	Motor Run Time	Page 2-34
Para 2-78, 35	24.0 Hrs	Motor Run Time	Page 2-34
Para 2-78, 35	8.0 Hrs	Motor Run Time	Page 2-34
Para 2-78, 38	1.5 Hrs	Bake Time	Page 2-34
Para 2-78, 39e	24.0 Hrs	Cure Time	Page 2-34
Para 2-90, 40	1.5 Hrs	Bake Time	Page 2-35
Para 2-90, 4	1.0 Hrs	Bake Time	Page 2-38
Para 2-90, 18	1.0 Hrs	Bake Time	Page 2-42
	82.5 Hrs		

Delay time in paragraph 2-78 is concurrent with other actions. Therefore, 82.5 total hurs are reduced by 68. 14.5 hours is used as the unique delay time, 14.5 ÷ 8 = 1.8125 days.

5.2 MODEL INPUT FILES

The model input files for RCC MANPGB were previously submitted under memo number NKE-E016-7603, dated July 6, 1989.

6.0 VALIDATION OF INPUT DATA

All profile data was validated in accordance with paragraph 7.2 and 7.3 of the Simulation Model Definition Document (SMDD). The profile data files included in this document were validated and accurately represent this RCC.

MINUTES OF

MODEL VALIDATION MEETING

June 19 thru June 23, 1989

WR-ALC/MDMSC

6-29-89

WR-ALC MODEL VALIDATION MEETING MINUTES

19 June 89:

- Jim Gillis started the meeting by introducing team members:

    - Jim Gillis
    - Gerald Peavy
    - Doug Keene
    - Lott Singletary

    AFLC Representative:

    - Trixie Brown

    MDMSC Representatives:

    - Bob Bashyam
    - Bill Rich
    - Roger VanderVoord
    - Scott Vroman

- Jim pointed out that AFLC instructed them not to sign off the Model Validation Form.

- Reviewed model output for RCC MANPSA. Evaluated throughput, historical flow hours vs. simulated flow hours, expected hours vs. standard hours.

- This evaluation was performed for each item number. During this process list of major assumptions, action items and concerns were noted.

    PCN 01900A: F-15 Speed Brake

    - Historical flow hours 933.5 vs. 466.70 of simulated flow hours.

        Assumption:

        Method of induction may be a problem. History does reflect 500 hours to complete first operation which is inspection.

        Historical backshop hours were greater than simulated hours. We decided to input backshop hours back into the model.

6-29-89

PCN 01900A: F-15 Speed Brake (continued)

- Action items:

  Doug to verify the manpower utilization. Bill to review expected and standard hours.

PCN 05502A: C-141 Aileron

- Simulated throughput 13.2% difference. The difference was due to sporadic induction method.

PCN 51334A: C-141 Leading Edge Horizontal Stabilizer

- Bill to review expected hours.

- Increase backshop hours by 180 hours based on historical report.

PCN 51352A: C-141 Access Door

- Bill to review expected hours.

- Increase backshop hours based on historical report.

PCN 51418A: C-141 Leading Edge Wing

- Bill to verify expected hours.

PCN 51454A: C-141 Petal Door

- Bill to review the subassembly process hours.

- History had one sample of 698 days - adjusted for this odd occurence and made hours from 2288 to 1334.

- This completes the evaluation of model output for RCC MANPSA. At the end of this evaluation. Bob summarized the action items and assumptions. Jim commented that the model seems to be doing what it is suppose to and asked MDMSC team to complete the action item and re-run the output. Jim also stated that either expected or standard hours can be used in establishing baseline of model based on IE's judgment. AFLC's representative, Trixie Brown, disagreed with Jim's comment. Validation team decided that during evaluation of difference between historical vs. simulation, 10% should be used only as a guideline not as a measurement.

Evaluation of RCC MANPGC:

- Evaluated the model output for the following PCNs: 06121A, 74061A, 74063A, 74146A, 74148A and 74149A.

- Review of throughput, historical vs. simulated flow hours and expected vs. standard hours revealed the following:

  - Expected vs. standard hours were within acceptable range.

  - Throughput was good.

  - Flow hours showed lot of difference between simulation and history. Review of historical report revealed that an unique pattern of process is being followed in Gyro Shop. Gyros after inspection were stored/held for long period of time before the start of repair operation.

  - Discussed about this problem. Doug and Jim wanted to have some methodology to show the unique holding process.

20 June 89:

- Bruce Kirk of MDMSC joined us to facilitate our brainstorming effort.

- Conducted brainstorming effort at Building 169. Morning session for Sheet Metal RCC's MANPSA, MANPSB, MANPSC, and MANPSD and afternoon for Gyro RCC's MANPGA, MANPGB, and MANPGC.

- Due to the nature of process and similarity we decided to have one brainstorming effort for Sheet Metal (4 RCCs) and one for Gyro (3 RCCs).

- Doug arranged both the sessions by bringing in representatives from manufacturing, scheduling, planning and quality.

- Both the sessions went out very good with a lot of participation. Developed fish bone - details of fish bone and brainstorming activities are covered in minutes of model validation/brainstorming.

21 June 89:

- Evaluated the model output for all the RCCs MANPSA, MANPSB, MANPSC, MANPSD, MANPGA, MANPGB, and MANPGC.

- Redlined the backshop hours and added buffer operations as requested by ALC for Gyro RCCs.

- Input all the changes and re-run the model.

- Dick Donnelly and Lou Mavros joined us to support our model validation effort.

- Dick, Lou, Bob and Gerald had an opportunity to meet Mr. Clinton Lewis. Discussed about the validity of model and about future task orders.

- Jim Gillis will be on vacation for the rest of the week.

22 June 89:

- Evaluated the re-run of model ouput after inputting the redlined corrections.

MANPSA

01900A: F-15 Speed Brake

- Expected vs. standard hours is acceptable.

- Historical vs. simulated flow hours - still have a problem. History shows operation 10 takes about 500 hours to complete. This is due to induction and priority problem. Operation 40 shows 68 hours to complete (waiting for engineer) whereas model shows 1 hour. One hours represents process hour whereas 68 hours includes waiting time also.

05502A: C-141 Aileron

- This a PDM item. No historical data available. Evaluated the output and verified with mechanics and planners to validate the model output.

051334A: C-141 Leading Edge Horizontal Stabilizer

- Standard vs. expected hours is within acceptable range.

- Backshop hours were off. Redlined the output.

51454A: C-141 Petal Door

- Model output does seem to represent as-is condition.

51352A: C-141 Access Door

- Redlined backshop hours to represent historical data.

MANPSD

09193A: F-15 Radome

- Expected vs. standard hours is within acceptable range.

- Simulated flow hours are almost double the historical. Review showed us operation 190 takes about 550 hours to complete.

- Operation 190 is repair operation performed by one mechanic for about 50 hours. Model shows the manpower availability as a problem.

- Doug pointed out that the model exaggerates the problem.

41059A: C-130 Radome Assembly

- Model output does seem to represent the as-is condition.

- Needed to verify the historical data of 500 hours for operation 10.

51420A: C-141 Wing Leading Edge

- Evaluated the output and redlined backshop hours.

40208A: C-130 Radome

- Ouput does seem to represent the as-is condition except the historical hours for Operation 30.

- History shows that it takes over 4000 hours to complete Operation 30.

- Bob to check the historical input data at St. Louis, if availabe and respond to WR-ALC.

03172A: F-15A Canopy

- Evaluated model output. History shows that it takes approximately 1180 hours to complete Operation 10.

- Operation 10 is to inspect and determine what parts are required to perform the repair. It does wait for a long time in getting those required parts.

MANPSB

- This is a manufacturing RCC.
- No historical data for analysis. Reviewed only the throughput.
- Model output was validated based on it's performance on the other 6 RCCs.

MANPG

- Evaluated the re-run of model out for RCCs MANPGA, MANPGB and MANPGC.
- Output for these RCCs were reviewed earlier. Buffer operation were added where necessary to represent historical data.
- Output for PCNs 74010A, 74074A, 74163A, 74126A, 74051A, 20012A, 06121A, 74061A, 74063A, 74146A, 74148A, and 74149A from all the three RCCs were individually evaluated.
- Flow hours, process hours and throughput were within acceptable range. Model does represent the as-is condition.
- Doug and Lott questioned the validity of historical data for PCNs 74074A and 20012A. Wanted to verify with manufacturing personnel.

23 June 89:

- Doug and Lott verified and confirmed the flow hour information.
- Reviewed the re-runs of model output.
- Bob compiled the meeting of minutes and reviewed with team members.

6-29-89

- WR-ALC/AFLC/MDMSC validation team agrees that the model seems to represent the approximation of as-is condition of RCCs MANPSA, MANPSB, MANPSC MANPSD, MANPGA, MANPGB and MANPGC; therefore, the model can be used as a baseline for experimentation.

____
Doug Keene, WR-ALC/MANEE

____
Lott Singletary, WR-ALC/MANEE

____
Jim Gillis, WR-ALC/MAWF

____
Gerald Peavy, WR-ALC/MAWF

____
Trixie Brown, AFLC/MAQF

Scott Vroman (signature)
____
Scott Vroman, MDMSC

H. V. "Bill" Rich
____
Bill Rich, MDMSC

for B Bashyam
____
Roger VanderVoord, MDMSC

B Bashyam
____
Bob Bashyam, MDMSC

6-29-89 / Rev-1
BB/fej

7.0 COMPUTER SIMULATION ANALYSIS OF RCC

The computer simulation analysis for RCC MANPGB was previously submitted under memo number NKE-E016-7603, dated July 6, 1989.

8.0 VALIDATION OF SIMULATION ANALYSIS

The validation of simulation analysis for RCC MANPGB was previously submitted under memo number NKE-E016-7603, dated July 6, 1989.

9.0 BRAINSTORMING

The minutes for RCC MANPGB brainstorming were previously submitted under memo number NKE-E016-7603, dated July 6, 1989.

MINUTES OF

BRAINSTORMING SESSIONS

June 20, 1989

WR-ALC/MDMSC

MINUTES OF BRAINSTORMING
SESSION FOR THREE GYRO RCCs
- June 20, 1989 Afternoon Session -

Doug Keene introduced Bruce Kirk to the members of the afternoon session. The following were in attendance:

Bashyam, Bob	MDMSC
Boyt, James	WR-ALC/MAQNG
Driver, Claude	WR-ALC/MANERG
Floyd, Donald	WR-ALC/MANPGB
Harrelson, Dan	WR-ALC/MANPGA
Hulett, Earmon	WR-ALC/MANSAA
Keene, Doug	WR-ALC/MANEE
Kirk, Bruce	MDMSC
Moriarty, Brenda	WR-ALC/MANERA
Pate, William	WR-ALC/MANPGA
Sessions, David	WR-ALC/MANEE
Smith, Oscar	WR-ALC/MANPGB
VanderVoord, Roger	MDMSC

Bruce started the brainstorming session by briefing the process of brainstorming and round robin solution. Following are the suggestions:

1. Space - Building 158.
2. Turn over of skilled people.
    - Grade structure vs. $
    - Not being replaced
3. Projected workload - higher actuals than projected.
4. Primarily funding from Oklahoma City - lack of funding so not hiring.
5. Layout - need more space to improve flow.

6. Equipment maintenance and calibration - availability of parts/manpower.

7. Induction system problem on assest availability.

8. ATE availability (saturates at 2 shifts).

9. Equipment modernization to improve throughput on rate gyros.

10. Parts availability - need local storage.

11. Quality of parts -

    - Bearings (rusty)

    - Poor part packaging

12. Present prioritizing does not warrant overtime.

13. Poor planning - "critical" end items budget. Receive sufficient people and overtime; everything else falls behind!

14. Space and equipment limitations result in 2nd shift for critical items.

15. Mil-specification parts some variability of quality.

16. Environmental restrictions on chemical cleaning.

17. Power

    A. Regulated

    B. Sudden loss (averages 2 times a month)

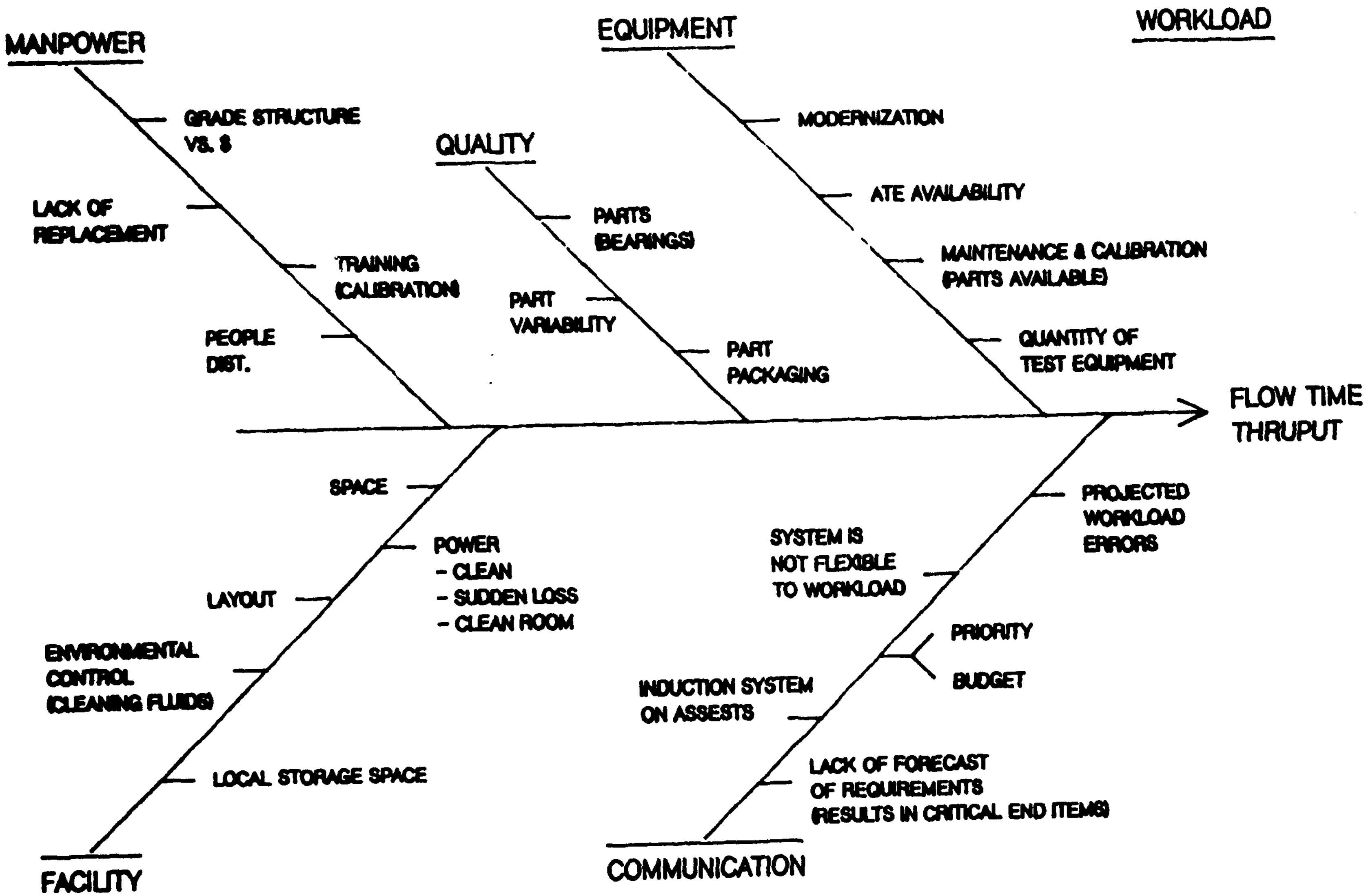
18. Clean room out of tolerance - power loss (air handlers then need to catch up).

DEVELOPED FISHBONE (CAUSE AND EFFECT) DIAGRAM.

<u>NOTE</u>: AS-IS SIMULATION MODEL WAS LOADED AT WR-ALC's VAX SYSTEM AND THE UDOS PROGRAM RAN SUCCESSFULLY ON 6-23-89.

THESE MINUTES WERE COMPILED BY BASHYAM.

GYRO SHOP
FISHBONE – CAUSE & EFFECT DIAGRAM



RCC: MAN FGB SUMMARY OF RE-EVALUATION

- Reformatted the results of L9 taguchi orthogonal array table.

- Evaluated throughput of each run for average throughput of RCC.

- Analyzed and tabulated results of best and worst PCN for each run including surge.

- This approach gives us a better understanding of the RCC's capability, process, and bottlenecks.

MANPGB CONTROL FACTORS

TABLE 10.2.2-1

BASE			BASE+ (AS-IS)			BASE++		
EQUIP. NO.	EQUIPMENT NAME	EQUIP. QTY.	EQUIP. NO.	EQUIPMENT NAME	EQUIP. QTY.	EQUIP. NO.	EQUIPMENT NAME	EQUIP. QTY.
3346	LEAK DETECTOR	5	3346	LEAK DETECTOR	10	3346	LEAK DETECTOR	5
5139	BALANCE	1	5139	BALANCE	3	5139	BALANCE	1
9548	CONSOLE	6	9548	CONSOLE	9	9548	CONSOLE	6
			2314	FILL STAND	1*	2314	FILL STAND	6**

LSC-20618

NOTES: * BATCH: MIN-1/MAX-25
** BATCH: MIN-1/MAX-6

MANPGB ~~SHEET METAL~~ GYRO SHOP TAGUCHI ORTHOGONAL ARRAY

TABLE 10.2.2-2

RUN #	FACTORS & LEVELS						WORKLOAD (THROUGHPUT)		
	MANPOWER			OVERTIME		EQUIPMENT	INDUCTIONS: 5048: 130% OF FY 88		
	1	2	3	SAT	SUN		AVG.	BEST	WORST
1	ALL					BASE	99.3 %	20012A / 99.6 %	74051A / 99.0 %
2	ALL			YES		BASE +	99.9 %	74051A / 99.9 %	20012A / 99.8 %
3	ALL			YES	YES	BASE ++	99.8 %	74051A / 99.9 %	20012A / 99.7 %
4	50%	50%				BASE ++	99.6 %	20012A / 99.6 %	74051A / 99.5 %
5	50%	50%				BASE	98.5 %	20012A / 99.9 %	74051A / 98.0 %
6	50%	50%		YES		BASE +	99.9 %	74051A / 100.0 %	20012A / 99.7 %
7	1/3	1/3	1/3	YES		BASE +	100.4 %	74051A / 100.6 %	20012A / 99.8 %
8	1/3	1/3	1/3	YES	YES	BASE ++	100.2 %	74051A / 100.2 %	20012A / 100.0 %
9	1/3	1/3	1/3	YES	YES	BASE	100.3 %	74051A / 100.5 %	20012A / 99.8 %
SURGE*	50%**	50%**				BASE	98.3 %	20012A / 99.5 %	74051A / 98.0 %

NOTES:
* INDUCTIONS = 4168 (2 QTRS)
** TWO 12 HOUR SHIFTS.

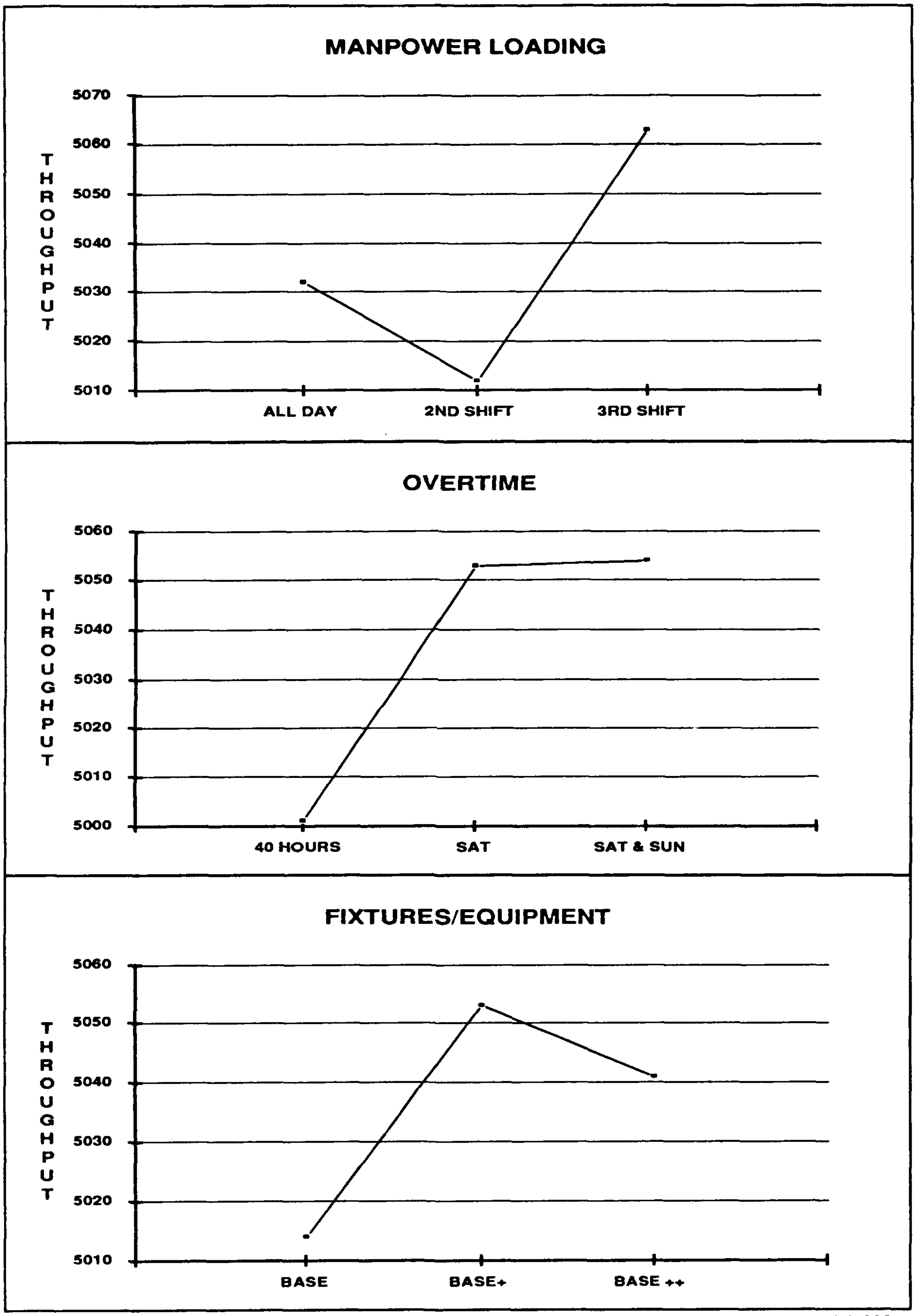
LSC-20619

MANPGB GYRO SHOP TAGUCHI ORTHOGONAL ARRAY

TABLE 10.2.2-1

RUN #	FACTORS & LEVELS						WORKLOAD (THROUGHPUT)			
	MANPOWER			OVERTIME		EQUIPMENT	130% OF FY 88		SURGE	
	1	2	3	SAT	SUN		QTY	%	QTY	%
1	ALL					BASE	5013	98.5	4098	98
2	ALL			YES		BASE +	5044	99		
3	ALL			YES	YES	BASE ++	5040	99		
4	50%	50%				BASE ++	5026	98.8		
5	50%	50%				BASE	4964	98		
6	50%	50%		YES		BASE +	5046	99		
7	1/3	1/3	1/3	YES		BASE +	5069	99.6		
8	1/3	1/3	1/3	YES	YES	BASE ++	5057	99		
9	1/3	1/3	1/3	YES	YES	BASE	5066	99.5		

LSC-20314



LSC-20311

MANPGB EXPERIMENTATION RESULTS
FIGURE 10.2.2-1

MANPGB - WRALC
FACTORS / ASSUMPTIONS

BASE : WORKLOAD IS SAME AS AS-IS CONDITION (FY88).

WKL: 5088 CHANGE RESOURCE FILE BY REDUCING EQUIPMENT QTY OF THE FOLLOWING.

EQUIPMENT	CHG. TO
3346	5
5139	1
9548	6

BASE+ : WORKLOAD AND RESOURCE FILES ARE ALL THE SAME AS AS-IS CONDITION.

BASE++ : WORKLOAD IS SAME AS AS-IS CONDITION. CHG. RESOURCE FILE AS FOLLOWS:

EQUIPMENT	CHANGE TO	BATCH
2314	6	MIN 1 MAX 1

SURGE : INCREASE FY88 WORKLOAD BY THE AVG. % OF WEAPON SYSTEMS INVOLVED
F111 : 71%, C141 : 246%, C131 : 159%.
AVG : 159%.
MANPOWER SPLIT THEM TO 12 HRS - 2 SHIFTS 5 DAYS A WEEK.

MANPGB - WRALC

MANPOWER:

1) $\frac{5013+5044+5040}{3} = 5032 = 99\%$

2) $\frac{4964+5026+5046}{3} = 5012 = 98\%$

3) $\frac{5066+5069+5057}{3} = 5064 = 99.5\%$

OVERTIME:

SAT: $\frac{5044+5046+5069}{3} = 5053 = 99\%$

SAT+SUN: $\frac{5040+5057+5066}{3} = 5054 = 99\%$

40HRS: $\frac{5013+5026+4964}{3} = 5001 = 98\%$

FIXTURE/ EQUIPMENT.

BASE: $\frac{5013+4964+5066}{3} = 5014 = 98.5\%$

BASE +: $\frac{5044+5046+5069}{3} = 5053 = 99\%$

BASE ++: $\frac{5040+5026+5057}{3} = 5041 = 99\%$

MANPGB - WRALC

SUMMARY

REVIEWED THE RESULTS OF THE OUTPUT ANALYSIS OF THIS EXPERIMENTAL DESIGN FOR RCC MANPGB. EXPERIMENT WAS DESIGNED TO ANALYSE THE SENSITIVITY OF QTY OF EQUIPMENT. ALSO CHANGED THE FILL STATION FROM ONE EQUIPMENT TO 6 INDIVIDUAL STATION WITH BATCH SIZE OF MIN: 1 AND MAX: 1.

SIMULATION OUTPUT INDICATE THAT THE THROUGHPUT WILL BE ACCOMPLISHED EVEN WITH LESS QTY OF EQUIPMENT.

FILL STATION WITH 6 INDIVIDUAL STATION DOES INDUCE MORE THROUGHPUT.

SURGE REQUIREMENT WERE PROCESSED FOR 2 QTR TO SEE THE SENSITIVITY. IT REVEALS THAT THERE SHOULD NOT BE ANY MAJOR CONCERN IN MEETING DEFERENT SURGE REQUIREMENT.

TECHNOLOGY INSERTION PROGRAM
WR-ALC
MANPG - GYRO SHOP

Bob Bashyam
Roger VanderVoord

Possible Focus Study List

Description	RCC
1. RCC WR/MANPGB and AGMC/MANPGB Automatic Test Equipment vs. Product Optimization	
2. RCC WR/MANPGB and AGMC/MANPGB Increase of Automatic Test Equipment Up Time	
3. Combine Gyro Rotor Repair to Common Line With Balanced Station Time	
4. Develop Program to Attack T. E. Obsolescence [Bench Sets]	
5. Fill Procedure for 74074A to Replace Present Station	
6. Automate Depaint, Unseal, Reseal Process	
7. Improve Bearing Procurement/Handling Procedure	
8. Laser Wheel Balancing (Delay/Monitor AGMC)	
9. Compare A.T.E. to Manual (Delay for Results From 1)	

TECHNOLOGY INSERTION PROGRAM
WR-ALC
MANPG - GYRO SHOP

Bob Bashyam
Roger VanderVoord

Possible Quick Fix List

	Description	RCC
1.	Improve Bearing Handling	All
2.	Motorize Dividing Heads	All
3.	Fixturize Induction Heater	MANPGB
4.	Remove Clean Room Garb	MANPGA
5.	Improve Random Drift Decisions	MANPGC
6.	Rearrange 74051A Repair Area	MANPGB
7.	Relocate Mass. Spectrometer	MANPGB
8.	Vent Mass. Spectrometer Vacuum Pumps	MANPGA
9.	Re-evaluate Diagnostic Checks	All
10.	Rebonding Disply Tapes	MANPGB
11.	Removal of 06121A Case	MANPGC
12.	Reclaim 74126A Spin Bearing	MANPGA
13.	Improve 74126A Fixture at OP 100	MANPGA
14.	Reduce Test Time 74010A	MANPGA

Following are the Potential Improvements for Quick Fix.

10.31 QUICK FIX OPPORTUNITY TO IMPROVE GIMBAL/SPIN BEARING HANDLING (MANPG)

10.31.1 Description of Current Operations

Bearings being removed from repairable gyroscope product are handled as non-reclaimable material. Little or no care is evident in the removal and/or storage of the bearings prior to attempts to refurbish.

10.31.2 Description of Current Process Problems

Bearings are being damaged during removal by pressing operations, open line storage and piling in uncontrolled containers. Storage is accomplished in open tote boxes or plastic bags with many piled loosely on top of each other continuing the opportunity for damage.

10.31.3 Description of New Process

MDMSC recommends tote tray inserts that locate the I.D. bore of the bearings in a manner to prevent contact of adjacent bearings and control vertical stacking. Further action is required in development of personnel training to instill importance of bearing handling during unit teardown. The use of the tote boxes should be continuious through bearing refurbishment and storage, only being discontinued when bearing is defined as scrap.

10.31.4 Rationale Leading to Change

Both WR-ALC and AGMC are presently engaged in bearing refurnishment with varying degrees of success. If handling damage can be eliminated or reduced, refurbishment yields can be improved. The refurbishment procedures remove contaminants but cannot correct physical damage to the bearings. The lack of proper handling of bearings was observed thru all three gyro RCC's.

Reliability/Maintainability Characteristics: Should improve MTBF by reducing possiblity of returning physically damaged bearings to product.

Human Factors Design Criteria: Re-establish the importance of proper procedure of teardown on unit acceptance yields.

Generally private industries use special bearing pullers during teardown - tote box inserts are used to handle and store bearings expected to be salvaged and returned to product.

10.31.5 Estimated Cost Savings

Actual line observations and interviews with RCC personnel suggest a yield improvement in refurbished bearings in excess of 20%. The improvement will give double fold savings by yielding more product per refurbishment cycle and reducing induction costs of additional new bearings.

Approximately 12,000 units are repaired in MANPG yearly. Assuming each contains an average of four precision ball bearings and half require refurbishment or replacement, 48,000 precision bearings would be available for consideration. Further if half are replaced, 24,000 are committed to refurbishment. The excepted 20% improvement would amount to 4,800 bearings reclaimed over present methods. Using $2.75 as an average cost per ABEC 5 ball bearing, $13,200/year savings is available. No additional labor is added because the refurbishment attempt is completed regardless.

10.31.6 Implementation Cost/Schedule

Some MANPG administrative costs will be incurred due to training of personnel and development of a family of tote box inserts. Schedule and performance will improve as availability of critical bearings improves from the high bearing reclamation yield.

The development of the inserts should require approximately 20 labor hours and would require approximately 200 tote box inserts at less than $5.00 each.

The implementation could be accomplished in three months.

10.32 QUICK FIX OPPORTUNITY TO MOTORIZE DIVIDING HEAD STANDS (MANPG)

10.32.1 Description of Current Operations

The manual test stands for directional and vertical displacement gyros are positioned and/or turned through cranking of hand wheels or hand wheel extenders.

10.32.2 Description of Current Process Problems

The hand cranking is laborous and is avoided by operator using alt. equipment and/or developing methods outside the T.O.

10.32.3 Description of New Process

MDMSC recommends the dividing heads of the manual test stands be motorized in both axis. The motor drives should be frictional to eliminate the need for expensive clutching systems and should allow for final positioning by the operator to eliminate encoders and servo systems. The drives should allow for a smooth constant rate but need not be of great accuracy.

10.32.4 Rationale Leading to Change

Directional gyros were observed waiting the availability of an alternate test set, KT426206, that was motor driven in one axis. Actual interviews of RCC personnel determined this was preferred to hand cranking the manual dividing heads. The hand cranking was very laborous and a smooth rate was difficult to maintain.

Safety Improvements: The hand wheels and extenders are presently in position to allow injury from tripping and/or running into. This hazard should be considered in the design.

Reliability/Maintainability Characteristics: Improvements possible due to closer adherence to T.O.'s.

Human Factors Design Criteria: Less laborous than hand cranking thereby reducing operator fatigue. Improvement in operator concentration.

10.32.5 Estimated Cost Savings

The benefit to be gained in test station capacity and versitility. By removal of the test stand avoidance, adherence to the T.O.'s will improve. Some cost savings are to be realized by reducing operator fatigue but would be difficult to quantify. Throughput should improve by reducing queuing time for the preferred test set.

10.32.6 Implementation Cost/Schedule

A single design would be necessary for all test stands. It would require approximately 75 hours to accomplish. The design could be incorporated into the test stands on a progressive basis to control cost occurrence. It should be incorporated for directional gyros first and then onto the vertical test stands. The actual cost of hardware implementation estimates should be made at completion of design phase. No adverse schedule impact is forseeable.

The design and build time for the modification could be accomplished within three months for the first group with build of one month for the following groups.

10.33 QUICK FIX OPPORTUNITY TO FIXTURIZE THE INDUCTION MACHINE (MANPG)

10.33.1 Description of Current Operations

To hold unit or subassembly in some hand clamping devise, activating the induction heater to heat the assembly until the solder flows. Strike the assembly on a part of the machine to impart enough energy to the assembly to force it apart.

10.33.2 Description of Current Process Problems

The units or subassemblies are being subjected to uncontrolled heat and shock forces producing damage to the units. The operation produces scrap and additional rework.

10.33.3 Description of New Process

MDMSC recommends that a list of all operations of disassembly performed on the induction machine be accomplished. A fixture designed with clamping devises for the list of units/subassemblies that can apply a separating spring force across the solder joint being heated. The spring force will be variable to allow control for the various units/subassemblies. Staging will be incorporated to assure heating of the separable joint with minimal heating of the rest of the assembly.

10.33.4 Rationale Leading to Change

Many observations of the induction machine operations were made. Much of the product from each of the three RCC's passes across it for disassembly operations. Forces great enough to distort parts and heating great enough to produce flaming insulation and cherry red metallic parts were seen in these observations. The suggested fixturization is used successfully in private industry.

Safety Improvements: Reduce or eliminate danger of injury from burns due to falling parts, burning insulation and solder splashes.

Environmental Hazards/Improvements: Elimination of fumes from burning insulation, solder fluxes and other combustible materials.

Reliability/Maintainability Characteristics: MTBF and MTBR should improve by eliminating structural changes in critical parts due to controlled temperature and reduced shock forces.

10.33.5 Estimated Cost Savings

Approximately 4,500 units pass across the induction heater for opening each year. The amount of scrap and/or damage caused by the present method is not recorded or identified. All units are experiencing unnecessary damage.

Large savings will be realized in greatly reducing unit/subassemble clean-ups, rewiring and part replacement costs. Fixtured disassembly should reduce disassembly damage, half clean-up time and eliminate rewiring due to heat damage. Intangible benefits will be gained through reducing structural change of metalic parts due to reduced heating. Tangible savings should also be obtained from increased MTBF though not quantifiable.

10.33.6 Implementation Cost/Schedule

Preparing a product list and accomplishing a fixture design will require approximately 100 hours with fixture build requiring a like amount. Implementation could be accomplished within two months of turn-on. No adverse schedule impact will be seen. The fixturization is add on causing little or no machine time interruption.

10.34 QUICK FIX OPPORTUNITY TO REMOVAL OF CLEAN ROOM GARB (MANPGA)

10.34.1 Description of Current Operations

MANPGA requires full suits, caped hoods and booties be worn and in place prior to entering the lab area. Air locks are also used for entering or exiting the suiting-up area.

10.34.2 Description of Current Process Problems

The requirement is inconsistent with other controls in the area and with like product in other areas. It is not considered necessary for like product by much of private industry today. The garb is doing little if anything to improve product cleanliness.

10.34.3 Description of New Process

Remove the requirements for the full suits, hoods and booties. Replace the air locks and dressing rooms with tack mats at lab entrances. Reprocess critical operations to laminar flow booths. Remove all excess material from the laminar flow booths. Forbid eating and drinking in the labs. Reduce dirty operations such as unsealing, resealing and filing or restrict them to force ventilated booths. Reduce line storage of product and equipment. NOTE: The restrictions on eating and drinking should be extended to MANPGB and MANPGC. The use of coat smocks might be encouraged to continue imortance of cleanliness.

10.34.4 Rationale Leading to Change

Observations of lab conditions, actual interviews with lab personnel, general knowledge of lab requirements through participation in the contamination control working group of the Inertial Guidance Community.

The present laminar flow booths are being badly misused. All are full of parts, tools, personal items. The filter areas are posted with schedules, tech. items, etc. All these items cause air flow restrictions and greatly reduce flow bench effectiveness.

Human Factors Design Criteria: Less restrictive of personnel movement, improved coverage by support functions.

10.34.5 Estimated Cost Savings

Labor savings will be realized from removal of all suit and unsuit up time. This is estimated to be greater than .8 hour per employee per day. Also savings can be realized in eliminated laundry costs of suits, hoods and booties. Additional cost savings will be realized from elimination of replacement costs. Product improvements will be accomplished by a disciplined cleaning schedule that is not limited to dust count improvement. An intangible savings should be realized through improved product support by removing the reluctance of support personnel to enter the lab areas. Areas presently used for suiting up also become availabe but building construction may limit it's usability.

10.34.6 Implementation Cost/Schedule

Some front end costs may be experienced by MANPG administration to develop laminar flow booth disciplines and cleaning schedules but these should be minimal and no adverse impact is expected on schedule.

The implementation schedule will be dependent on review of T.O. requirements and possible reluctance of change. AGMC and private industry practices and success rates should encourage acceptance.

10.35 QUICK FIX OPPORTUNITY TO IMPROVE RANDOM DRIFT DECISIONS (MANPGC)

10.35.1 Description of Current Operations

After sealing, units are placed on scorsby tables and connected to the test panel. The unit's heading error value is automatically printed out each half hour. One to twenty units are able to be tested at any time. An operator periodically enters the room and observes each unit's drift trend. As unit deviates from specification the readings are calculated for trending. At some point known only to this operator and influenced by time of day trending units are rejected, removed from test and sent to the sealing room along with test data to be opened and adjusted. The unit is resealed, returned to test and the process is restarted. Procedure is repeated until unit passes the eight hour test or is a hard failure.

10.35.2 Description of Current Process Problems

The rejection rate for first and second attempts appears to be 30%. From limited data, 30% appeared to continue into the third and fourth attempt. The decision to readjust does not seem to be bounded either by amount of trending or length of run time. The units are unsealed and adjusted on the second shift only and this may account for the looseness in decision timing. It does not appear to be controlled well enough to assure consistent product.

10.35.3 Description of New Process

Incorportate a decision devise into the panel to plot trending and automatically discontiue test at time of failure. Add a vented solder station and fill manifold to the test area to allow for immediate readjust and return to test. Use the operator who presently observes and plots the trending to increase his productivity.

10.35.4 Rationale Leading to Change

Discussions with the test personnel and review of available test data lead to the opinion that the control does not assure consistent product. It also lead to the conclusion product flow could be improved if adjustments could be made at the test site.

The approach generally taken by private industry in this type of testing is to tightly describe the acceptance values and allow for automatic rejection at the earliest point. This allows for least false testing time and quickest return to productive work. The approach imporves throughput and reduces flow time.

10.35.5 Estimated Cost Savings

Elimination of move time and queue times waiting for second shift operator. Development of adjustment expertise from cause and effect relationship. Efficient usage of testers time. Consistent rejection/acceptance decisions.

10.35.6 Implementation Cost/Schedule

Costs to be incurred would be the addition of a go/no-go devise on the present panel plus installation costs of a vented solder station and fill manifold. No adverse impact on schedule.

Schedule time to implement the change should require less than three months.

10.36 QUICK FIX OPPORTUNITY TO REARRANGE CN 74051A TEST/ REPAIR AREA (MANPGB)

10.36.1 Description of Current Operations

The repair stations are located on a heavy traffic aisle between the main building corridor and the sealing area. The test panels are located next to the repair stations on a dead end aisle.

10.36.2 Description of Current Process Problems

The repair operators are subjected to many distractions by the heavy traffic pattern through their area. Both their peers from other areas and various support personnel pass the work stations in performance of the daily tasks.

10.36.3 Description of New Process

Exchange the 010 test/calibration panel line with the repair operators line (CN 74051A). The move would remove the repair operators from the traffic pattern and it's accompanying distractions. The distractions would not impact the test/calibration panel line as severely because concentration span time is shorter and unit run times between adjustments is non-productive but necessary.

10.36.4 Rationale Leading to Change

Personnel observations and actual interviews with line supervision and line operators. General knowledge of length of concentration span times for gyro assembly and repair.

Safety Improvements: Do not exist.

Human Factors Design Criteria: Improved concentration times.

10.36.5 Estimated Cost Savings

The repair operators will increase their productivity through less distraction and camaraderie from being outside of the traffic pattern. The test operators should not be adversely effected because their task has inherently more non-productive time.

10.36.6 Implementation Cost/Schedule

Re-layout of the area would require approximately 20 hours and rearrangement approximately 60 hours of labor. It could be accomplished in about two months.

10.37 QUICK FIX OPPORTUNITY TO RELOCATION OF MASS SPECTROMETERS (MANPGB)

10.37.1 Description of Current Operations

Units are solder sealed in the repair area. Hand carried to the mass spectrometer. Leak checked. Hand carried back to the repair area. The two areas are approximately 120 paces apart. The movement is made through other repair areas with the normal distractions that occur.

10.37.2 Description of Current Process Problems

Time is being wasted in non-productive travel. The time wasted is not limited to just the actual walk time but is increased due to socializing, waiting to incorporate the walk with other desired activities. The operator is removed from supervisor's servalance.

10.37.3 Description of New Process

Seal units in the repair area. Leak check in the repair area. Continue work in the repair area.

10.37.4 Rationale Leading to Change

Actual interview with RCC personnel revealed that the mass spectrometers had been placed in this remote area to reduce malfunction of the system due to air contamination in the repair area. If the contamination condition is real, it can be overcome with flushing mass spectrometers with uncontaminated air with proper duct work. This approach is used in general industry where required.

The problem may be exaggerated by increasing sensitivity of the mass spectrometer beyond the rate required to meet the product requirements.

10.37.5 Estimated Cost Savings

MDMSC recommends that the mass spectrometers be relocated in the repair area. Savings to be realized would be 0.1 hour/unit checked. Minimum of 1000 units/year are checked.

10.37.6 Implementation Cost/Schedule

Cost to move the three mass spectrometers would be four hours each or 12 hours. If an air flushing system proves necessary an additional 10 hours of rearrangement cost would be required. The move could be accomplished within one month of turn-on.

10.38 QUICK FIX OPPORTUNITY TO VENTING THE VACUUM PUMPS OF MASS SPECTROMETERS (MANPGA)

10.38.1 Description of Current Operations

Mass spectrometers called out for leak checking of CN 74074A series gyros have been shutdown. The reason given is that the discharge from the rough vacuum pumps increases the dust count in the particulate specification levels. This action forces gyros to be hand carried approximately two hundred feet to a mass spectrometer outside the area.

10.38.2 Description of Current Process Problems

Approximately 0.2 hours of non-productive labor is added to each unit processed. Process flow is further interrupted by the requirement to unsuit and resuit in clean room garb. Some batching is attempted but it is rather hit and miss than planned.

10.38.3 Description of New Process

Leak check CN 74074A units on specified equipment with venting and/or filtering in place.

10.38.4 Rationale Leading to Change

Simple observation recommended that the discharged air could easily be vented or filtered to eliminate the increase in dust count. The mass spectrometers could then be returned to operation.

10.38.5 Estimated Cost Savings

Reduce labor hours on units leak checked by a minimum of 0.2 hour/assembly. Approximately 2000 units of the CN 74074A family are yielded each year. A minimum yearly savings of 2000 X 0.2 hours X $ /hour is available.

10.38.6 Implementation Cost/Schedule

Costs to vent the mass spectrometers would require less than 2 hours each X 2 units. Filtering if required could add $50.00 each. Scheduling would not be impact.

10.39 QUICK FIX OPPORTUNITY TO RE-EVALUATE NEED FOR DIAGNOSTIC CHECKS (MANPG)

10.39.1 Description of Current Operations

Receive unit, perform a complete incoming test (diagnostic check) on C/N 74146A gyroscope, teardown and repair as required, etc. The diagnostic check is performed on final test stand, KT426206, which show a usage rate of 41% at the present.

10.39.2 Description of Current Process Problems

Ninety percent of the units being repaired require complete teardown and rebuild of the gyro wheel. The ninety percent wheel repair figure was established through interview. The standards data sheets, E0468 labor standard operation resource std/method analysis, places the occurence factor at 100%. With this high a percentage of complete teardown, diagnostic testing prior to teardown is of very limited value.

10.39.3 Description of New Process

Receive the units, teardown through the wheel, rebuild complete as per T.O.'s.

10.39.4 Rationale Leading to Change

If 90% to 100% of the units require teardown through the wheel most failures identified other than wheel failures will be removed or changed in character by the teardown process. The failures that are not found will be identified through the normal build up process. Further, the 10% that do not contain identifiable wheel failure, probably contain wheels of limited remaining life.

Reliability/Maintainability Characteristics: The MTBF and MTBR should both be impacted in a positive manner with removal of early failures of the 10% figure for wheels not presently rebuilt.

10.39.5 Estimated Cost Savings

Removal of diagnostic test time, 0.5 hours/unit offset by the addition of 3.7 hours divided by 0.1 = .37 hours/unit for an overall reduction of .13 hours/unit x 1020 units/year or 133 hours/year.

10.39.6 Implementation Cost/Schedule

No cost to implement should be experienced. No affect on schedule. Change could be implemented immediately.

NOTE: The logic applied to this unit should be refined to develop a percentage number where diagnostic test should be dropped and 100% wheel rebuild demanded for all gyro product.

10.40 QUICK FIX OPPORTUNITY TO REBONDING OF 20012A TAPES (MANPGB)

10.40.1 Description of Current Operations

Replace tapes that have become unbonded in service or teardown with a new tape. Scrap old tape.

10.40.2 Description of Current Process Problems

The tapes that have become unbonded appear to be unnecessary scrap if a new bond could be accomplished.

10.40.3 Description of New Process

Remove parted tapes, clean, thermo-compression bond and reassemble into unit.

10.40.4 Rationale Leading to Change

Actual interviews with repair line supervisor and general knowledge of thermo-compression bonding. The tapes are not damaged other than separating. No jig or figuring should be necessary. The original parting line is evident for restaging.

10.40.5 Estimated Cost Savings

The present tapes experience 30% replacement. The present production rate for the 20012A family is approximately 1300/year or replacement rate of 500/year. Rebonding costs are .05 hours/ tapes. The cost of replacement tapes is $104.77/tape. (1299/ year X 21% replacement rate.) Gross savings/year of $28.6K. Note: Other like families of indicators should be reviewed for like tape problems.

10.40.6 Implementation Cost/Schedule

The cost of a thermo compression bonder (mico-bonder) is approximately $2,500.00. Plus two hours installation. Schedule is dependent only on delivery of the bonder as it is a line addition. The installation could be accomplished on delivery.

10.41 QUICK FIX OPPORTUNITY TO RECLAIM C/N 74126A SPIN AXIS BEARINGS (MANPGA)

10.41.1 Description of Current Operations

The outer races of the spin axis bearings of the 74126A gyro rotors are pressed out and scrapped along with the ball compliment and shaft.

10.41.2 Description of Current Process Problems

The present operation does not consider re-use of either bearing or bearing races. The races are placed in large boxes which tend to further damage parts.

10.41.3 Description of New Process

Press out outer races place races, shaft and ball compliments as a matched set into some type of protective container. Route container to bearing reclamation area for cleaning and evaluation. Route acceptable sets to wheel build area for re-use.

10.41.4 Rationale Leading to Change

Observation of wheel teardown showed races being removed that appeared to show little or no wear. Some of the bearings still contained lubrication with no discolorization. Bearings and races were examined under high magnification and no wear was evident. The bearings and races are replaced in matched pairs. Examination of the unit does not immediately reveal the reason for matching race to bearing. This must be studied but which ever is required, a process for reusing the bearings could be applied.

Reliability/Maintainability Characteristics: These should be re-evaluated for impact after the process is developed. At this point no impact is identified.

10.41.5 Estimated Cost Savings

Greater than 50% of the repaired 74126A gyroscopes require wheel rebuild. No additional cost should be incurred to control and package bearings for possible reclamation. The actual cost savings to be obtained can only be protected with development of a reclamation process and establishment of the process' success rate.

10.41.6 Implementation Cost/Schedule

A reclamation process and evaluation will require the services of a manufacturing engineer for one month and the support of a gyro technician for one to two weeks. The reclamation process could then be implemented after development of this process with no direct impact on repair schedule.

10.42 QUICK FIX OPPORTUNITY TO REDUCE OPERATOR MOVEMENT THROUGH FIXTURE IMPROVEMENT. (74126A, OPERATION 100) (MANPGA)

10.42.1 Description of Current Operations

Place directional gyroscope into calibration stand. Sit down on very low stool to observe azimuth scale through straight line borescope. Stand to adjust leveling axis, sit on low stool to verify setting. Restand to continue calibration.

10.42.2 Description of Current Process Problems

The standing, sitting, standing, sitting produces both operator fatigue and unsafe conditions. The stool is required to be very low due to eye alignment. The danger to the operator is increased by the stool being castered. Also, necessary to the sighting operation.

10.42.3 Description of New Process

Place directional gyroscope into the calibration stand. Observe azimuth scale through an angled borescope. Establish at standing eye level. Adjust leveling axis. Verify setting. Continue calibration.

10.42.4 Rationale Leading to Change

Observation of the operator performing the directional gyro calibration followed with interviews with the operators and first line supervisor..

Safety Improvements: Removal of injury potential from missing or moving the castored stool while sit-down or standing. Reduction of floor obstruction with the inherent gain in personnel movement freedoms.

Environmental Hazards/Improvements: As described in safety.

Reliability/Maintainability Characteristics: Not affected.

Human Factors Design Criteria: Reduction of operator fatigue from elimination of deep knee bends required to sit and/or stand to the castored stool.

10.42.5 Estimated Cost Savings

Direct dollars savings are not predictable from this change. The savings will be found in reduced operator fatigue. The intangible savings are the reduction of station litter and the removal of a safety hazard of tripping over the stool and/or missing it while attempting to lower one's self to sit down.

10.42.6 Implementation Cost/Schedule

The only cost associated with the change is the purchase of an angled borescope to replace the present in-line borescope. Such a devise would not exceed $250.00. Schedule is not impacted. The change could be implemented immediately after receiving the borescope.

10.43 QUICK FIX OPPORTUNITY TO REDUCE TEST TIME/IMPROVE TEST ACCURACY FOR C/N 74010A VERTICAL GYRO, OPERATIONS 20 & 200 (MANPGA)

10.43.1 Description of Current Operations

Both operation 20 and 200 are performed in the same manner. The gyroscope is tested on the automatic test stand, #704424, contraves vertical console. If the unit fails for drift accuracy, the unit is routed to the manual panel, L.T. 3330, gyro test set to be re-run and accepted if drift accuracy meets specification requirements.

10.43.2 Description of Current Process Problems

Present method required retest of approximately 44% of the product. It does not assure improved accuracy of product being returned to the field.

10.43.3 Description of New Process

Route all product to manual panel, L.T. 3330 gyro test set, for operations 20 and 200. Accept or reject by test results obtained. Correct test program for automatic test stand, #704424 contraves vertical test console before testing any product across it.

10.43.4 Rationale Leading to Change

Actual interview with test personnel revealed the double test procedure. Further discussion exposed the reasoning behind the procedure. The computer program in the contraves vertical console improperly calculates Earth rate drift in one or more headings. When the unit under test fails drift rates, it is assumed that the program error is the reason for the failure and therefore the failure is not valid and re-run is justified. This is valid. However Earth rate correction is a fixed rate at a heading and latitude; therefore, an incorrect value is applicable to both passing and failing units. To re-run only failures does not assure shipping acceptable product.

Reliability/Maintainability Characteristics: Present practices sends marginal to failing product to the field. The proposed method assures product returning to field meets specification. This should effect both reliability and maintainability in a positive manner.

10.43.5 Estimated Cost Savings

Immediate gain will be the elimination of re-tests or 1/3 of test time/unit (44% re-test). This is one labor hour/re-test or 1/2 labor hour/unit tested. Present schedule forecasts 1060 units/year. Total savings to be expected 1/2 hour X 1060 units = 530 labor hours minimum.

10.43.6 Implementation Cost/Schedule

No implementation cost is required to accomplish testing as described. Costs will be incurred if the A.T.E. Program is corrected. This cost should be estimated by Contraves and/or base programmers. Timing is also dependent on contraves input.

10.44 QUICK FIX OPPORTUNITY TO OBSOLESCENSE OF OLD BENCH TEST SETS (74146A WHEEL BLD) (MANPG).

10.44.1 Description of Current Operations

The older bench test sets and ruler supply panels for the C/N 74146A, J4 direction gyro wheel ass'y, KT426193 are no longer supportable. They are of 1950 design age and contain switches and meters no longer available. The devices have been repaired in varying manners just to continue operation. Numerous starts are sometimes required to become operational. Taps or kicks are also used. The condition is general over the older units. Discussion with panel and engineering planners confirmed observations that the conditions are increasing due to age of both design and hardware of the support test stands. Most product is of the mid-fifties to early sixties design.

10.44.2 Description of Current Process Problems

Due to age of both design and hardware of the support test stands. Most product is of the mid-fifties to early sixties design. The product that the test equipment services will continue to be repaired and returned to field for many more years but is very questionable if the present support test equipment will remain supportable over such a time frame .

10.44.3 Description of New Process

10.44.4 Rationale Leading to Change

The goal of the study is identify, plan and execute corrective actions prior to lengthy production interruptions due to unsupportable test equipment. Such a plan must be completed to assure wartime/readiness and/or surge acceptable posture.

10.44.5 Estimated Cost Savings

The benefit to be obtained is continued support of the present product line and their aircraft systems.

The goal is at risk of picking the wrong start point. The goal and condition of the test equipment would predict a line shut down without an alternate test approach is possible any time. The other risk is that a satisfactory alternate method is impractical al all because of expense and/or longivity of the product line.

10.44.6 Implementation Cost/Schedule

The study should be scoped to attack one RCC at a time - possibly even one product line - identification of problems will overlap lines and/or RCC's because of like product, age and design approach. I would suggest that MANPGC be the first RCC. If that is still too large, attack directional gyro first - 74146A, 74148A and 74126A with the 74149A slaving control also included. I would further suggest the study at either level will require 2 to 3 months to general approach and cost trending.

10.45 QUICK FIX OPPORTUNITY TO IMPROVE BEARINGS PROCUREMENT AND HANDLING PROCEDURES (MANPG).

10.45.1 Description of Current Operations

The responsible OC-ALC Item Manager specifies the technical description, requests competitive bids from qualified suppliers, selects vendor(s), establishes shipment schedules and procures the required instrument bearings for annual production requirements for all ALCs. All follow up and status of the procurement is also accomplished by OC-ALC Item Manager. AGMC has no authority at all in the procurement process.

10.45.2 Description of Current Process Problems

Instrument bearing quality related problems are a major cost and schedule impact at AGMC and WR-ALC aircraft gyroscope repair activities. This impact manifests itself in corrosion that is frequently evident visually on packaged bearings when initially received at the MAPGB facility. Currently, significant rework/ repair costs occur associated with bearing re-inspection, scrap efforts, and nearly 100% repair/cleaning for salvage.

10.45.3 Description of New Process

10.45.4 Rationale Leading to Change

To improve supplier reliability, procurement specifications and material handling procedures to substantially reduce labor costs and increase throughout in AGMC GRU repair operations.

10.45.5 Estimated Cost Savings

An improvement in the quality of instrument bearings available from the ALC material control inventory will eliminate current rework/repair costs associated with re-inspection and nearly 100% cleaning efforts required to produce acceptable bearings. As an example, AGMC currently plans to purchase and implement another Cyl-Sonic cleaning system to meet capacity requirements. This could be eliminated saving a minimum $150,000 implementation expense. Also, the technology could be transferred across the Command avoiding similar rework costs at WR-ALC.

There are no technical risks identified with the insertion of this improvement into the repair processes at both ALCs. Only possible risk might be the administrative difficulty of the AFLC Item Management System to quickly respond to procurement revisions.

- Reduction in ALC bearings repair/salvage/scrap costs.
- Estimated 50% reduction possible in bearings inventory.
- Reduced overheard costs.
- Eliminate the need for an additional Cyl-Sonic cleaning system dedicated to instrument bearings rework. (Cost avoidance of approximately $150,000 capital expense plus floor space allocation costs.)

10.45.6 Implementation Cost/Schedule

A total review of supplier reliability, procurement specifications and material handling procedures is needed at both ALCs to identify opportunities for quality and productivity improvements. MDMSC will meet with vendors and the item manager to resolve concerns. A two to three month period of time is expected to be sufficient to evaluate both ALCs, the bearings supplier(s) and the OC-ALC item manager.

Bob, I don't know what heading to put this under:

Staffing Estimates (preliminary):

It should be understood that the following estimate overview is preliminary in nature. Further cost analysis details will be available upon submittal of the final Contract Summary Report CDRL B008 (approx. 26 January 1989).

	DESCRIPTION	DURATION	EFFORT
MDMSC:			
	T.O. MGR.	2-3 Months	50%
	SR. I.E.	2-3 Months	100%
	I.E.	2-3 Months	100%
	M & P Engr.	1-2 Months	50%
	Tech Writer	1 Month	50%
	T.I. Program Administrative Costs		10%
	MDMSC Travel Expenses (Actuals)		

AFLC Estimates:

Air Force Administration Costs
Integration/Implementation Costs
OC-ALC Item Manager Implementation Costs

[redacted]

Following are the Potential Improvements for Focus Studies.

Appendix

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC RCC: MANPGA OF:

NAME: VANDERVOORD FS: GS-5

HEADING: FILL PROCEDURE FOR 74074A TO REPLACE PRESENT STATION

10.1.1 Description of Current Operation:

Filling. The rate gyroscope is to be filled with damping fluid, part number 113B5890G1 or DS510-100CS ± 2%, using purging and filling equipment, 231E427G1. Filter through a one-micron filter. Refer to Technical Manual, Operation and Service Instructions, Gyro and Accelerometer Oil Filling Equipment, TO 33D3-9-140-1, for procedures necessary to prepare the purging and filling equipment for filling sensors, and for detailed operation instructions.

a. Uncoil fill tube in bellows end of unit to be filled, being careful not to fracture tube at point where the tube emerges from bellows.

b. Loosen thumbscrew of heater clamp on purging and filling equipment. The heater clamp forms bellows setting for unit to be filled. Insert the sensor, bellows end down, into the heater clamp. Be sure sensor is firmly seated at bottom of clamp because the clamp seat is used to establish final bellows position. Tighten knurled heater clamping screw. Fill tube on the bellows end runs through the hole in seat of the clamp and into oil supply line coupling.

c. Connect knurled vacuum coupling on transparent tubing to oil filler tube at pickoff end of sensor, and tighten coupling.

d. Tighten coupling at bellows end fill tube connection to oil supply line.

e. Energize heater clamp to apply heat to the unit being filled. Operate fill equipment for five hours to evacuate all air, vapor, and other gases from unit. A pressure of 25 microns or less shall be maintained during entire evacuation cycle.

f. Remove heat from the unit be deenergizing heater after five hours of application. Allow unit to cool to room temperature while continuing to evacuate the unit. Allow unit to cool for at least one hour while being evacuated.

g. Pump damping fluid into bellows end of unit at 10 to 15 psig. Maintain vacuum at pickoff end during fill. When fluid can be seen above rate gyro assembly in the fill equipment transparent tube, continue to fill for a least forty-five minutes.

h. Pinch off pickoff end fill tube so that pinched end is no higher than stator pins.

i. Maintain 10 to 15 psig fluid pressure through bellows end fill tube for one hour to ensure that bellows has bottomed against bellows fixture.

j. Pinch off bellows end fill tube about one inch long. Fluied pressure must be at least 8 psig at time of pinch-off.

k. Both fill tube pinch-offs should result in cold-welded joints that are tight enough to prevent leakage of damping fluid. Apply a ball of solder SN-60, to end of each fill tube to completely cover the pinch-off joint.

l. Remove rate gyro assembly from fill equipment.

m. Coil the fill tube at bellows end into bellows. Tube must lie flat against surface of bellows and must not extend into bellows convolutions.

n. Measure depth of bellows int he bellows assembly, using a depth micrometer. Bellows shall be 0.330 to 0.350 inch below outer surface of the bellows assembly. Measure to flat surface of the bellows.

Overall Assessment of Current Operation:

Current Process Problems:

Equipment is a ~~four~~ headed pressure, heat, vacuum system that requires abnormal maintainance time. Seldom are both banks in operation. Present downtime is so great, the work load has been renegotiated to work only a skeleton crew. Personnel has been reassigned to other areas with the RCC.

Shop Organization:

Rationale Leading to Change:

Simplify filling procedures and equipment to reduce time required to perform operation. Greatly improve reliability and availability of station time.

Supporting Data:

Description of New Process:

Mechanically cock the bellows to obtain the .330" to .350" dim. in T.O.

6.44n.
Place unit in bell jar with filters, flap in place.
Pump down to pressure of <25 microns for 5 hours.
Fill filter resv. with DS 570-100CS ± 2%.
Slide flap to allow silicone oil to enter filter - control rate to fill unit in 1 hour minimum (need to develop)
Over fill to some level in funnel to allow for loss with pressure increase.
Vent to one atmosphere.
Remove bell jar.
Seal as before.
Uncock bellows.

Study required to develop.

1. Cocking method.
2. Length of pump down.
3. Rate of fill.
4. Test approach for comparision.

Productivity Improvements:

Quality Improvements:

Resource Utilization:

Flexibility:

Benefits/Trade-offs:

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC   RCC: WR/MANPGB & AGMC/MANPBG   QF:

NAME: VANDERVOORD   FS: GS-1

HEADING: RCC WR/MANPGB & AGMC/MANPBG ON AUTOMATIC TEST EQUIPMENT VS. PRODUCT OPTIMATION

Description of Current Operation:

Perform incoming diagnostic test procedure and final acceptance test procedure on the contraves automatic test equipment. Print out unit performance values with product specification limits and accept, reject decisions. Record this same information for storage to the hard disk drives. Store all hard disks. Note: To date no usage of stored data is being planned.

Overall Assessment of Current Operation:

USE AGMC WRITE UP
CHECK WITH BILL BUCHNEIR

Current Process Problems:

Shop Organization:

Rationale Leading to Change:

The data presently stored should be used to develop:

a) Test stand capabilities
b) Test stand accuracies
c) Test stand maintainance schedule
d) Test equipment error budgets
e) Test equipment error biasing
f) Product trending
g) Product repeatabilities
h) Necessities of individual tests
i) Etc.

Supporting Data:

Description of New Process:

Productivity Improvements:

The data can be sorted and compared to give calibration centering data for both test stands and product. This will allow for maximizing product acceptance to the product specification. It will improve product yield in a positive manner. Improved field reliability by assuring middle specification product entering the field. Allow for the development of meanful and timely preventive maintainance schedules. Assure test panel to test panel compatibility is maintained. Product trending can be identified allowing timely corrective actions. Confidence levels can be established that should identify areas that can reduce test times and frequencies. Weak areas of test equipment will be identified, allowing for correction and the inherent decrease in test equipment down time.

Quality Improvements:

Resource Utilization:

Flexibility:

Benefits/Trade-offs:

The data required by the study is available and stored in a usable form at both locations. It is of ample size to satisfy needs for meaningful distribution studies. Navy has developed similar programming through Fletac for A.T.E. capability studies. MDMSC is familiar with the programming through the association with the Harpoon and GMB109B programming.

The unknown required to be established by the study are format of the data stored, number on computer programs required and programming output format for maximizing data usability.

The stability of the study area is stable through 1992 per the forecasted workload report WG324-130.

Cost Savings:

Implementation Cost/Schedule:

The study should develop programs to extract the data from the disk storage, organized the data, sort it for test distribution studies and predict product trending. The study will require the service of the following:

* Site Leader	3 months
* Test Engineer	3 months
* Computer Programmer	?
* Computer Operation Team	?
* Tech Writer	?

* Requires input from compt. people. Time will be required at both sites (WR/AGMC) but AGMC should be used to develop methodology and programming approach.

Impact:

Safety Improvements:

Environmental Hazards/Improvements:

Reliability/Maintainability Characteristics:

Human Factors Design Criteria:

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC RCC: WR-MANPGB & AGMC-MANPBG QF: ______

NAME: VANDERVOORD FS: GS-2

HEADING: RCC WR-MANPGB & AGMC-MANPBG TO OPTIMIZE UTILIZATION OF GYRO A.T.E. THRU THE REDUCTION OF TEST EQUIPMENT DOWN TIME

Description of Current Operation:

The preferred method of operation at both locations is to route all incoming and final acceptance testing across the contraves automatic test stations. The desire is to reduce labor input by performing testing on multiple units and test stations with minimum test personnel and to gain maximum product reliability and integrity through reduction of personnel biaing ? and test influences. The desire presently cannot be realized because A.T.E. is not usable approximately 50% of the time because of malfunction and/or breakdown or lack of confidence of the test values obtained. Focus study No.______ will address the confidence problem. This focus study will cover test equipment availability.

Overall Assessment of Current Operation:

USE AGMC WRITE UP
BILL BUCHMEIR

Current Process Problems:

The low availability of the equipment. The lack of confidence in values obtained causing morale problems and distrust between test and repair areas. Increases in test time because multiple tests cannot be run or validation of failures requires manual testing.

Shop Organization:

Rationale Leading to Change:

The need for the study is the exterme downtime of the A.T.E. and the lack of confidence in the test values obtained. The goal of this study is to reduce the station down enough to realize 90% availability of the A.T.E. for maximum test events of Gyro product. Such improvement will improve measurably the return on investment of vital pram funded equipment and improve confidence level in gyro product returning to service. It will also increase technology consistency between WR-AFLC and AGMC by common solutions to like problems.

Supporting Data:

Description of New Process:

Productivity Improvements:

Quality Improvements:

Resource Utilization:

Both RCC's maintain monthly measurements of auto test equipment availability. AGMC is a formal reporting system referred to as station no. summary all MPBGA, job 4932 A9040A while Warner Robins has an informal report developed by the A.T.E. supervisor for his personal use. Though in different format and completeness both reports show uptime/downtime of test stations.

Flexibility:

Benefits/Trade-offs:

The opportunity to succeed in the stated goals are very possible. The percentage of availability is consistent with availability of like equipment in private industry today. The main risk to not being able to obtain the goal is from lack of detailed knowledge of station design, history of panel failure causes and degree of design margin from panel equipment budgeted error profiles. The A.T.E. presently is the main test equipment for both RCC's and should be capable of testing all present product. Any new inducted systems should be applicable with minor fixturization and fronted computer programming costs.

Cost Savings:

Implementation Cost/Schedule:

(Bill I believe you should write this section with Bashyam's help. You will require services of knowledgable test engineer, system people and visits to contraves if detailed design and equipment specifications are not available. I would suggest 4/5 months study time with possibly some equipment re-specing and complete maintainance schedules and trouble shooting manuals.)

Impact:

Safety Improvements:

Environmental Hazards/Improvements:

Reliability/Maintainability Characteristics:

Human Factors Design Criteria:

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC RCC: WR-MANPG QF:

NAME: VANDERVOORD FS: GS-3

HEADING: WR-MANPG TO COMBINE GYRO ROTOR ASEMBLY REPAIR TO A COMMON LINE FLOW

Description of Current Operation:

Gyro units for repair are disassembled and the rotor assemblies removed and set aside for repair and rebuild. The rotor assembly is replaced by a previously repaired rotor assembly and the rebuild of the gyro unit under repair is completed. The removed rotor assemblies are accumulated into batches of ten to twenty assemblies. They are then repaired as a group by some member of the line tech. personnel in the particular gyro repair line. The rebuild action is informally scheduled by line needs and/or tech. availability. The present method is common for all gyro lines and across the three WR-MANPG RCC's.

Overall Assessment of Current Operation:

- OBSERVATION -

Current Process Problems:

The present method requires much duplication of equipment. Each product line requires run-in stations, balance machines, leak detectors, filling equipment, ovens, etc. The utilization time of the equipment is generally very light. Rotor assemblies for the gyro assemblies require repair approximately 85% of the time and represent about 2% of the average hours to repair a gyro assembly. The method limits expertise by greatly reducing consecutive repetitive experiences by an operator. It limits common methods for simular assemblies, reduces recognition of common problems. It also increases equipment costs for new technology. The cost of parts inventory is also increase for common parts. The build of rotor assemblies in small quantities and many different technicians and locations encourages deviations from the T.O. methods.

Shop Organization:

Rationale Leading to Change:

The study goals are to substantially reduce labor input for gyro rotor assembly repair, to increase expertise through repetitive operations, reducing attention spans, increasing field reliability through consistent build practices and reduction of reaction time to common problems and/or part deviations. The change will produce improved cross teaming developing rotor repair experts across all gyro product. It will imporve production/process flexibility by familiarizing engineering and planning of alternate build methods. The change will also prepare WR-ALC to except and integrate the new laser rotor balancing procedures being devleoped by AGMC-MAPBG without having to duplicate the expensive laser balancer on each product line.

Supporting Data:

Description of New Process:

Productivity Improvements:

(Bob, this paragraph will require more field information. The model may help in developing "AS IS" costs and a base for "TO BE" inputs. I suggest parts of the study will be necessary to develop savings. Many may prove intangible and/or required by introduction of laser balance. Some others are quipment and space utilization and in house/field reliability improvement.)

Quality Improvements:

Resource Utilization:

Flexibility:

Benefits/Trade-offs:

One identified risk of combining rotor assembly repair will be schedule compliance. The present method allows each line supervisor to control the availability of repaired rotor assemblies for his product line. However, it does not consider best line load and/or optimize quantity. It does not consider repair quality or training procedures/requirements. It is an "Oh, by the way..." scheduling and has lead to uncontrolled build in many areas.

Cost Savings:

Implementation Cost/Schedule:

(Bob, the effort for F.W. will be identifying area to combine repair, gather all present equipment requirement, produce an area layout and process flow. The study should also suggest a scheduling plan to satisfy F/C line requirements. Some production schedule impact may be experienced during change over.

Impact:

Safety Improvements:

Environmental Hazards/Improvements:

Reliability/Maintainability Characteristics:

Human Factors Design Criteria:

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC RCC: QF:

NAME: VANDERVOORD FS: GS-4

HEADING: OBSOLESCENSE OF OLD BENCH TEST SETS (74146A WHEEL BLD)

Description of Current Operation:

The older bench test sets and ruler supply panels for the C/N 74146A, J4 direction gyro wheel ass'y, KT426193 are no longer supportable. They are of 1950 design age and contain switches and meters no longer available. The devices have been repaired in varying manners just to continue operation. Numerous starts are sometimes required to become operational. Taps or kicks are also used. The condition is general over the older units. Discussion with panel and engineering planners confirmed observations that the conditions are increasing due to age of both design and hardware of the support test stands. Most product is of the mid-fifties to early sixties design.

Overall Assessment of Current Operation:

Current Process Problems:

Due to age of both design and hardware of the support test stands. Most product is of the mid-fifties to early sixties design. The product that the test equipment services will continue to be repaired and returned to field for many more years but is very questionable if the present support test equipment will remain supportable over such a time frame .

Shop Organization:

Rationale Leading to Change:

The goal of the study is identify, plan and execute corrective actions prior to lengthy production interruptions due to unsupportable test equipment. Such a plan must be completed to assure wartime/readiness and/or surge acceptable posture.

Supporting Data:

Description of New Process:

Productivity Improvements:

The benefits to be obtained is continued support of the present product line and their aircraft systems.

Quality Improvements:

Resource Utilization:

Flexibility:

Benefits/Trade-offs:

The goal [illegible] at risk of picking the wrong start point. The goal and condition of the test equipment would predict a line shut down without an alternate test approach is possible any time. The other risk is that a satisfactory alternate method is impractical al all because of expense and/or longivity of the product line.

Cost Savings:

Implementation Cost/Schedule:

The study should be scoped to attack one RCC at a time - possibly even one product line - identification of problems will overlap lines and/or RCC's because of like product, age and design approach. I would suggest that MANPGC be the first RCC. If that is still too large, attack directional gyro first - 74146A, 74148A and 74126A with the 74149A slaving control also included. I would further suggest the study at either level will require 2 to 3 months to general approach and cost trending.

Impact:

Safety Improvements:

Environmental Hazards/Improvements:

Reliability/Maintainability Characteristics:

Human Factors Design Criteria:

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC RCC: MANPGA QF: ____________

NAME: VANDERVOORD FS: GS-5

HEADING: FILL PROCEDURE FOR 74074A TO REPLACE PRESENT STATION

Description of Current Operation:

Filling. The rate gyroscope is to be filled with damping fluid, part number 113B5890G1 or DS510-100CS ± 2%, using purging and filling equipment. Filter through aone-micron filter. Refer to Technical Manual, Operation and Service Instructions, Gyro and Accelerometer Oil Filling Equipment, TO 33D3-9-140-1, for procedures necessary to prepare the purging and filling equipment for filling sensors. and for detailed operation instructions.

a. Uncoil fill tube in bellows end of unit to be filled, being careful not to fracture tube at point where the tube emerges from bellows.

b. Loosen thumbscrew of heater clamp on purging and filling equipment. The heater clamp forms bellows setting for unit to be filled. Insert the sensor, bellows end down, into the heater clamp. Be sure sensor is firmly seated at bottom of clamp because the clamp seat is used to establish final bellows position. Tighten knurled heater clamping screw. Fill tube on the bellows end runs through the hole in seat of the clamp and into oil supply line coupling.

c. Connect knurled vacuum coupling on transparent tubing to oil filler tube at pickoff end of sensor, and tighten coupling.

d. Tighten coupling at bellows end fill tube connection to oil supply line.

e. Energize heater clamp to apply heat to the unit being filled. Operate fill equipment for five hours to evacuate all air, vapor, and other gases from unit. A pressure of 25 microns or less shall be maintained during entire evacuation cycle.

f. Remove heat from the unit be deenergizing heater after five hours of application. Allow unit to cool to room temperature while continuing to evacuate the unit. Allow unit to cool for at least one hour while being evacuated.

g. Pump damping fluid into bellows end of unit at 10 to 15 psig. Maintain vacuum at pickoff end during fill. When fluid can be seen above rate gyro assembly in the fill equipment transparent tube, continue to fill for a least forty-five minutes.

h. Pinch off pickoff end fill tube so that pinched end is no higher than stator pins.

i. Maintain 10 to 15 psig fluid pressure through bellows end fill tube for one hour to ensure that bellows has bottomed against bellows fixture.

j. Pinch off bellows end fill tube about one inch long. Fluied pressure must be at least 8 psig at time of pinch-off.

k. Both fill tube pinch-offs should result in cold-welded joints that are tight enough to prevent leakage of damping fluid. Apply a ball of solder SN-60, to end of each fill tube to completely cover the pinch-off joint.

l. Remove rate gyro assembly from fill equipment.

m. Coil the fill tube at bellows end into bellows. Tube must lie flat against surface of bellows and must not extend into bellows convolutions.

n. Measure depth of bellows int he bellows assembly, using a depth micrometer. Bellows shall be 0.330 to 0.350 inch below outer surface of the bellows assembly. Measure to flat surface of the bellows.

<u>Overall Assessment of Current Operation</u>:

<u>Current Process Problems</u>:

Equipment is a four headed pressure, heat, vacuum system that requires abnormal maintainance time. Seldom are both banks in operation. Present downtime is so great, the work load has been renegotiated to work only a skeleton crew. Personnel has been reassigned to other areas with the RCC.

Shop Organization:

Rationale Leading to Change:

Simplify filling procedures and equipment to reduce time required to perform operation. Greatly improve reliability and availability of station time.

Supporting Data:

Description of New Process:

Mechanically cock the bellows to obtain the .330" to .350" dim. in T.O.

6.44n.
Place unit in bell jar with filters, flap in place.
Pump down to pressure of <25 microns for 5 hours.
Fill filter resv. with DS 570-100CS ± 2%.
Slide flap to allow silicone oil to enter filter - control rate to fill unit in 1 hour minimum (need to develop)
Over fill to some level in funnel to allow for loss with pressure increase.
Vent to one atmosphere.
Remove bell jar.
Seal as before.
Uncock bellows.

Study required to develop.

1. Cocking method.
2. Length of pump down.
3. Rate of fill.
4. Test approach for comparision.

Productivity Improvements:

Quality Improvements:

Resource Utilization:

Flexibility:

Benefits/Trade-offs:

Cost Savings:

Implementation Cost/Schedule:

Impact:

Safety Improvements:

Environmental Hazards/Improvements:

Reliability/Maintainability Characteristics:

Human Factors Design Criteria:

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC RCC: QF:

NAME: VANDERVOORD FS: GS-6

HEADING: AUTOMATE DEPAINT, UNSEAL RESEAL PROCESS

Description of Current Operation:

Gyro units are currently manually unsealed, depainted, resealed and leak checked in a semi-enclosed room adjacent to normal displacement gyro repair and test activities.

Overall Assessment of Current Operation:

AGMC WRITEUP

Current Process Problems:

Environmental, safety, and equipment conditions are substandard as compared to most AGMC facilities. Without an enclosed ventilation system there is a risk of periodic foreign object contamination when processing equipment malfunctions.

Shop Organization:

Rationale Leading to Change:

To substantially reduce labor costs and increase throughput in AGMC GRU repair operations through implementation of modernized equipment, batch processing methods.

Supporting Data:

Description of New Process:

Productivity Improvements:

Eliminate technicians exposure to irritating fumes and high temperature heavy-duty soldering irons with the implemetnation of semi-automatic processing deseal/reseal equipment and improved facilities.

Quality Improvements:

Resource Utilization:

Flexibility:

Benefits/Trade-offs:

There are technical risks identified with the insertion of this improvement into the repair processes at AGMC. Consider the risks of not being able to successfully automate, obtain adequate seals, etc. Also, some inventory stockpiling may be required in the immediate sealing area prior to production interruption during facility rearrangements.

Cost Savings:

Reduced overhead costs.

Implementation Cost/Schedule:

A thorough review of state-of-the-art commercial aerospace Gyro manufacturers will address the cost effective modernization improvements possible at AGMC sealing, leak checking and finishing operations. A two to three month period of time is expected to be sufficient to evaluate private industry and AGMC. Expand to include others doing automated depaint, unseal, etc.

Impact:

Safety Improvements:

Environmental Hazards/Improvements:

Reliability/Maintainability Characteristics:

Human Factors Design Criteria:

Bob, what heading should this go under?:

Staffing Estimates (preliminary):

It should be understood that the following estimate overview is preliminary in nature. Further cost analysis details will be available upon submittal of the final Contract Summary Report CDRL B008 (approx. 26 January 1989).

	DESCRIPTION	DURATION	EFFORT
MDMSC:	T.O. MGR	2-3 Months	50%
	SR. I.E.	2-3 Months	100%
	I.E.	2-3 Months	100%
	M & P Engr.	1-2 Months	50%
	Tech Writer	1 Month	50%
	T.I. Program Administrative Costs		10%
	MDMSC Travel Expenses (Actuals)		

AFLC Estimates:

Air Force Administration Costs
Integration/Implementation Costs

FS: GS-6

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC RCC: ______ QF: ______

NAME: VANDERVOORD FS: GS-7

HEADING: IMPROVE BEARINGS PROCUREMENT AND HANDLING PROCEDURES

Description of Current Operation:

The responsible OC-ALC Item Manager specifies the technical description, requests competitive bids from qualified suppliers, selects vendor(s), establishes shipment schedules and procures the required instrument bearings for annual production requirements for all ALCs. All follow up and status of the procurement is also accomplished by OC-ALC Item Manager. AGMC has no authority at all in the procurement process.

Overall Assessment of Current Operation:

Current Process Problems:

Instrument bearing quality related problems are a major cost and schedule impact at AGMC and WR-ALC aircraft gyroscope repair activities. This impact manifests itself in corrosion that is frequently evident visually on packaged bearings when initially received at the MAPGB facility. Currently, significant rework/ repair costs occur associated with bearing re-inspection, scrap efforts, and nearly 100% repair/cleaning for salvage.

Shop Organization:

Rationale Leading to Change:

To improve supplier reliability, procurement specifications and material handling procedures to substntially reduce labor costs and increase throughout in AGMC GRU repair operations.

Supporting Data:

Description of New Process:

Productivity Improvements:

An improvement in the quality of instrument bearings available from the ALC material control inventory will eliminate current rework/repair costs associated with re-inspection and nearly 100% cleaning efforts required to produce acceptable bearings. As an example, AGMC currently plans to purchase and implement another Cyl-Sonic cleaning system to meet capacity requirements. This could be eliminated saving a minimum $150,000 implementation expense. Also, the technology could be transferred across the Command avoiding similar rework costs at WR-ALC.

Quality Improvements:

Resource Utilization:

Flexibility:

Benefits/Trade-offs:

There are no technical risks identified with the insertion of this improvement into the repair processes at both ALCs. Only possible risk might be the administrative difficulty of the AFLC Item Management System to quickly respond to procurement revisions.

Cost Savings:

- Reduction in ALC bearings repair/salvage/scrap costs.
- Estimated 50% reduction possible in bearings inventory.
- Reduced overheard costs.
- Eliminate the need for an additional Cyl-Sonic cleaning system dedicated to instrument bearings rework. (Cost avoidance of approximately $150,000 capital expense plus floor space allocation costs.)

Implementation Cost/Schedule:

A total review of supplier reliability, procurement specifications and material handling procedures is needed at both ALCs to identify opportunities for quality and productivity improvements. MDMSC will meet with vendors and the item manager to resolve concerns. A two to three month period of time is expected to be sufficient to evaluate both ALCs, the bearings supplier(s) and the OC-ALC item manager.

Impact:

Safety Improvements:

Environmental Hazards/Improvements:

Reliability/Maintainability Characteristics:

Human Factors Design Criteria:

Bob, I don't know what heading to put this under:

Staffing Estimates (preliminary):

It should be understood that the following estimate overview is preliminary in nature. Further cost analysis details will be available upon submittal of the final Contract Summary Report CDRL B008 (approx. 26 January 1989).

	DESCRIPTION	DURATION	EFFORT
MDMSC:			
	T.O. MGR.	2-3 Months	50%
	SR. I.E.	2-3 Months	100%
	I.E.	2-3 Months	100%
	M & P Engr.	1-2 Months	50%
	Tech Writer	1 Month	50%
	T.I. Program Administrative Costs		10%
	MDMSC Travel Expenses (Actuals)		

AFLC Estimates:

Air Force Administration Costs
Integration/Implementation Costs
OC-ALC Item Manager Implementation Costs

FS: GS-7 ~~GS-7~~

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC RCC: MANPBG OF:

NAME: VANDERVOORD FS: GS-8

HEADING: LASER WHEEL BALANCING (DELAY/MONITOR AGMC)

Description of Current Operation:

A new pram funded dynamic balancing laser system for gyro rotors is scheduled to be installed in the AGMC Gyro Reference Unit Wheel Repair Facility during the first quarter of CY 1989. WR-ALC is not as yet ready to specify or define a specific system.

DROP

Overall Assessment of Current Operation:

Current Process Problems:

A significant material and labor cost is incurred by the frequent rework scrap generated by improper manual drilling of the rotor wheel during the difficult precision balancing process.

Shop Organization:

Rationale Leading to Change:

Once the AGMC Laser Balancing System is operational and an attractive return on investment (ROI) can be verified utilizing Taguchi investigation methods, MDMSC will act as coordinator to accelerate the implementation of a similar Rotor Dynamic Balancing Laser System at WR-ALC to provide technology consistency across AFLC.

Supporting Data:

Description of New Process:

Productivity Improvements:

Accelerate the implementation of AGMC's Laser Balancer and verify attained cost savings and ROI. MDMDSC can perform as technology transfer manager to insert this same process improvement at WR-ALC in the shortest possible amount of time.

Quality Improvements:

Resource Utilization:

Flexibility:

Benefits/Trade-offs:

Once AGMC's Laser Balancing System is operational and accepted by all users there are no technical risks identified with the insertion of this improvement into the repair processes at WR-ALC.

Cost Savings:

Implementation Cost/Schedule:

A relatively quick study is needed at both ALC's to identify opportunities for quality and productivity improvements. A one to two month period of time is expected to be sufficient to evaluate both ALC's involved.

Impact:

Safety Improvements:

Environmental Hazards/Improvements:

Reliability/Maintainability Characteristics:

Human Factors Design Criteria:

Bob, what heading?

Staffing Estimates (preliminary):

It should be understood that the following estimate overview is preliminary in nature. Further cost analysis details will be available upon submittal of the final Contract Summary Report CDRL B008 (approx. 26 January 1989).

	DESCRIPTION	DURATION	EFFORT
MDMSC:	T.O. MGR	1-2 Months	50%
	SR. I.E.	1-2 Months	100%
	I.E.	1-2 Months	100%
	M & P Engr	1 Month	50%
	Tech Writer	1 Month	50%
	T.I. Preogram Administrative Costs		10%
	MDMSC Travel Expenses (Actuals)		

AFLC Estimates:

Air Force Administration Costs
Integration/Implementation Costs
WR-ALC Floorspace Allocation Costs

FS: GS-8

TECHNOLOGY INSERTION PROGRAM

ALC: WR-ALC RCC: ________ QF: ________

NAME: VANDERVOORD FS: GS-9

HEADING: COMPARE A.T.E. TO MANUAL (DELAY FOR RESULTS FROM 1)

Description of Current Operation:

Diagnostic tests and/or final acceptance tests are often performed on both A.T.E. and manual test sets. The duplication of tests is because of lack of confidence in one or both pieces of equipment. The problem is evident at both AGMC-MANPBG and WR-ALC, MANPG. The difference between the basses is AGMC places more faither in the manual stations and accepts product in dispute from manual station values while WR-ALC, MANPG in general uses the A.T.E. as the final acceptance measure.

Overall Assessment of Current Operation:

AGMC WRITEUP

Current Process Problems:

The basic problem is evident from opposite approaches taken by the separate bases. The acceptability of values from either set of equipment is by opinion or rationale of the acceptor and not from an engineering researched position. Opportunity to compromise product is very great in either method. Both locations perform redundant testing, increasing labor input unnecessarily.

Shop Organization:

Rationale Leading to Change:

Determine quantified statistics through Taguchi* analysis of compatibility and/or differences between the GRU A.T.E. and manual test stations to allow full utilization of the RCC equipment resources. Use distributions and values obtained through Focus Study 6 A.T.E. vs. Product for A.T. E. characteristics.

* - I do not believe that "Taguchi" will do anything toward this end! This should be results of aseies of test data comparisions. A Taguchi array may rate number of comparisions necessary and impact weight of some conditions.

Supporting Data:

Description of New Process:

Productivity Improvements:

In addition to the obvious elimination of duplicate testing, reliability of the product and the increase in field time should result in further cost savings. Both will be obtained by shipping more product meet specification allowing maximum field time before failure. There are alos pisitive intangible benefits to be gained in employee morale and product confidence.

Quality Improvements:

Resource Utilization:

(Obvious savings from duplicate test - occurrence factor will vary with product line - data is in model also should have occurence factor from WCD history.)

Flexibility:

Benefits/Trade-offs:

One risk that must be considered is that an indepth study will result in neither test methods meet the product specification. Another consideration is that product randomeness is too great to produce meaningful tests.

Cost Savings:

Implementation Cost/Schedule:

A total review is needed at both ALC's to identify opportunities for quality and productivity improvements. A two to three month period of time is expected to be sufficient to evaluate both ALC's involved.

Impact:

Safety Improvements:

Environmental Hazards/Improvements:

Reliability/Maintainability Characteristics:

Human Factors Design Criteria:

Bob, what heading?

Staffing Estimates (preliminary):

It should be understood that the following estimate overview is preliminary in nature. Further cost analysis details will be available upon submittal of the final Contract Summary Report CDRL B008 (approx. 26 January 1989).

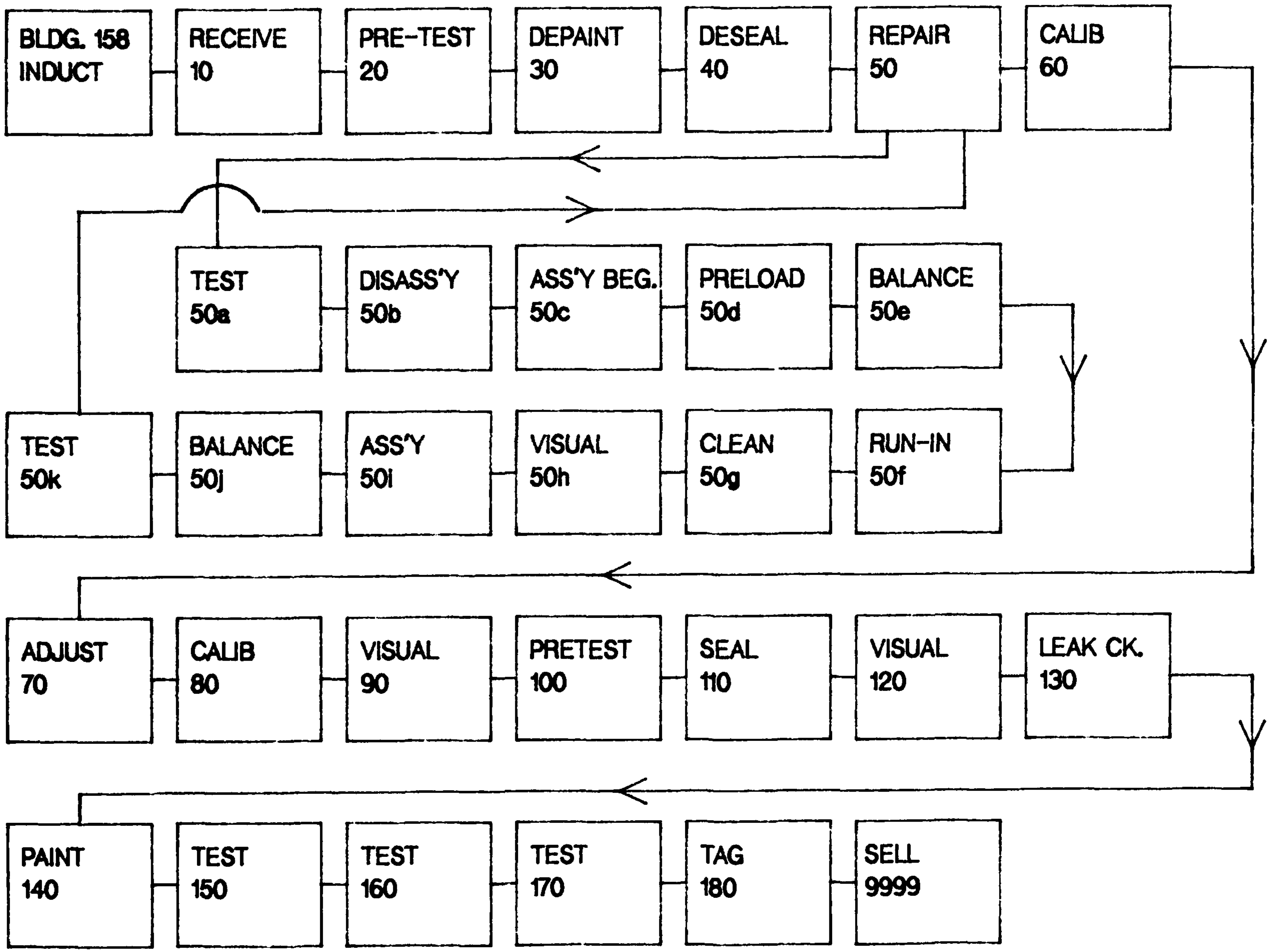
	DESCRIPTION	DURATION	EFFORT
MDMSC:			
	T.O. MGR	2-3 Months	50%
	SR. I.E.	2-3 Months	100%
	I.E.	2-3 Months	100%
	M & P Engr	1-2 Months	50%
	Tech Writer	1 Month	50%
	T.I. Program Adiminstrative Costs		10%
	MDMSC Travel Expenses (Actuals)		

AFLC Estimates:

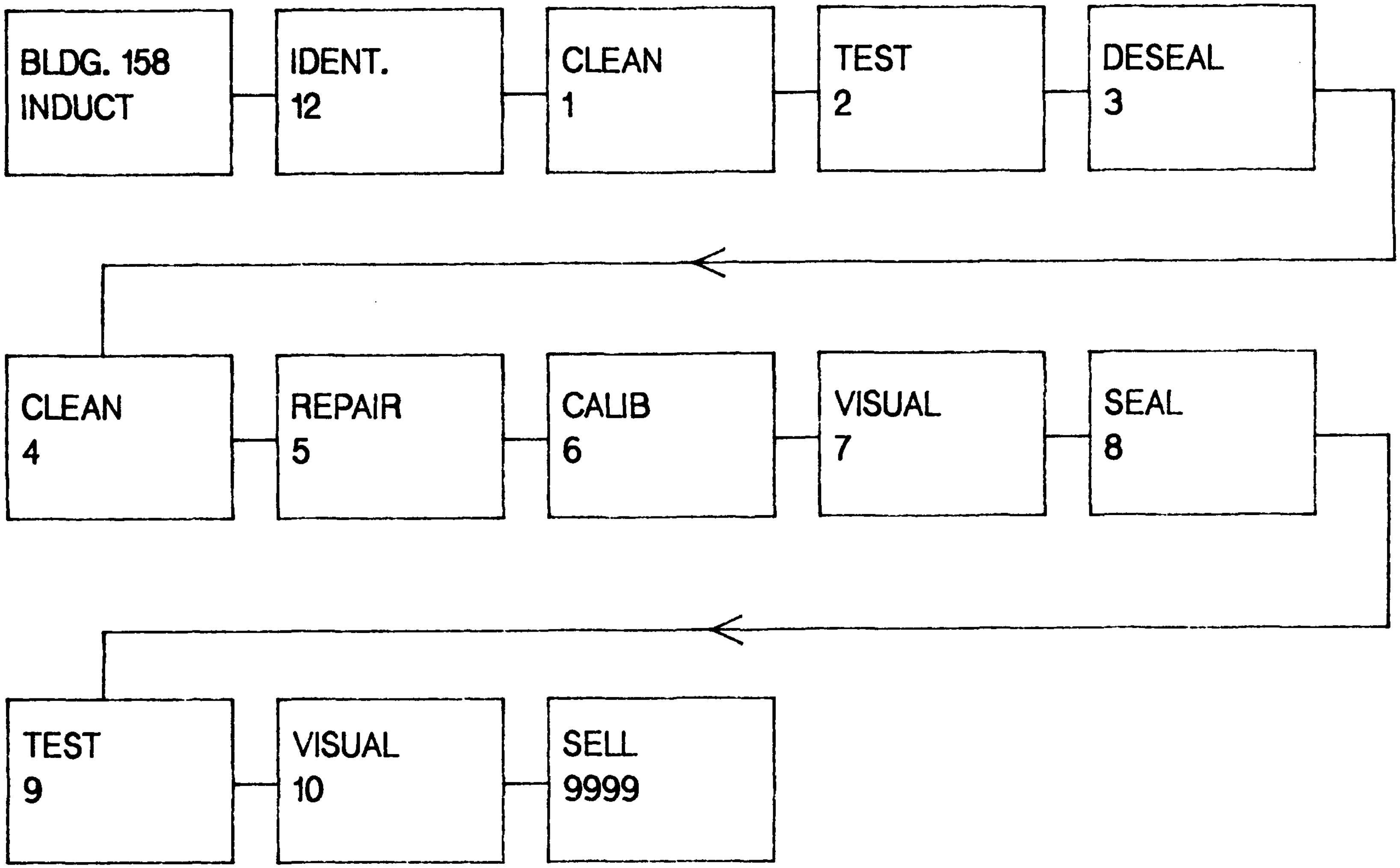
Air Force Administration Costs
Integration/Implementation Costs

FS: GS-9

PROCESS FLOWCHART PCN 74051A



PROCESS FLOWCHART PCN 20012A



ITEM CHECKL

(For Internal Use, Not a Model Input)

NAME R. VANDERVOORD ALC WR DATE 4-10-89 RCC MANPGB SHEET 1 OF 1

ITEM NUMBER	SPECIFY IF PCN ~~NGN~~ ~~RH~~	WCD NO.	WCD DATE	OPERATION PROFILE	DS/AS PROFILE	PARALLEL OPS PROFILE	HISTORICAL DATA	INDUCTION SELL DATE	BLANK WCD	STAMPED OFF WCD REVISIONS	STANDARD HOURS	STANDARD FLOW TIMES	PROCESS FLOW CHARTS
20012A	PCN	N/A	✓	✓	N/R	N/R	✓	✓	✓		✓	✓	✓
7H051A	PCN	N/A	✓	✓	✓	N/R	✓	✓	✓	✓	✓	✓	✓

LSC-20098A

ITEM SUMMARY

(For Internal Use, Not a Model Input)

NAME R. VANDERVOORD ALC WR DATE 4-11-89 RCC MANPGB SHEET 1 OF 1

ITEM NUMBER	WCD	WORKLOAD TYPE	HISTORICAL FLOW TIME	STANDARD HOURS	EXPECTED HOURS
PCN ~~NSN~~ ~~P/N~~ R001RA	N/A	MISTR	1ø = < 50 WKS	8.45	12.2
PCN NSN P/N					
PCN ~~NSN~~ ~~P/N~~ 74051A	N/A	MISTR	1ø = < 20 WKS	10.87	12.0
PCN NSN P/N					
PCN NSN P/N					
PCN NSN P/N					
PCN NSN P/N					
PCN NSN P/N					
PCN NSN P/N					
PCN NSN P/N					
PCN NSN P/N					
PCN NSN P/N					

NOTE: HISTORICAL FLOW TIME WILL BE GENERATED BY DATA PROCESSING. IF NO HISTORY IS COLLECTED ON WCD DATA COLLECTION SYSTEM, THIS INFORMATION MUST BE OBTAINED ON-SITE. EXPECTED HOURS WILL BE GENERATED FROM OPS. PROFILES BY DATA PROCESSING.