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LEVEL III

(12)

AIR FORCE

HUMAN RESOURCES

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HUMAN RESOURCES, LOGISTICS AND COST FACTORS IN WEAPON SYSTEM DEVELOPMENT: DEMONSTRATION IN THE FULL SCALE DEVELOPMENT PHASE OF AIRCRAFT SYSTEM ACQUISITION, APPENDIXES B TO R.

By

Gerard F. King

Dynamics Research Corporation
60 Concord Street
Wilmington, Massachusetts 01887

(10) Gerard F. King

William B. Askren

LOGISTICS AND TECHNICAL TRAINING DIVISION
Wright-Patterson Air Force Base, Ohio 45433

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This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

ROSS L. MORGAN, Technical Director
Logistics and Technical Training Division

RONALD W. TERRY, Colonel, USAF
Commander

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coordinated human resource technology	life cycle costing	technical manuals
design option decision trees	logistic support elements	training
human resource in design trade-offs	maintenance manpower modeling	weapon system acquisition
instructional system development	system ownership costing	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The coordinated human resource technology and the consolidated data base were demonstrated in the full-scale development phase of weapon system acquisition. The results of this demonstration are reported in Volume I. This volume consists of Appendixes B through R to that demonstration report and provides additional details of the demonstration.

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INTRODUCTION

The information presented in Appendices B to R was developed during the demonstration of the coordinated human resource technology (CHRT) and the consolidated data base (CDB) in the full-scale development phase of aircraft acquisition. These data supplement those included in the basic report and provide significant additional detail.

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APPENDIX B
DESIGN OPTION DECISION TREES

This section lists the full set of Design Option Decision Trees, which were completed during the MED Phase demonstration. Samples are provided.

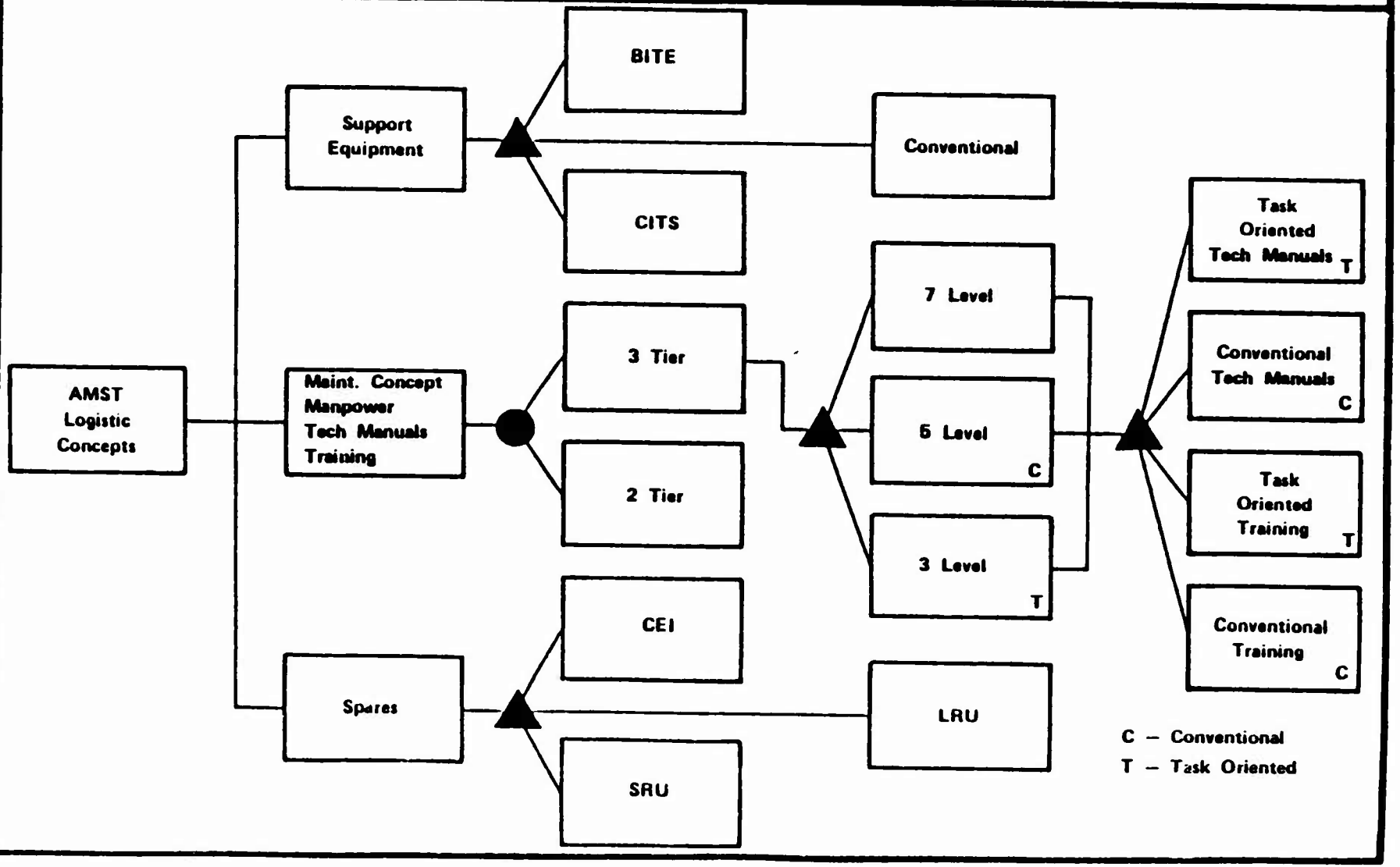
DESIGN OPTION DECISION TREE DRAWING LIST

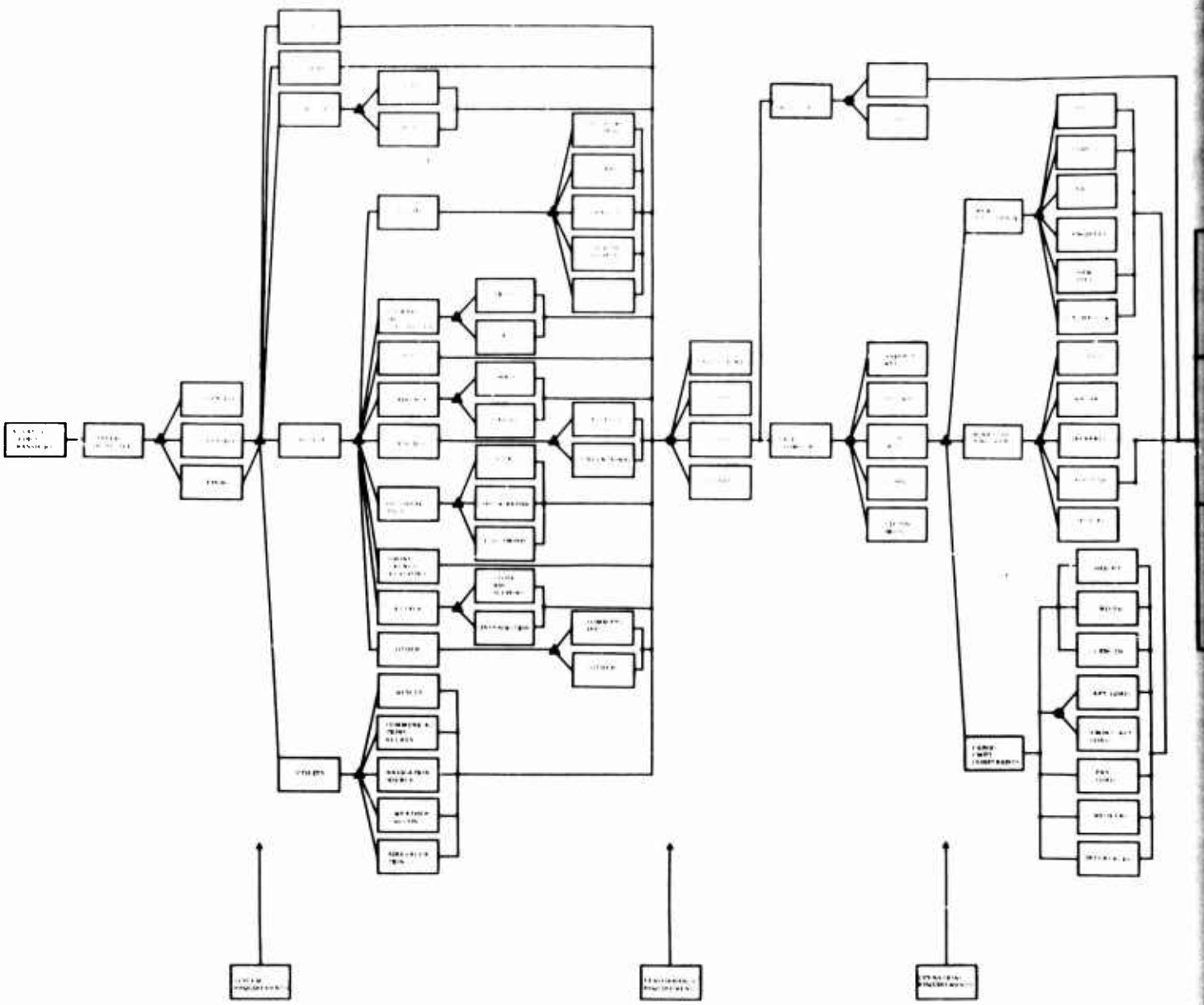
DWG #	TITLE	SHEET	OF
*--	AMST Logistic Option Tree	1	1
*1000	AMST System	1	1
*1100	AMST Avionics	1	8
1100	AMST Avionics (ECM)	2	8
1100	AMST Avionics (Radar)	3	8
1100	AMST Avionics (Navigation)	4	8
1100	AMST Avionics (Communications)	5	8
1100	AMST Avionics (Integration)	6	8
*1100	AMST Avionics (Info. Process.)	7	8
1100	AMST Avionics (Inst. & Display)	8	8
*1200	AMST Landing Gear	1	3
*1200	AMST Landing Gear (Main Gear)	2	3
1200	AMST Landing Gear (Nose Gear)	3	3

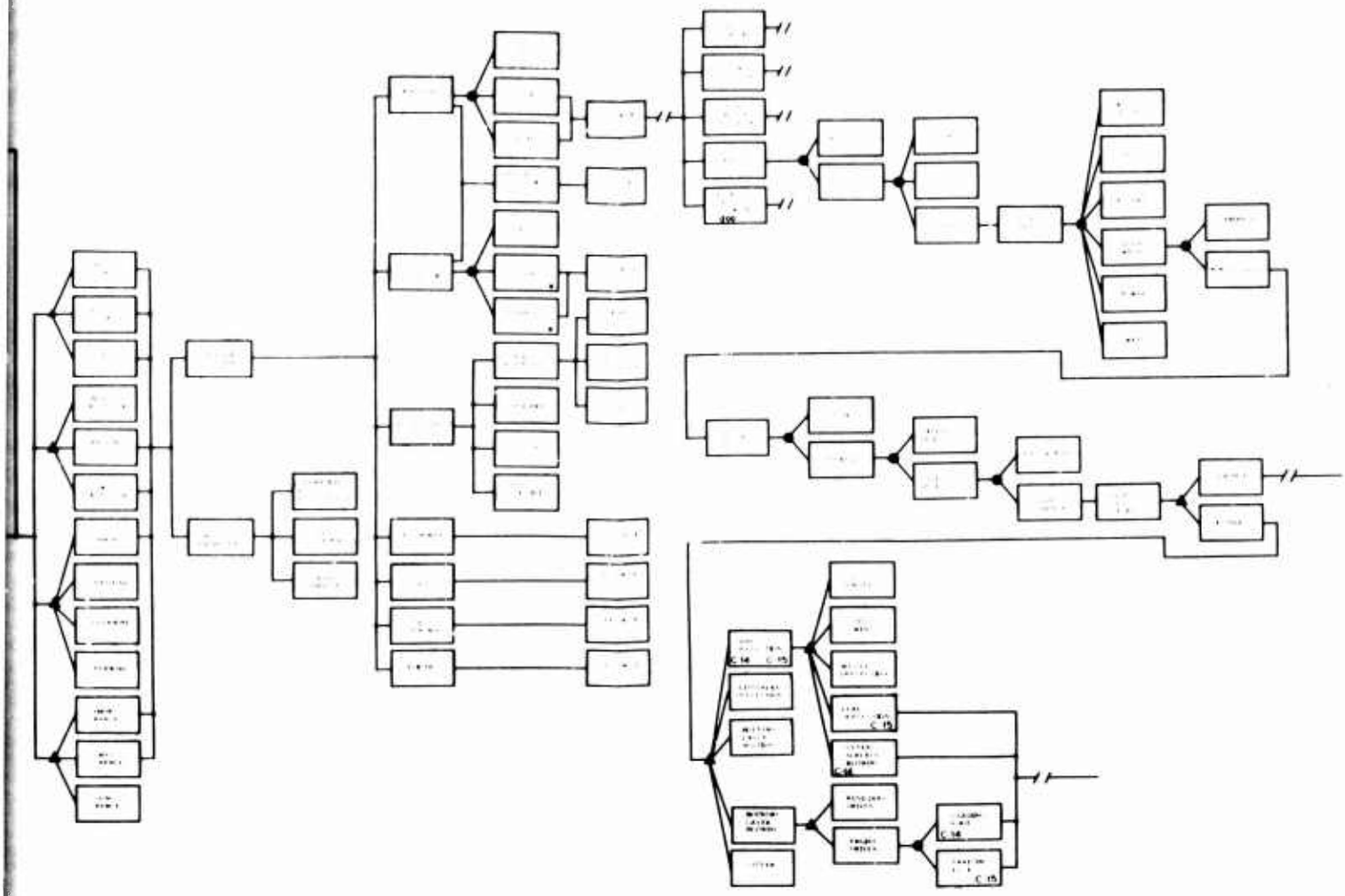
---

* Indicates those design option decision trees included in this report.

DEMONSTRATE CHRT IN FULL SCALE DEVELOPMENT
AMST MED PHASE
LOGISTICS OPTION TREE







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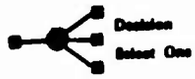
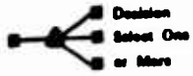
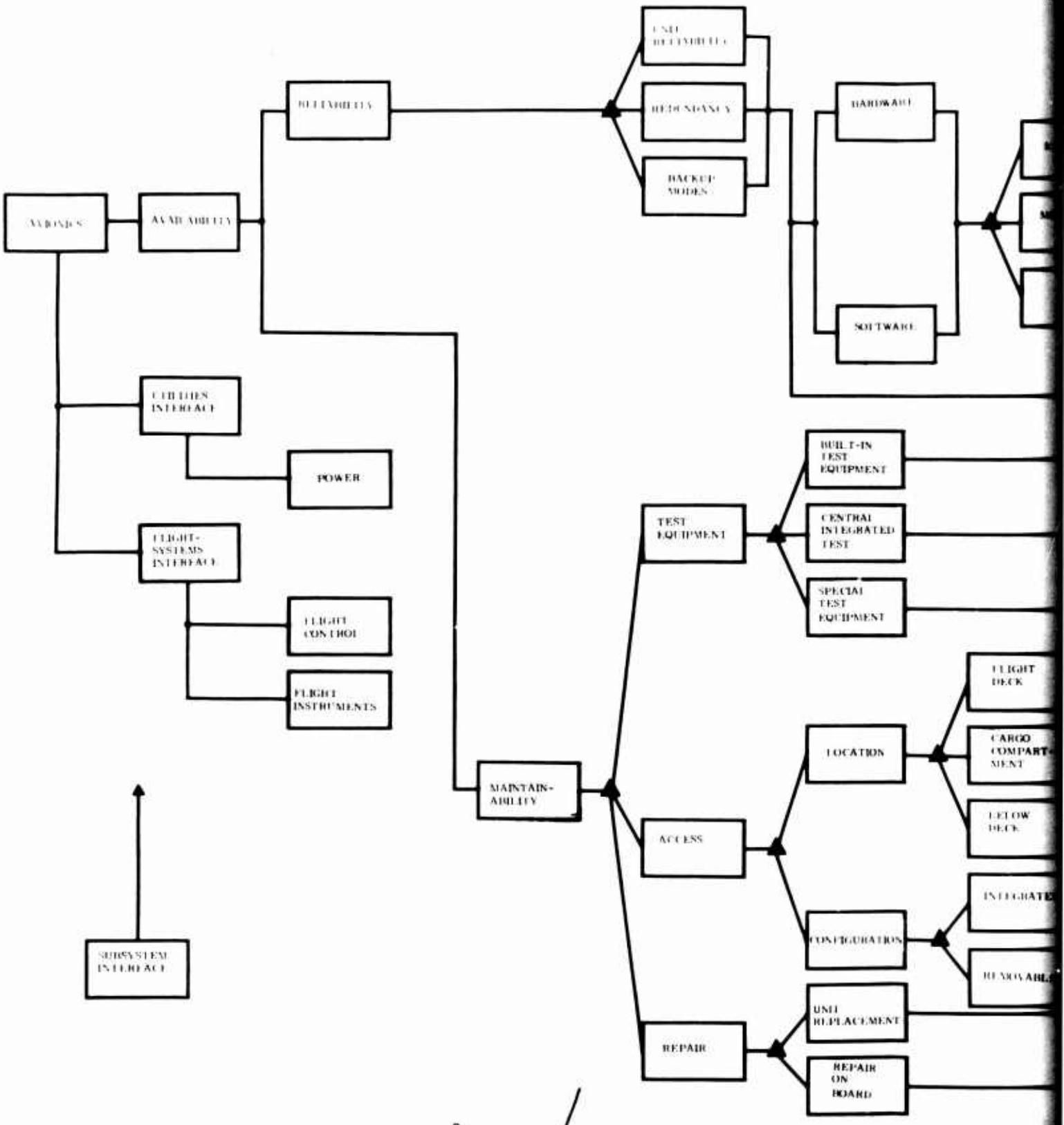


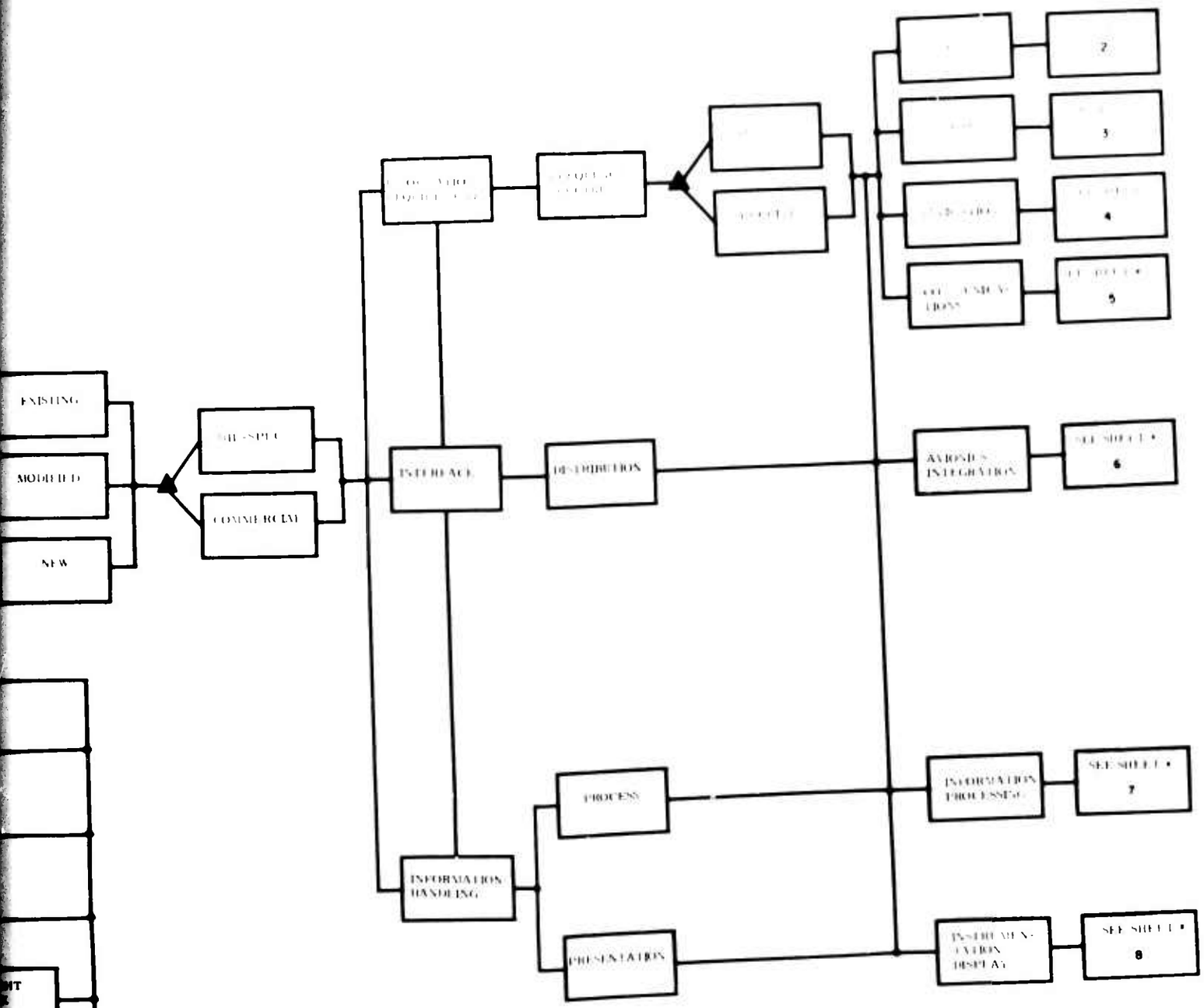


DECISION TO BE MADE

DRC DYNAMICS RESEARCH CORPORATION 60 CONCORD STREET, WILMINGTON, MA 01887			
DECISION TREE-AMST SYSTEM			
SIZE J	CODE IDENT CHRT	DRAWING NO. 1000	REV B
SCALE NONE	10 OCTOBER 1978	SHEET 1 OF 1	

2


AVIONICS
AVAILABILITY
RELIABILITY
UNIT RELIABILITY
REDUNDANCY
BACKUP MODES
HARDWARE
SOFTWARE
CREW INTERFACE
POWER
FLIGHT-SYSTEMS INTERFACE
FLIGHT CONTROL
FLIGHT INSTRUMENTS
SUBSYSTEM INTERFACE
MAINTAIN-ABILITY
TEST EQUIPMENT
BUILT-IN TEST EQUIPMENT
CENTRAL INTEGRATED TEST
SPECIAL TEST EQUIPMENT
ACCESS
LOCATION
FLIGHT DECK
CARGO COMPART-MENT
BELOW DECK
CONFIGURATION
INTEGRATED
REMOVABLE
REPAIR
UNIT REPLACEMENT
REPAIR ON BOARD



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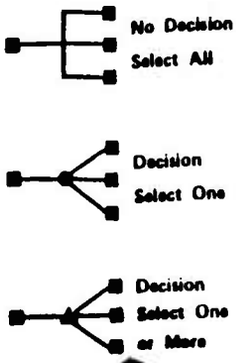

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DECISION TREE–AMST AVIONICS

SIZE	CODE IDENT	DRAWING NO.	REV
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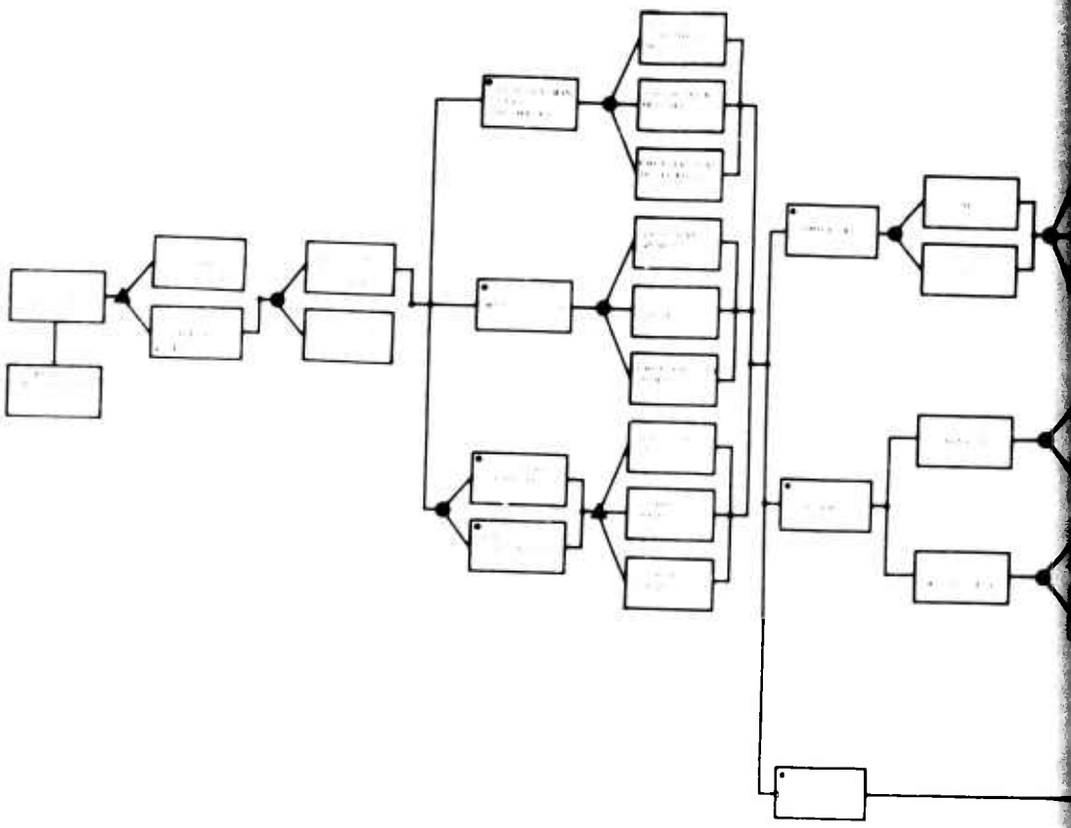

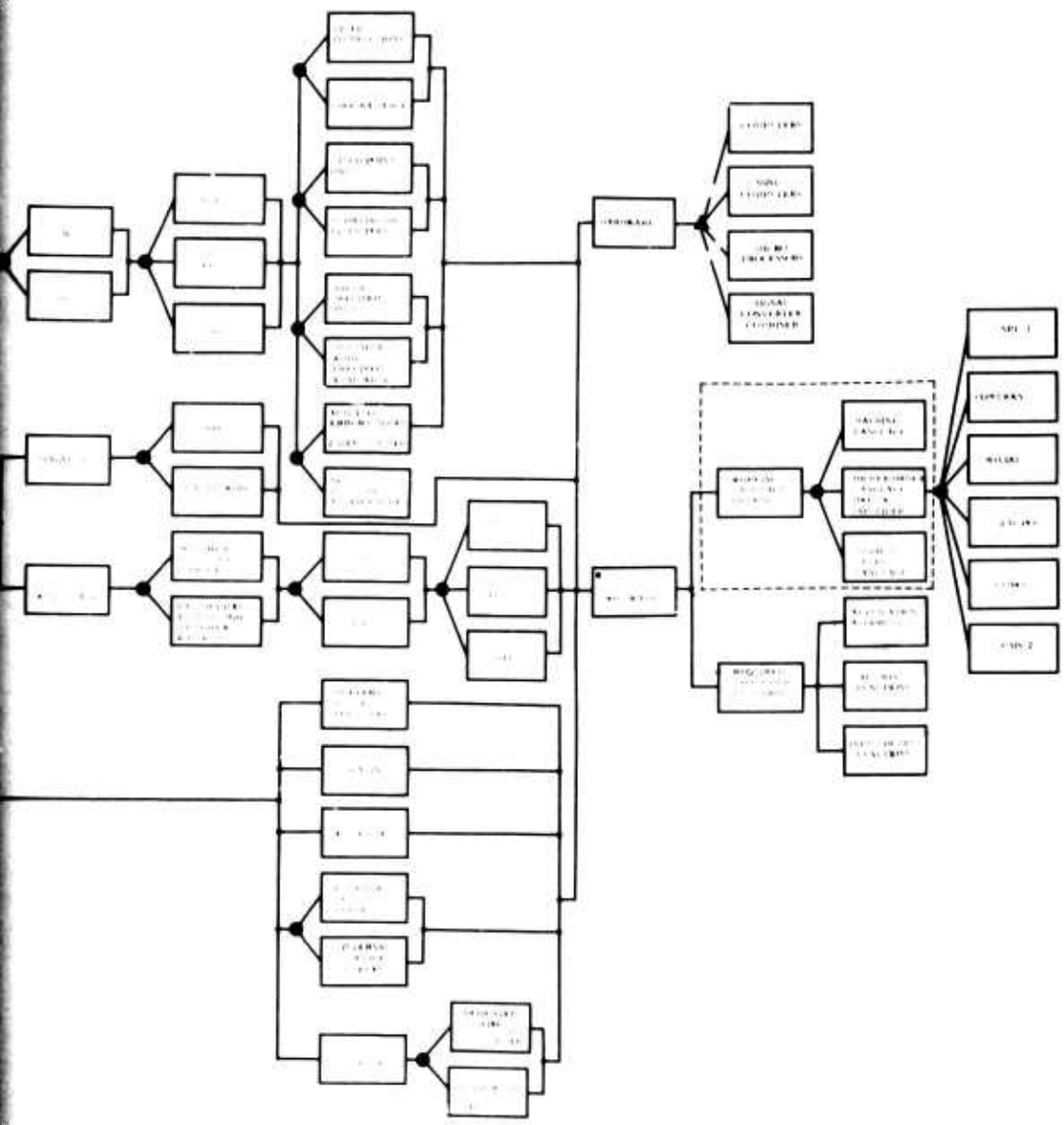

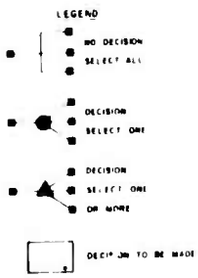

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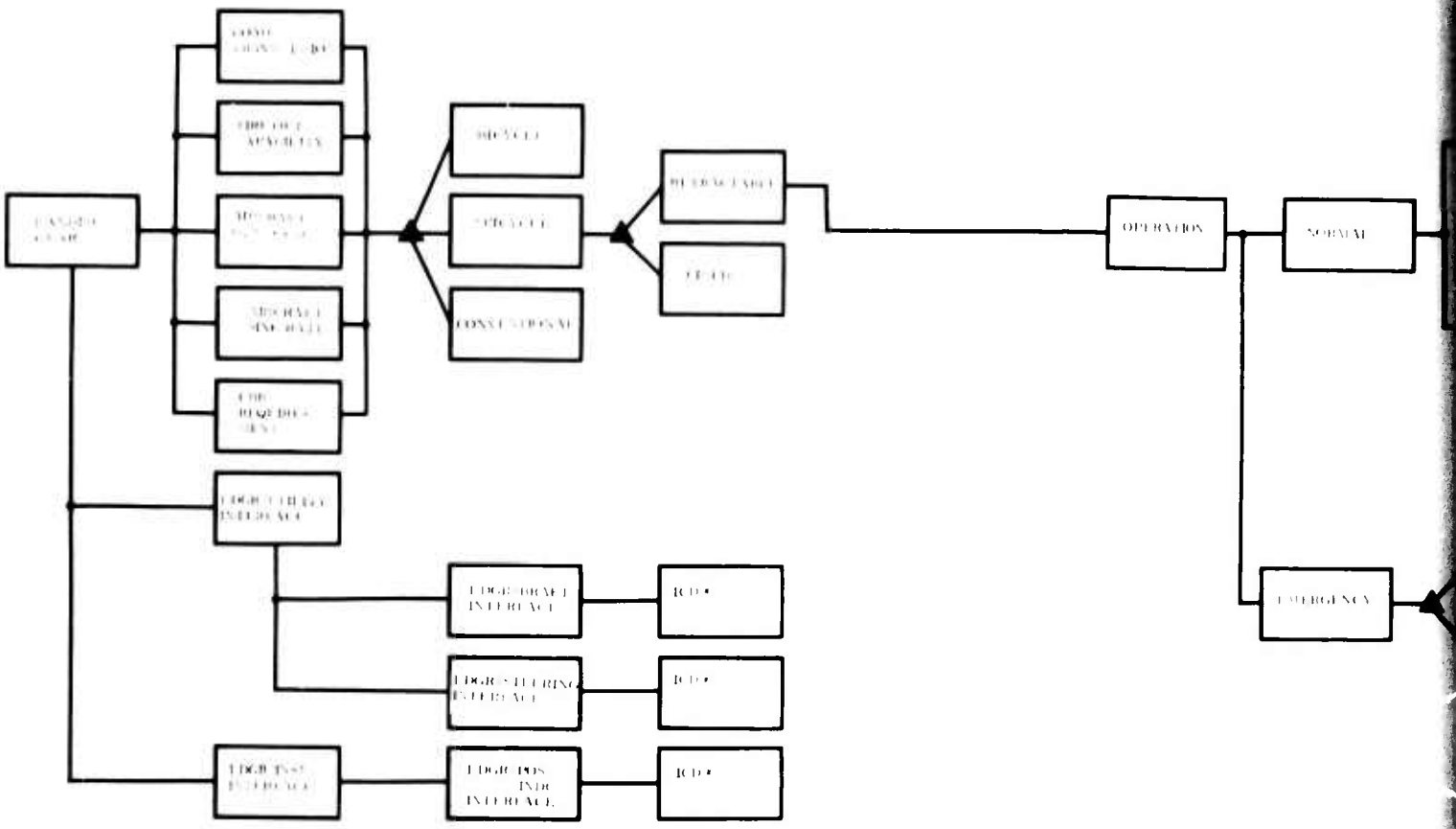
DECISION TREE-AMST
AVIONICS (INFO PRCS)

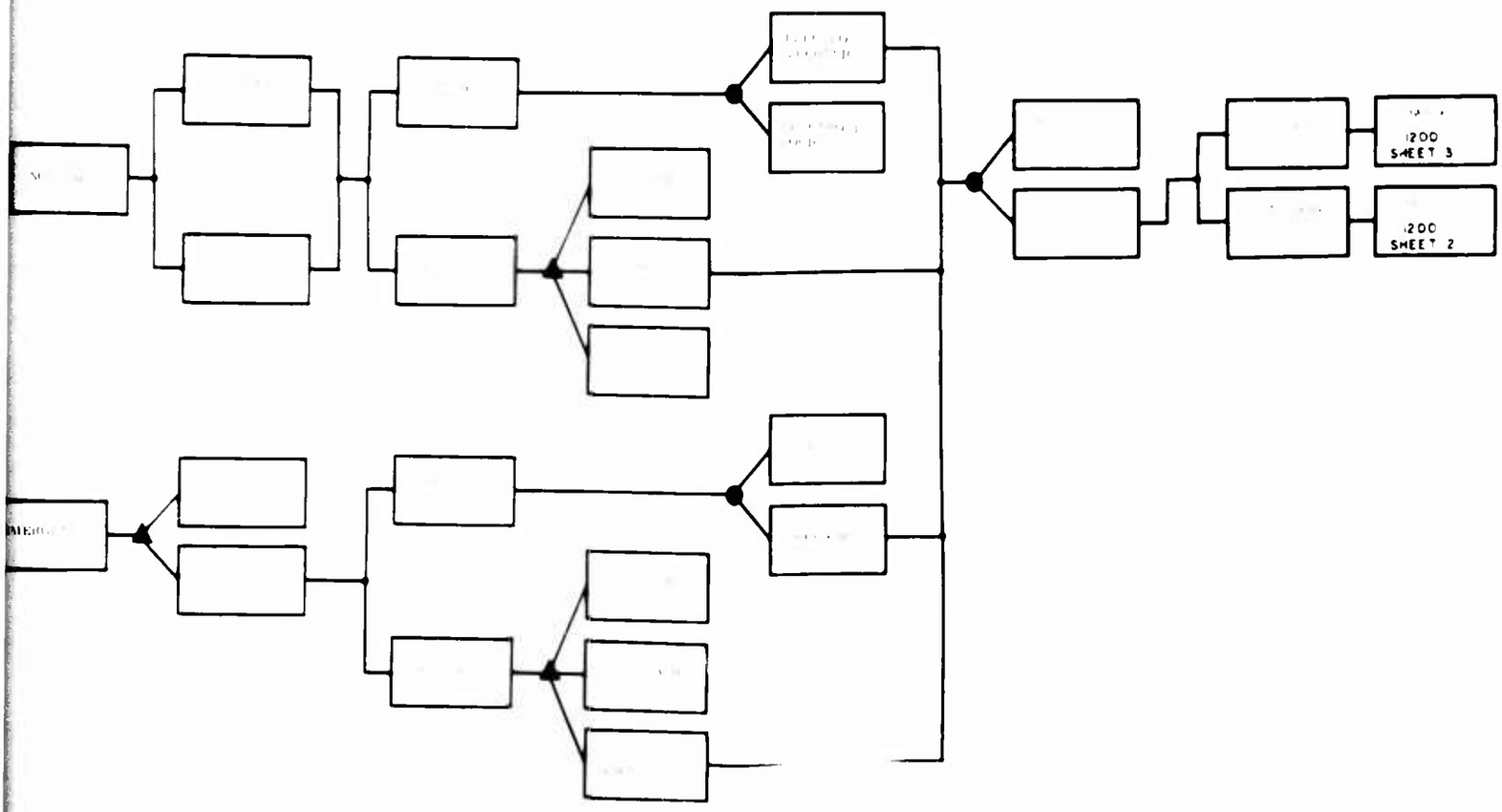
SIZE	CODE IDENT	DRAWING NO	REV
J	CHRT	1100	B

SCALE NONE | 10 OCTOBER 1978 | SHEET 1 OF 1

2

1


OPERATION
NORMAL
EMERGENCY



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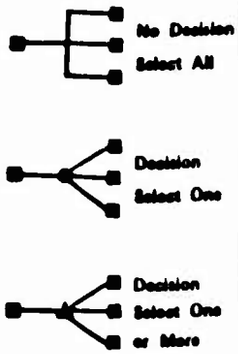

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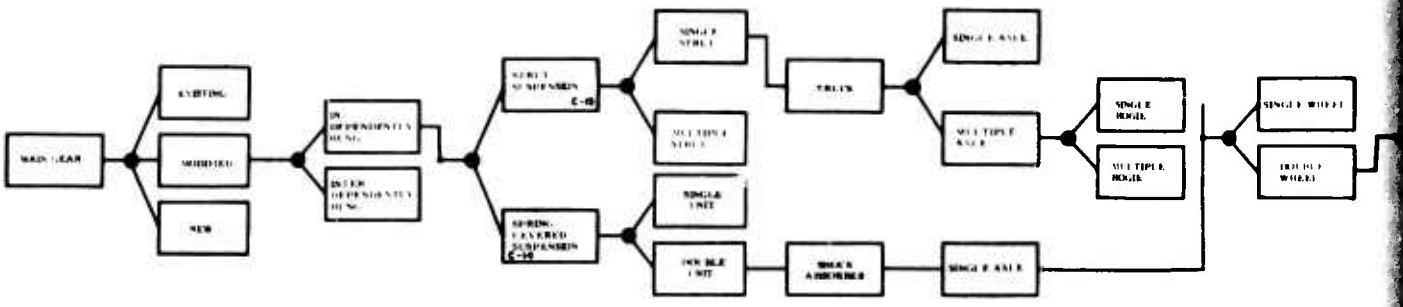
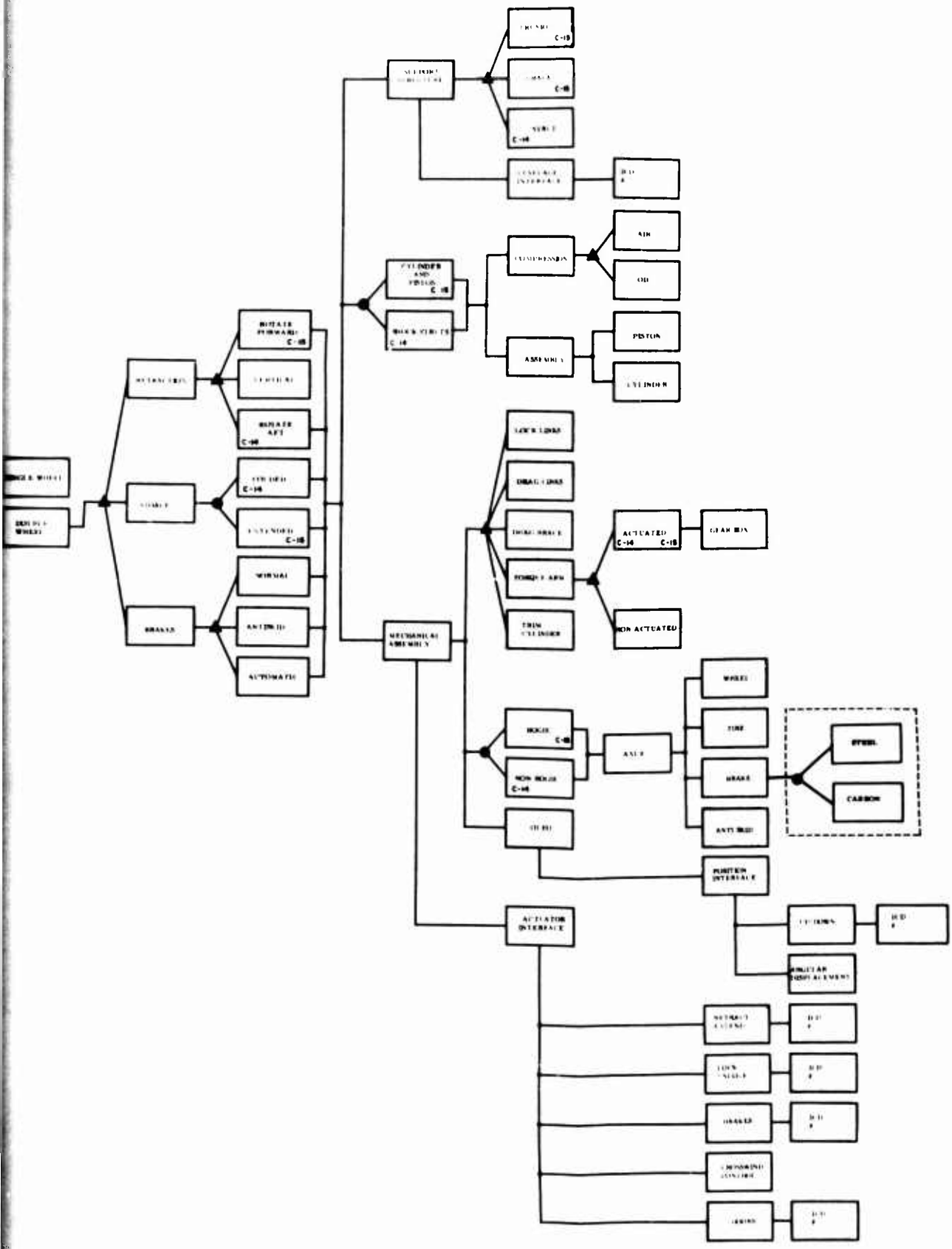
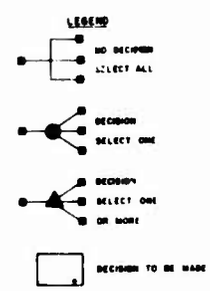
DECISION TREE–AMST LANDING GEAR

SIZE	CODE IDENT	DRAWING NO.	REV
J	CHRT	1200	B

SCALE · NONE | 10 OCTOBER 1978 | SHEET 1 OF 3


EXISTING
MODIFIED
NEW
SINGLE UNIT
SINGLE AXLE
SINGLE ROGIE
SINGLE WHEEL





DRC DYNAMICS RESEARCH CORPORATION
60 CONCORD STREET, WILMINGTON, MA 01887

DECISION TREE–AMST LANDING GEAR (MAIN GEAR)

SIZE	CODE IDENT	DRAWING NO	REV
J	CHRT	1200	B

SCALE NONE | 10 OCTOBER 1978 | SHEET 1 OF 1

2

1

GUIDELINES
APPENDIX C
TASK-ORIENTED APPROACH GUIDELINES

Maintenance action networks are prepared to reflect a conventional approach to personnel, training, and technical manuals. The conventional approach assumes 5-skill-level manning on the flightline with 3-skill-level helpers. These personnel are supported with conventional training and conventional technical manuals. A major system level alternative considered during this demonstration was a task-oriented approach. This assumes primarily 3-level skills on the flightline supported with task-oriented training and task-oriented technical manuals. In order to evaluate this option, the maintenance action networks had to be updated to reflect direct impact of such an approach. This section describes the conservative actions taken and rationale used to accomplish this update.

The action is described and the rationale for each action then follows in parentheses. The rationale has been substantiated by a thorough review of the literature which addresses the implications of the task-oriented approach. The percentages used are representative of conclusions found in the literature.

1. Reduce the times for flightline cannot-duplicate, troubleshoot, and maintain an aircraft by 10 percent each. (Proceduralized aids reduce maintenance times.)

2. Reduce flightline probability of cannot-duplicate by 50 percent and reduce the number [illegible] cannot-duplicate actions accordingly. (Pr[illegible]lized aids will increase possibility of [illegible] time diagnosis.)

3. Increase MFHBMA, as appropriate, based on action (2) above.

4. Reduce shop probability of cannot duplicate by 50 percent and reduce the number of flightline remove and replace actions accordingly. (Proceduralized aids reduce false removals.)

5. Increase the number of flightline cannot-duplicate

actions by the same number of action (4) to reflect early cannot-duplicate determination. (Proceduralized aids reduce false removals.)

6. Retain personnel quantity and AFSC skills, but modify skill levels as follows:

   a. Assure that one 413X1 is always a 5-level to provide supervision.

   b. Assure that all shop personnel called to flightline are 5-level (no reduction in shop skills is assumed for this study).

   c. Set all flightline specialists performing cannot-duplicate, troubleshooting, and remove and replace tasks at the 3-level (proceduralized aids allow jobs to be performed by lesser skills).

   d. For maintain-on-aircraft acitons and each AFSC involved, require one specialist at 5-level and all others of the same AFSC at the 3-level. (Maintain-on-aircraft is assumed to be a more difficult and complex action. Therefore, skills cannot be reduced.)

APPENDIX D

SAMPLE RMCM REPORTS

STANDARD STATION-KEEPING EQUIPMENT

REPORT NO. 1 -- SYSTEM COST

PIUP = 15 YEARS BASE YEAR - 1978

ORIGINAL - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD
PERTURBED - NOCHANGE

	ORIGINAL		PERTURBED		DIFFERENCE
	COST	% LCC	COST	% LCC	
RC - RECURRING					
CS - SUPPORT.....	52,950,152.5	63.470%	52,950,152.5	63.470%	0.
CO - OPERATION.....	0.	0. %	0.	0. %	0.
NRC - NON-RECURRING					
CRD - R & D.....	0.	0. %	0.	0. %	0.
CSI - SYSTEM INVESTMENT.....	18,685,890.0	22.398%	18,685,890.0	22.398%	0.
COI - SUPPORT INVESTMENT.....	11,788,884.3	14.131%	11,788,884.3	14.131%	0.
CDP - DISPOSAL.....	0.	0. %	0.	0. %	0.
LCC - TOTALS.....	83,424,927.0	100.000%	83,424,927.0	100.000%	0.

REPORT NO. 2 -- EXPANDED NON-RECURRING COSTS (NRC)

ORIGINAL - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD
PERTURBED - NOCHANGE

	ORIGINAL		PERTURBED		DIFFERENCE
	COST	% LCC	COST	% LCC	
RC - RECURRING	52,950,152.5	63.470%	52,950,152.5	63.470%	0.
PIUP = 15 YEARS					
CDP - DISPOSAL	0.	0. %	0.	0. %	0.
NRC - NON-RECURRING					
CRD - R & D	0.	0. %	0.	0. %	0.
CSI - SYSTEM INVESTMENT					
CPP - PROCUREMENT	18,685,890.0	22.398%	18,685,890.0	22.398%	0.
CPM - PROJECT MANAGEMENT	0.	0. %	0.	0. %	0.
COI - SUPPORT INVESTMENT					
CPTI - MAINTENANCE TRAINING	0.	0. %	0.	0. %	0.
CSPI - SPARES	11,625,288.5	13.935%	11,625,288.5	13.935%	0.
CDRI - SE, DEPOT	0.	0. %	0.	0. %	0.
CSEI - SE, FIELD	0.	0. %	0.	0. %	0.
CSWI - SOFTWARE ACQUISITION	0.	0. %	0.	0. %	0.
CJGI - MAINTENANCE MANUALS	163,146.5	0.196%	163,146.5	0.196%	0.
CIMI - INVENTORY MANAGEMENT	449.3	0.001%	449.3	0.001%	0.
CFAI - FACILITIES	0.	0. %	0.	0. %	0.
LCC - TOTALS	83,424,927.0	100.000%	83,424,927.0	100.000%	0.

REPORT NO. 3 -- EXPANDED RECURRING COSTS (RC)

ORIGINAL - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD
PERTURBED - NOCHANGE

	ORIGINAL COST	ORIGINAL % LCC	PERTURBED COST	PERTURBED % LCC	DIFFERENCE
NRC - NON-RECURRING	30,474,774.3	36.530%	30,474,774.3	36.530%	0.
CDP - DISPOSAL	0.	0. %	0.	0. %	0.
RC - RECURRING (FOR PIUP = 15 YEARS)					
CO - OPERATION					
CFL - FUEL	0.	0. %	0.	0. %	0.
COP - PERSONNEL					
CAC - AIRCREW	0.	0. %	0.	0. %	0.
COO - OTHER OPERATIONS	0.	0. %	0.	0. %	0.
CS - SUPPORT					
COM - ON-EQUIPMENT MAINTENANCE	8,191,877.9	9.819%	8,191,877.9	9.819%	0.
CSM - INTERMEDIATE MAINTENANCE	6,809,978.6	8.163%	6,809,978.6	8.163%	0.
CPT - TRAINING	2,919,809.4	3.500%	2,919,809.4	3.500%	0.
CSP - SPARES	4,812,479.3	5.769%	4,812,479.3	5.769%	0.
CDR - DEPOT MAINTENANCE	29,995,337.0	35.955%	29,995,337.0	35.955%	0.
CSE - SUPPORT EQUIPMENT	0.	0. %	0.	0. %	0.
CSW - SOFTWARE	0.	0. %	0.	0. %	0.
CJG - MAINTENANCE MANUALS	183,539.8	0.220%	183,539.8	0.220%	0.
CIM - INVENTORY MANAGEMENT	37,130.4	0.045%	37,130.4	0.045%	0.
LCC - TOTALS	83,424,927.0	100.000%	83,424,927.0	100.000%	0.

REPORT NO. 4 -- COSTS BY SUBSYSTEM CONTRIBUTIONS

RECURRING COST ELEMENTS (PER YEAR)

OUTPUT FILE - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD

ID	COM	CSM	CPT	CSP	CDR	CJG	CIM	TOTAL
	% RCY	% RCY	% RCY	% RCY	% RCY	% RCY	% RCY	% RCY
DAN250	537,295.5	346,828.5	185,645.9	320,831.9	1,999,689.1	11,635.9	2,165.9	3,404,092.8
	15.221	9.825	5.259	9.089	56.648	0.330	0.061	96.433
DAN250	8,829.7	107,170.1	9,008.0	0.	0.	600.1	309.4	125,917.3
	0.250	3.036	0.255	0.	0.	0.017	0.009	3.567
	546,125.2	453,998.6	194,654.0	320,831.9	1,999,689.1	12,236.0	2,475.4	3,530,010.2
	15.471	12.861	5.514	9.089	56.648	0.347	0.070	100.000

OTHER RECURRING COSTS -- CSE.....	0.
	0.
CSW.....	0.
	0.
CFL.....	0.
	0.
CAC.....	0.
	0.
COO.....	0.
	0.
TEST STATION/TEST DRAWER (CSM).....	0.
	0.
TEST STATION/TEST DRAWER (CPT).....	0.
	0.
CDR OVERHAUL.....	0.
	0.
TOTAL RCY.....	3,530,010.2
	100.000

NON-RECURRING COST ELEMENTS

ID	CSPI	% NRC	CJGI	% NRC	CPP	% NRC	CIMI	% NRC	TOTAL	% NRC
DAN250	11,622,279.5	38.137	155,145.1	0.509	18,685,890.0	61.316	393.1	0.001	30,463,707.8	99.964
DAN250	0.	0.	8,001.4	0.026	0.	0.	56.2	0.000	8,057.6	0.026
	11,622,279.5	38.137	163,146.5	0.535	18,685,890.0	61.316	449.3	0.001	30,471,765.3	99.990

OTHER NON-RECURRING COSTS --		
CPTI.....		0.
		0.
CORI.....		0.
		0.
CSEI.....		0.
		0.
CSWI.....		0.
		0.
CFAI.....		0.
		0.
CPD.....		0.
		0.
CPM.....		0.
		0.
SPRTS.....		3,009.0
		0.010
WRMC.....		0.
		0.
TOTAL NRC.....	30,474,774.3	
	100.000	

REPORT NO. 5 -- COSTS BY LRU CONTRIBUTIONS

RECURRING COST ELEMENTS (PER YEAR)

OUTPUT FILE - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD

ID	COM	CSM	CPT	CSP	CDR	CIM	TOTAL
	% RCY	% RCY	% RCY	% RCY	% RCY	% RCY	% RCY
DAN251	29,585.3	9,954.8	5,854.6	9,606.5	80,718.5	309.4	136,029.1
	0.838	0.282	0.166	0.272	2.287	0.009	3.854
DAN252	211,687.6	120,945.7	65,381.6	205,553.9	1,617,676.3	309.4	2,221,554.6
	5.997	3.426	1.852	5.823	45.826	0.009	62.933
DAN253	283,185.3	212,115.4	111,389.0	102,245.7	284,294.3	309.4	993,539.2
	8.022	6.009	3.155	2.896	8.054	0.009	28.146
DAN254	7,481.3	2,655.5	1,977.8	1,980.7	9,610.7	309.4	24,015.5
	0.212	0.075	0.056	0.056	0.272	0.009	0.680
DAN255	510.1	22.9	97.0	100.8	1,031.6	309.4	2,071.8
	0.014	0.001	0.003	0.003	0.029	0.009	0.059
DAN256	4,335.8	1,111.2	848.8	1,336.8	6,267.3	309.4	14,209.3
	0.123	0.031	0.024	0.038	0.178	0.009	0.403
DAN257	510.1	22.9	97.0	7.5	90.6	309.4	1,037.5
	0.014	0.001	0.003	0.000	0.003	0.009	0.029
DAN253	8,829.7	107,170.1	9,008.0	0.	0.	309.4	125,317.2
	0.250	3.036	0.255	0.	0.	0.009	3.550
	546,125.2	453,998.6	194,654.0	320,831.9	1,999,689.1	2,475.4	3,517,774.2
	15.471	12.861	5.514	9.089	56.648	0.070	99.653

OTHER RECURRING COSTS -- CSE.....	0.
	0.
CSM.....	0.
	0.
CJG.....	12,236.0
	0.347
CFL.....	0.
	0.
CAC.....	0.
	0.
CDO.....	0.
	0.
TEST STATION/TEST DRAWER (CSM).....	0.0
	0.000
TEST STATION/TEST DRAWER (CPT).....	0.0
	0.000
CDR OVERHAUL.....	0.
	0.
TOTAL RCY.....	3,530,010.2
	100.000

NON-RECURRING COST ELEMENTS

ID	CSPI	% NRC	CPP	% NRC	CIMI	% NRC	TOTAL	% NRC
DAN251	424,774.2	1.394	1,863,000.0	6.113	56.2	0.000	2,287,830.4	7.507
DAN252	7,593,069.9	24.916	7,452,000.0	24.453	56.2	0.000	15,045,126.0	49.369
DAN253	3,273,665.2	10.742	5,589,000.0	18.340	56.2	0.000	8,862,721.4	29.082
DAN254	88,206.9	0.289	1,204,740.0	3.953	56.2	0.000	1,293,003.0	4.243
DAN255	25,481.7	0.084	1,086,750.0	3.566	56.2	0.000	1,112,287.9	3.650
DAN256	215,188.6	0.706	1,409,670.0	4.626	56.2	0.000	1,624,914.8	5.332
DAN257	1,892.9	0.006	80,730.0	0.265	56.2	0.000	82,679.1	0.271
DAN253	0.	0.	0.	0.	56.2	0.000	56.2	0.000
	11,622,279.5	38.137	18,685,890.0	61.316	449.3	0.001	30,308,618.8	99.455

OTHER NON-RECURRING COSTS -- CPTI..... 0. 0.

CDRI..... 0. 0.

CSEI..... 0. 0.

CSWI..... 0. 0.

CJGI..... 163,146.5 0.535

CFAI..... 0. 0.

CRD..... 0. 0.

CPM..... 0. 0.

SPRTS..... 3,009.0 0.010

WRMC..... 0. 0.

TOTAL NRC..... 30,474,774.3 100.000

REPORT NO. 6 -- RELIABILITY, MAINTAINABILITY, AND AVAILABILITY BY SUBSYSTEM

OUTPUT FILE - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD

SUBSYS	MFHBMA	MTTR		MTTR/KFH		MMH/KFH		AVAIL	SUBSYSTEM LCC CONTRIBUTION	
		FLIGHT	SHOP	FLIGHT	SHOP	FLIGHT	SHOP		FLIGHT	SHOP
DAN250	26.30	2.985	1.853	113.506	70.441	178.388	118.920	0.89806	11,798,819.4	73,649,952.0
DAN250	78.00	0.300	2.500	3.846	32.051	3.846	32.051	0.99617	346,666.0	1,790,161.1

REPORT NO. 7

MANHOUR COSTS PER YEAR BY AFSC'S AND SUBSYSTEMS SUPPORTED

OUTPUT FILE - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD

ANNUAL BASE FLYING HOURS (ABFH) = 21043.80
NUMBER OF BASES (NB) = 6
PERCENT OF TOTAL LABOR DEVOTED TO DIRECT LABOR (EFF) = 60.00%

AFSC	SUBSYS	LOADED LABOR RATE (LLR N)	DIRECT MMH/FH FLIGHTLINE (FMMH N,M)	TOTAL LABOR FLIGHTLINE (MURF N,M)	DIRECT MMH/FH SHOP (SMMH N,M)	TOTAL LABOR SHOP (MURS N,M)	TOTAL LABOR	TOTAL COST
32831		7.779271						
	DAN250		0.05647	1980.624	0.04848	1700.320	3680.945	240,938.5
	DAN250		0.00385	134.896	0.	0.	134.896	8,829.7
	TOTAL		0.06032	2115.520	0.04848	1700.320	3815.841	249,768.2
32851		12.759271						
	DAN250		0.11351	3980.986	0.07044	2470.566	6451.552	615,062.7
	DAN250		0.	0.	0.03205	1124.135	1124.135	107,170.1
	TOTAL		0.11351	3980.986	0.10249	3594.701	7575.686	722,232.8
53153		12.759271						
	DAN250		0.00841	294.987	0.	0.	294.987	28122.73
	TOTAL		0.00841	294.987	0.	0.	294.987	28122.73

REPORT NO. 8A

SPARES REQUIREMENTS -- INVESTMENT

OUTPUT FILE - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD

NUMBER OF BASES (NB) = 6
ANNUAL PEAK BASE FLYING HOURS (PBFH) = 56116.80
EXPECTED BACK ORDER (EBO) = 0.10

DEPOT REPAIR CYCLE TIME (DRCT) = 0.17 YRS.
BASE REPAIR CYCLE TIME (BRCT) = 0.13 YRS.

	SHOP SPARES		DEPOT SPARES		UNIT COST		COST OF LRU SPARES		COST OF SRU SPARES		
LRU	LRU (STKL)	SRU (STKS)	LRU (DPLL)	SRU (DPLS)	LRU (UC)	SRU (UCSRU)	SHOP (LRUSS)	DEPOT (LRUDS)	SHOP (SRUSS)	DEPOT (SRUDS)	TOTAL COST
DAN251	1	6	9.28353	3.09451	6000	1000.00	6,000.0	55,701.2	6,000.0	3,094.5	70,795.7
DAN252	1	1	48.69408	35.42681	24000	2000.00	24,000.0	1,168,658.0	2,000.0	70,853.6	1,265,511.6
DAN253	1	1	26.07214	86.46846	18000	666.67	18,000.0	469,298.6	666.7	57,645.6	545,610.9
DAN254	1	2	1.70732	1.24492	3880	1293.33	3,880.0	6,624.4	2,586.7	1,610.1	14,701.1
DAN255	1	0	0.21341	0.	3500	1166.67	3,500.0	747.0	0.	0.	4,247.0
DAN256	6	2	0.99593	0.71138	4540	1513.33	27,240.0	4,521.5	3,026.7	1,076.6	35,864.8
DAN257	1	0	0.21341	0.	260	260.00	260.0	55.5	0.	0.	315.5
DAN253	1	0	0.	0.	0	0.	0.	0.	0.	0.	0.
TOTAL	13	12	87.17984	126.94608	60180	7900.00	82,880.0	1,705,606.1	14,280.0	134,280.4	1,937,046.6

TOTAL ALL BASES..... 11,622,279.4

OTHER COSTS:

SPARE PARTS (SPRTS)..... 3,009.0

WAR RESERVE MATERIAL COST (WRMC)..... 0.

TOTAL..... 3,009.0

TOTAL CSPI..... 11,625,288.4

REPORT NO. 88

SPARES REQUIREMENTS PER YEAR -- REPLACEMENT

OUTPUT FILE - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD

NUMBER OF BASES (NB) = 6
ANNUAL BASE FLYING HOURS (ABFH) = 21043.80

LRU	NRTS PROB. (PN)	CONDEMNATION RATE LRU (FCL)	CONDEMNATION RATE SRU (FCS)	UNIT COST LRU (UC)	UNIT COST SRU (UCSRU)	COST OF SPARES LRU (LRURS)	COST OF SPARES SRU (SRURS)	TOTAL COST
DAN251	0.02610	0.01	0.05	6000.00	1000.00	1,253.0	348.1	1,601.1
DAN252	0.13690	0.01	0.05	24000.00	2000.00	26,289.5	7,969.4	34,259.0
DAN253	0.07330	0.01	0.05	18000.00	666.67	10,557.1	6,483.8	17,040.9
DAN254	0.00480	0.01	0.05	3880.00	1293.33	149.0	181.1	330.1
DAN255	0.00060	0.01	0.05	3500.00	1166.67	16.8	0.	16.8
DAN256	0.00280	0.01	0.05	4540.00	1513.33	101.7	121.1	222.8
DAN257	0.00060	0.01	0.05	260.00	260.00	1.2	0.	1.2
DAN253	0.	0.01	0.05	0.	0.	0.	0.	0.
TOTAL	0.24510	0.08	0.40	60180.00	7900.00	38,368.5	15,103.5	53,472.0

TOTAL CSP (ALL BASES) -- 320,831.9

REPORT NO. 9 -- SUPPORT EQUIPMENT REQUIREMENTS/COST

OUTPUT FILE - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD

ANNUAL PEAK BASE FLYING HOURS (PBFH) = 56116.80
NUMBER OF BASES (NB) = 6
AVAILABLE ANNUAL OPERATING HOURS (AAOH) = 2080.00

SE ID	TEST STATION DEMAND TIME (TSDEM)	TEST STATION REPAIR TIME (TSDOT)	UTIL RATE (A)	# PER BASE (NSER)	UNIT COST (UCSE)	SE COST/BASE (CPUSE)	INITIAL SE SPARES COST/BASE (CSESM)	COST OF INTER-CONNECTION HARDWARE (IH)	COST OF SOFTWARE (CSU)	INVESTMENT COST (CSEI)	REPLACEMENT COST (CSE)
88888	0	0	0	0	0	0	0	0	0	0	0
TOTAL SHOP PECULIAR SE COSTS PER BASE.....						0	0	0	0	0	0

OTHER BASE LEVEL COSTS:
COMMON SHOP BASE SE COST (BCA).....
EQUIPMENT INDEPENDENT BASE SE COST (BPA)....
PECULIAR AND COMMON FLIGHTLINE SE (FLA).....
TOTAL OTHER SE COSTS (OBSEC).....

TOTAL SE COST PER BASE..... 0. 0

CSEI -- TOTAL NON-RECURRING SE COST (ALL BASES)..... 0
CSE -- TOTAL RECURRING SE COST PER YEAR (ALL BASES)..... 0
TOTAL RECURRING SE COST OVER USAGE PERIOD OF 15 YEARS..... 0

SUPPORT EQUIPMENT LIFE CYCLE COST..... 0

REPORT NO. 10 -- COST OF TRAINING

OUTPUT FILE - AMST STATION KEEPING EQUIPMENT COST DATA - STANDARD

ANNUAL BASE FLYING HOURS (ABFH) = 21043.80
NUMBER OF BASES (NB) = 6

AFSC	TTS COURSE LENGTH WEEKS (NWK)	TTS COST/ AFSC (CTTS)	OJT COST/ AFSC (COJT)	MANPOWER REQUIREMENTS (MU)	ANNUAL TURNOVER RATE (TRS)	TOTAL COST
32851	0.	0.	2,512.0	3.94567	0.254	3,178.3
32831	30.00	19,734.5	0.	1.98742	0.676	29,127.9
53153	0.	0.	2,834.0	0.15364	0.246	136.1

TOTAL COST PER BASE..... 32,442.3
TOTAL CPT (ALL BASES)..... 194,654.0
TOTAL RECURRING CPT (PIUP = 15 YEARS)..... 2,919,809.5
NON-RECURRING INITIAL CADRE COST (CPTI)..... 0.
LIFE CYCLE TRAINING COST..... 2,919,809.5

APPENDIX E
PRELIMINARY TASK IDENTIFICATION MATRIX

The Preliminary Task Identification Matrix (PTIM) is designed for the purpose of identifying the maintenance task requirements for each item on the equipment list and noting at what level (organizational, intermediate, depot) the task is carried out. The sources of data for developing the matrix are many and varied. Where the matrix is being developed for a new system that is still under development, the analysis has to depend heavily on the systems documentation that is required by the Air Force systems engineering management procedure. When the system for which the PTIM is being developed already exists, the following documents can be utilized:

- Technical Orders and Manuals (TOs and TMs)
- Engineering Reports
- Standard Operating Procedures
- Parts Inventories
- Special Tools and Test Equipment Manuals
- Illustrated Parts Breakdowns
- Other Records

In addition to the above, valuable information can be obtained through interviews with knowledgeable maintenance personnel who are familiar with the equipment. In our case, it is anticipated that TOs and TMs and interviews with knowledgeable and experienced maintenance personnel will be the main source of information for the completion of the PTIM. It should be kept in mind that PTIM is just that, i.e., preliminary or first cut statements of the total set of maintenance tasks that are performed on the system. It is, therefore, subject to refinement and greater detail as the ISD/JGD process develops.

It is obviously critical to identify all hardware items since the omission of an item will result in the omission of tasks and hence they will not be represented in the JGM and

training. The inputs for equipment identification as specified in AFHRL-TR-73-43 (I & II) are as follows:

1. Group Assembly Parts List, Numerical Indexes, and the S M & R codes.

2. Optimum Repair Level Analysis.

   Level of Repair Analysis in compliance with MIL-STD-1390 (Navy).

4. Provisionary Lists.

5. End Item Maintenance Sheets or Maintenance Sheets system documentation.

6. Technical Orders and Manuals.

As a minimum, the preparation of the PTIM requires a Group Assembly Parts List or an Illustrated Parts Breakdown and the associated Source, Maintenance, and Recoverability codes. The format for the PTIM is essentially as shown in Figure E-1. The column and row headings are defined as follows:

Maintenance Function

1.	adjust	-	to manipulate the equipment in some manner so as to bring it to some specified position or state--usually to bring it from some out-of-tolerance condition to an in-tolerance condition.
2.	align	-	to bring into precise adjustment or correct relative position by lining up.
3.	calibrate	-	using special measurements or comparison with a standard, to determine the accuracy, deviation, or variation in a piece of equipment and to correct where necessary.

Found in Troubleshooting	Code	System Hardware Item	DRC Code	Reference Designator	Maintenance Function													Notes
					1	2	3	4	5	6	7	8	9	10	11	12	13	
					Adjust	Align	Calibrate	Check out	Troubleshoot	[illegible]	Disassemble/assemble	Inspect	Lubricate	Operate	Remove/replace	Repair	Service	

Figure E-1 Format for PTIM

4.	check out	-	to perform specific operations to verify operational readiness of the equipment--to test.
5.	troubleshoot	-	to isolate the source of a malfunction or failure to an item whose parts are replaceable or repairable.
6.	clean	-	to wash, scrub, or apply solvents to remove dirt, corrosion, or grease.
7.	disassemble/ assemble	-	to remove and replace the parts of an item for purposes of inspection, cleaning, repair, or replacement.
8.	inspect	-	to perform a visual, auditory, or tactile examination or check for specific conditions in order to determine the serviceability of an item by comparing its physical and mechanical characteristics with some standard.
9.	lubricate	-	to put lubrication on specific locations.
10.	operate	-	to control equipment in order to achieve the intended function.
11.	remove/ replaced	-	to interchange an unserviceable item with a serviceable one.
12.	repair	-	to restore an item to operable condition by means other than total replacement of a part.
13.	service	-	to perform operations required periodically such as replenish consumable supplies, to keep an item in proper operating condition.

Whereas in the format recommended in AFHRL-TR-73-43 (I & II) checkout/troubleshoot is listed as one maintenance function,

they probably should be separated, as one can occur without the other especially in the case of scheduled maintenance.

Systems Hardware Item

The equipment items are listed in the row headings. The titles that are being used in CHRT (e.g., brakes/anti-skid) are adequate for initial efforts at the PTIM; however, at some point, these pieces of equipment must be broken down into finer detail. A simple identification such as Main Landing Gear - Mechanical Parts is not sufficient. The greater detail can be obtained from the Group Assembly Parts List or from the IPB.

Code-Reference Designator

The codes showing subordination should be as specified in MIL-M-008910A (AS) and the codes as well as the reference designator should follow the guidelines suggested in AFHRL-TR-73-43 (I & II). However, it is suggested that there also be a code column carrying the DRC code designator (e.g., GLC-173) since this will facilitate the cross-checking of data within the CDB.

Found in Troubleshooting

A check will be placed in this column when, if the hardware item malfunctions, the malfunction is uncovered by the troubleshooting of a superordinate hardware item. The items checked are those that are replaced or repaired as the result of a particular troubleshooting routine.

One further departure from the PTIM format presented in AFHRL-TR-73-43 (I & II) is suggested. The matrix cells are divided diagonally so that in each cell the notation of level of maintenance can be entered and, when the PTIM is annotated, the head, book, joint notation can also be entered. However, this results in an unnecessarily cluttered display, and a separate matrix for both these notations would be better despite the added pieces of paper.

The cell entries for the PTIM are as follows:

- No maintenance task of this type is performed on the hardware item.

O A maintenance task of this type is performed at the organizational level.

I A maintenance task of this type is performed at the intermediate level.

D A maintenance task of this type is performed at the depot level.

O A maintenance task of this type is performed at both the organizational and intermediate levels.

PTIMs of several detail levels follow. These were derived from a PTIM for the entire landing gear which is not shown. A PTIM for those hardware items removed and order of removal for the subject task is provided in Figure E-2. Finally, a detailed PTIM is provided in Figure E-3.

FOUND IN TROUBLESHOOTING	CODE					SYSTEM HARDWARE ITEM	DRC CODE	REFERENCE DESIGNATOR	MAINTENANCE FUNCTION 1 ADJUST	2 ALIGN	3 CALIBRATE	4 CHECK OUT	5 TROUBLESHOOT	6 CLEAN	7 DISASSEMBLE/ASSEMBLE	8 INSPECT	9 LUBRICATE	10 OPERATE	11 REMOVE/REPLACE	12 REPAIR	13 SERVICE	NOTES
	1	7				Wheel & Tire Assembly	GLG170	C-141														
						Tire						I	I			●			I	D	●	
						Wheel						I	I	I	I	I			I	I		
						Bearings (2 ea)						I	I	I		I	I		I			
						Grease Retainers (2 ea)										I			I			
						Felt Seals (2 ea)										I			I			
						Retainer Rings (2 ea)										I			I			
						Snap Ring (Inner) (1)										I			I			
						Lock Ring (1)										I			I			
						Axle Nut (1)										I			I			
						Cotter Pin (1)										I			I			
						Stud Detector (1)						I	I			I		I	I			
						Screws (3 ea)										I			I			
						Hub Cap (1)										●			I			
						Snap Ring (1)										●			I			
						Nut Lock (1)										●			I			
						Valve Core (1)										●			I			
						Valve Cover (1)										●			I			

Figure E 2 LANDING GEAR DETAILED PTIM (IN ORDER OF REMOVAL – WHEEL, TIRE, AND BRAKE ASSEMBLY)

FOUND IN TROUBLESHOOTING	CODE					SYSTEM HARDWARE ITEM	DRC CODE	REFERENCE DESIGNATOR	MAINTENANCE FUNCTION 1 ADJUST	2 ALIGN	3 CALIBRATE	4 CHECK OUT	5 TROUBLESHOOT	6 CLEAN	7 DISASSEMBLE/ASSEMBLE	8 INSPECT	9 LUBRICATE	10 OPERATE	11 REMOVE/REPLACE	12 REPAIR	13 SERVICE	NOTES
	1	3				Brake Assembly	GLG140	C-141														
						Brake			1	1	1	1	1	1	1	1		1	1	1	1	
						Spacer (Outer)										1			1			
						Bolt										1			1			
						Washer Torque Link										1			1			
						Nut										1			1			
						Spacer (Inner)										1			1			

Figure E-2 (concluded)

FOUND IN TROUBLESHOOTING	CODE					SYSTEM HARDWARE ITEM	DRC CODE	REFERENCE DESIGNATOR	MAINTENANCE FUNCTION														NOTES
									ADJUST	ALIGN	CALIBRATE	CHECK OUT	TROUBLESHOOT	CLEAN	DISASSEMBLE/ASSEMBLE	INSPECT	LUBRICATE	OPERATE	REMOVE/REPLACE	REPAIR	SERVICE		
									1	2	3	4	5	6	7	8	9	10	11	12	13		
	1					Landing Gear System																	
	1	1				Main Landing Gear																	
	1	1	1			Mechanical Parts																	
	1	1	1	32		Leveler Rod Assembly									1				1				
	1	1	1	32	1	Cotter Pin													1				
	1	1	1	32	2	Nut													1				
	1	1	1	32	3	Washer													1				
	1	1	1	32	4	Washer													1				
	1	1	1	33		Torque Link Assembly													1				
	1	1	1	33	1	Star Washer													1				
	1	1	1	33	2	Nut													1				
	1	1	1	33	3	Bolt													1				
	1	3				Brakes/Anti Skid																	
	1	3	1			Skid Detector					1	1		1	1		1	1					
	1	3	2			Brakes			1	1		1	1	1	1	1		1	1	1	1		
	1	3	2	1		Rotor Disc							1		1	1			1				
	1	3	2	2		Spacer (Outer)													1				
	1	3	2	3		Spacer (inner)													1				

Figure 5-3 LANDING GEAR DETAILED PRELIMINARY TASK IDENTIFICATION MATRIX (PTIM) (Task – Remove and Replace Main Landing Gear Brake

LANDING GEAR DETAILED PRELIMINARY TASK IDENTIFICATION MATRIX (PTIM)

(TASK - REMOVE AND REPLACE MAIN LANDING GEAR BRAKE)

03/79

FOUND IN TROUBLESHOOTING	CODE					SYSTEM HARDWARE ITEM	DRC CODE	REFERENCE DESIGNATOR	MAINTENANCE FUNCTION														NOTES
									1 ADJUST	2 ALIGN	3 CALIBRATE	4 CHECK OUT	5 TROUBLESHOOT	6 CLEAN	7 DISASSEMBLE/ASSEMBLE	8 INSPECT	9 LUBRICATE	10 OPERATE	11 REMOVE/REPLACE	12 REPAIR	13 SERVICE		
	1	7				Wheel and Tire																	
	1	7	1			MLG Wheels							I	I	I	I	I				I	I	
	1	7	1	1		MLG Wheel Assembly									I	I	I				I		
	1	7	1	1	1	Snap Ring															●		
	1	7	1	1	2	Hub Cap										●					●		
	1	7	1	1	3	Grease Retainer Ring															I		
	1	7	1	1	4	Felt Grease Ring															I		
	1	7	1	1	5	3 Screws (Stud Detector)															I		
	1	7	1	1	6	Cotter Pins (Lockring)															I		
	1	7	1	1	7	Axle Nut															I		
	1	7	1	1	8	Lock Ring															I		
	1	7	1	1	9	Grease Retainer Ring								I							I		
	1	7	1	1	10	Bearing (Outboard)							I	I		I	I				I		
	1	7	1	1	11	Seaspring															I		
	1	7	1	1	12	Grease Retainer								I							I		
	1	7	1	1	13	Felt Grease Seal															I		
	1	7	1	1	14	Grease Retainer								I							I		
	1	7	1	1	15	Bearing (Inboard)							I	I		I	I				I		

Figure E 3 (continued)

LANDING GEAR DETAILED ANNOTATED TASK IDENTIFICATION MATRIX (ATIM)

(TASK - REMOVE AND REPLACE MAIN LANDING GEAR BRAKE)

03/79

FOUND IN TROUBLESHOOTING	CODE					SYSTEM HARDWARE ITEM	DRC CODE	REFERENCE DESIGNATOR	MAINTENANCE FUNCTION															NOTES
									ADJUST	ALIGN	CALIBRATE	CHECK OUT	TROUBLESHOOT	CLEAN	DISASSEMBLE/ASSEMBLE	INSPECT	LUBRICATE	OPERATE	REMOVE/REPLACE	REPAIR	SERVICE			
									1	2	3	4	5	6	7	8	9	10	11	12	13			
	1	7	5			MLG TIRE		29																
	1	7	5	1		Valve Cover		28							B									
	1	7	5	2		Valve Core		27							H									
	1	1	1	13		Axle		22						B		J								

H - Head
B - Block
J - Joint

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APPENDIX F
USER DESCRIPTION

Various types of user descriptions are discussed in AFHRL-TR-73-43. Initially, the Air Force would provide the technical manual developer with a preliminary user description, a statement of the type of maintenance technician expected to be working on the system. It describes the technician in terms of aptitudes, experience, and job related skills and knowledges. At the same time the Air Force would specify an existing military population most analogous to the expected technical manual users. The contractor would then assess this population to determine differences between the statement of characteristics listed in the preliminary user description and those of the analogous population. This assessment would eventually result in a modified user description, a more complete and realistic statement of the technical manual user.

The resources were not available during this study to implement this procedure. Instead a description of the type personnel who might have been assigned to the AMST was prepared and entitled an estimated user description. The technical manual sample was prepared with this population in mind. The sample estimated user description used is provided as follows.

ESTIMATED USER DESCRIPTION

The Estimated User Description (for the 431X2 career field) is that of personnel being trained with the use of proceduralized technical manuals and task-oriented training procedures. The requirements are as follows:

1. Aptitude: A minimum of 50 be obtained in Mechanical, through the use of Armed Forces Vocational Aptitude Battery (ASVAB) scoring criteria for USAF personnel.

2. Reading Level: A reading level be obtained of more than 60 using the same scoring criteria.

3. Aptitude: Average (ASVAB)

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4. Average Time in Service - 18 months

5. Prior Indirect Training - 3 months BMT
Prior Direct Training - Half of the personnel have the required AFSC and 30 days OJT. The other half have eight weeks task-oriented training.

6. Prior Military Work Experience - Half have 2 years experience with the C-130 aircraft. The other half have no military work experience.

APPENDIX G
TECHNICAL MANUAL/TRAINING TRADE-OFF GROUND RULES

A set of ground rules which direct the technical manual/training trade-off is also developed through the integrated task analysis. These ground rules are similar for all systems but must be reviewed and modified for the particular weapon system and user of interest. These ground rules are initially used in developing the ATIM and continuing the tech manual/training trade-off to lower levels. It is important to note that tasks are covered in both manuals and training but the emphasis is different. For example, the need for test equipment and limits to be observed may be presented in a manual, but the use of test equipment is taught. Simple ground rules which are particularly applicable to task-oriented training and proceduralized manuals follow.

Put into Technical Manuals

- Behavioral sequences that are complex and long and which would put a burden on memory
- Behavioral sequences which would require extremely lengthy training/practice periods to produce sufficiently reliable performance
- Tasks that utilize reference information such as tables, graphs, flow charts and schematics, tolerances, etc.
- Tasks that are aided by the presence of illustrations
- Tasks that involve comple
- Tasks that involve complex discriminations or where similarity of cues cause confusion
- Tasks that are performed under stressful conditions that might degrade performance - except time stress
- Infrequently performed tasks.

- Tasks where the probability of error is high and errors are costly.
- Tasks with branching step structures.
- Where low skill level personnel are used.
- Where turnover is high.
- Where procedures change from time to time.

Put into Training:

- Tasks that are not easily described in book form.
- Tasks that are not easily learned on the job (unless they can be put into tech manuals).
- Tasks that need a great deal of practice for acceptable proficiency.
- Tasks where there is little room for error and the errors are costly.
- Tasks which are performed frequently on the job.
- Tasks requiring high speed - where the rate stimulus inputs are high and response outputs are high.
- Tasks that are performed under stress - especially time stress.
- Where environmental constraints interfere with or prohibit use of aids.
- Tasks performed by a large proportion of individuals in a given specialty.

APPENDIX H
TASK ANALYSIS WORK SHEETS*

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* Task analysis worksheet samples are provided in this appendix. These cover two tasks: remove brake and install brake. These tasks are accomplished after the wheel and tire have been removed.

TASK ANALYSIS WORK SHEET

Task #	Task Description	Notes & Cautions	Tools & Equipment	Training and JPA Implications
B	Remove Brake			
1.	Remove outer spacer (19) from axle	B-1 Initial conditions: Aircraft is jacked up with wheel and tire assembly removed.		
2.	Request hydraulic specialist to 1) depressurize #3 hydraulic system per T.O. 1C-141A-2-3JG-1 2) disconnect hydraulic line (4) from swivel fitting (3) 3) cap fitting and plug line			
3.	Separate torque link from brake			
a)	With screwdriver, bend lock tab on star washer (32) out of the indent on nut (33)	B-3A Tab must be completely out of indent or nut won't loosen. May require hammer & punch to get tab completely out of the way.	screwdriver hammer punch	B-3 Trg. Whole procedure of torque link removal as there are contingencies difficult to cover in JPA JPA Listing basic steps without attempting to include alternate procedures on basis of contingencies.
b)	With spanner wrench, loosen nut (33) 3 or 4 turns		spanner wrench	
c)	Tap nut (33) with hammer to free bolt (30)		hammer	
d)	By h and, remove nut (33), star washer (32), and bolt (30)	B-3d If bolt sticks, reinstall nut a few turns and rap with hammer again. Do not hit end of bolt or else threads may be damaged.		
e)	Set torque link out of the way by lifting it up and back			

Task #	Task Description	Notes & Cautions	Tools & Equipment	Training and JPA Implications
B4.	With assistant, remove brake (20) from axle	B-4 Caution: Brake must be eased off (not allowed to drag) so as to protect bearing surfaces on axle. Warning: Weight of brake 250 lbs. Warning: Fingers are in some jeopardy		B-4 Trg. Practice on brake removal with explanation of importance of protecting bearing surfaces Trg. Proper method of brake removal to avoid injury to back or fingers
5.	Use brake dolly, transport old brake to the service chariot	B-5 Note: Usually new brake would be picked up from chariot at this point in anticipation of brake installation	brake dolly	
6.	Remove inner spacer (20) from axle			
	END OF TASK			

Task #	Task Description	Notes & Cautions	Tools & Equipment	Training and JPA Implications
C	Install Brake			
1.	Using solvent, clean axle (22) and spacers (19, 21)	C-1 Inspect spacers for wear or damage	solvent P-D-680	C-1 Trg. Demonstration with examples of adequate and inadequate cleaning
a)	Clean axle and spacers thoroughly with solvent			
b)	Wipe off any excess solvent			
2.	Apply thin film of grease to axle	C-2 Note: Spacers are not greased, just axle	grease MIL-G-81322	C-2 Trg. Demonstration required
3.	Install inner spacer (21) on axle (make sure it is all the way on)	C-3 Flared end goes on first. Frequently requires turning and jiggling to insure that spacer is all the way on		C-3 Trg. Training of technique to get spacer all the way on and demonstration of visual cues to indicate satisfactory execution
4.	Get new brake and completely remove any service tags and wire attachments	C-4 Brake dolly should be used for transport Warning: Possible injury from weight of brake. Any lifting must involve two people.	brake dolly	C-4 Trg. Safety procedures in lifting and handling
5.	Align rotor and stator discs of brake		screwdriver	C-5 Trg. Must be trained—too difficult to describe in JPA
6.	With assistant, install brake onto axle	C-6 Brake must be fully abutted to shoulder on inner spacer Caution: Brake must be eased on so as to avoid damage to bearing surfaces on axle Warnings: Weight of brake, 250 lbs. and hazard to fingers while handling		C-6 Trg. Visual cues that indicate satisfactory task performance Trg. Explanation of importance of protecting bearing surfaces Trg. Safety precautions in lifting and handling

Task #	Task Description	Notes & Cautions	Tools & Equipment	Training and JPA Implications
C7.	Install torque link (31)			
a)	Align torque link with brake	C-7a Bolt holes in link and brake must line up exactly		C-7 Trg. Entire task must be thoroughly trained
b)	Install bolt (30)	C-7b Direction of bolt insertion is critical: threaded end must point toward opposite tire. Flat edge of bolt head must line up with alignment bar on brake housing. (If not lined up, bolt cannot be all the way through and this creates a hazardous condition.) Threaded end of bolt will protrude 1/32 inch from brake housing when installed correctly. (Bolt may have to be tapped with hammer so it will extend the 1/32 inch)	hammer	JPA Indication of proper protrusion can be depicted by the thickness of a line or by the separation between two thin lines.
c)	install star washer (32) on end of bolt (30)	C-7c Hole in washer conforms to the shape of bolt end so it can be positioned only in a certain position (i.e., washer cannot rotate on bolt end). If washer won't stay in place on end of bolt, a little grease can be put on brake housing so washer can adhere. (But make certain bolt is protruding sufficiently.)		

Task #	Task Description	Notes & Cautions	Tools & Equipment	Training & JPA Implications
C7d)	Install nut (33), tightening it by hand	C-7d Caution: Make sure star washer remains properly positioned on end of bolt		
e)	Using spanner wrench, tighten nut (33)	C-7e Tighten to remove all end play May need to use hammer & punch to tighten	spanner wrench (hammer & punch)	
f)	Line up a tab on star washer (32) with an indent on nut (33) by tightening nut slightly		spanner wrench (hammer & punch)	
g)	Using screwdriver, bend tab on star washer (32) part way into nut indent		screwdriver	
h)	Using hammer & punch, seat tab into indent		hammer & punch	
8.	Request hydraulic specialist to:			
a)	Remove cap from fitting (3) and plug from line (4)			
b)	Connect line (4) to swivel fitting (3)			
c)	Bleed brake per T.O. 1C-141A-2-3JG-2			
d)	Service hydraulic system per T.O. 1C-141A-2-2JG-5			
e)	Check adjustment of brake and leak check brake per T.O. 1C-141A-2-12JG-6			
9.	Engage parking brake			
a)	Depress upper portion of rudder pedals (40) full forward			
b)	Pull parking brake handle (39) out			
c)	Release rudder pedals (40)			
10.	Install outer spacer (19)	C-10 Flared end away from brake		

END OF TASK

APPENDIX I
TEST EQUPIMENT AND TOOL USE FORMS

The test equipment and tool use forms are initiated early during the integrated task analysis. Initially, they are used to identify the test equipment and tools required and to describe their functions. Finally, the form is used to document the technical manual and training trade-off for test equipment and tools. Those prepared for the torque wrench and one type of spanner wrench are included.

TEST EQUIPMENT AND TOOL USE FORM

Torque Wrench — Equipment Nomenclature

PN 7227089-10 — Equipment Number

Date _____

Analyst _____

Functions	JPA Training Trade-Off	
	Information to be included in JPA	Information to be given in Training
1. Calibrated to 960 inch-pounds - to torque axle nut 2. Calibrated to 480 inch-pounds - to torque axle nut after checking lock ring 3. Calibrated to 600 inch-pounds (rectangular head) to check lock ring	1. Steps in tightening nut and ring 2. Steps in aligning lock ring holes	1. How to use torque wrench 2. Importance of keeping lock ring in place while tightening nut 3. Alignment of lock ring holes

TEST EQUIPMENT AND TOOL USE FORM

Spanner Wrench — Equipment Nomenclature

PN 2559550 — Equipment Number

Date _____

Analyst _____

Functions	JPA Training Trade-Off	
	Information to be included in JPA	Information to be given in Training
Used to remove and install brake torque link nut and bolt	1. Use spanner wrench to remove & install torque link nut 2. Directive to align lock tab from star washer with a slot in nut	1. Identification of wrench 2. How wrench is used to loosen & tighten torque link nut 3. How to align lock tab from star washer with slot in the nut 4. How to discriminate when end play between nut and bolt is removed

APPENDIX J
ANNOTATED TASK IDENTIFICATION MATRICES

The ATIM file is established after completion of the PTIM, user description, technical manual/training trade-off ground rules and task analysis worksheet files. These files provide the decision data necessary to prepare the ATIM; the allocation of task coverage to training or technical manuals.

The ATIM is retained in the CDB as hard copy in a format similar to the PTIM. The complete ATIM for the task - remove and replace main landing gear brake is shown.

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LANDING GEAR DETAILED ANNOTATED TASK IDENTIFICATION MATRIX (ATIM)

(TASK – REMOVE AND REPLACE MAIN LANDING GEAR BRAKE)

03/79

H - Head
B - Back
J - Joint

FOUND IN TROUBLESHOOTING	CODE					SYSTEM HARDWARE ITEM	DRC CODE	REFERENCE DESIGNATOR	MAINTENANCE FUNCTION: 1 ADJUST	2 ALIGN	3 CALIBRATE	4 CHECK OUT	5 TROUBLESHOOT	6 CLEAN	7 DISASSEMBLE/ASSEMBLE	8 INSPECT	9 LUBRICATE	10 OPERATE	11 REMOVE/REPLACE	12 REPAIR	13 SERVICE	NOTES
	1					Landing Gear System																
	1	1				Main Landing Gear																
	1	1	1			Mechanical Parts																
	1	1	1	32		Lowder Rod Assembly		37							H							
	1	1	1	32	1	Cotter Pin		36											H			
	1	1	1	32	2	Nut		35							H							
	1	1	1	32	3	Washer		34							H							
	1	1	1	32	4	Washer		38							H							
	1	1	1	33		Torque Link Assembly		31							H							
	1	1	1	33	1	Star Washer		32											H			
	1	1	1	33	2	Nut		33							H							
	1	1	1	33	3	Bolt		30							H							
	1	3				Brakes/Anti Skid		20 6														
	1	3	1			Skid Detector		6							B	B						
	1	3	2			Brakes		20														
	1	3	2	1		Rotor Drum				H					J							
	1	3	2	2		Spacer (Outer)		19						B	B	J						
	1	3	2	3		Spacer (Inner)		21						B	B	J						

LANDING GEAR DETAILED ANNOTATED TASK IDENTIFICATION MATRIX (ATIM)

(TASK – REMOVE AND REPLACE MAIN LANDING GEAR BRAKE)

03/79

H = Head
B = Block
J = Joint

FOUND IN TROUBLESHOOTING	CODE					SYSTEM HARDWARE ITEM	DRC CODE	REFERENCE DESIGNATOR	MAINTENANCE FUNCTION: 1 ADJUST	2 ALIGN	3 CALIBRATE	4 CHECK OUT	5 TROUBLESHOOT	6 CLEAN	7 DISASSEMBLE/ASSEMBLE	8 INSPECT	9 LUBRICATE	10 OPERATE	11 REMOVE/REPLACE	12 REPAIR	13 SERVICE	NOTES
	1	7				Wheel and Tire		13 & 29								H			J			
	1	7	1			MLG Wheels		13														
	1	7	1	1		MLG Wheel Assembly																
	1	7	1	1	1	Snap Ring		23							B							
	1	7	1	1	2	Hub Cap		5							B							
	1	7	1	1	3	Grease Retainer Ring		9						B	B							
	1	7	1	1	4	Felt Grease Ring		1						B	B							
	1	7	1	1	5	3 Screws (Skid Detector)		24							B							
	1	7	1	1	6	Cotter Pins (Locking)		25											J			
	1	7	1	1	7	Axle Nut		7							J							
	1	7	1	1	8	Lock Ring		8							J							
	1	7	1	1	9	Grease Retainer Ring		11						B	B							
	1	7	1	1	10	Bearing (Outboard)		12						B	B		J					
	1	7	1	1	11	Snapring		18							B							
	1	7	1	1	12	Grease Retainer		17						B	B							
	1	7	1	1	13	Felt Grease Seal		16						B	B							
	1	7	1	1	14	Grease Retainer		15						B	B							
	1	7	1	1	15	Bearing (Inboard)		14						B	B		J					

LANDING GEAR DETAILED PRELIMINARY TASK IDENTIFICATION MATRIX (PTIM)

(TASK – REMOVE AND REPLACE MAIN LANDING GEAR BRAKE)

69/79

FOUND IN TROUBLESHOOTING	CODE	SYSTEM HARDWARE ITEM	DRC CODE	REFERENCE DESIGNATOR	MAINTENANCE FUNCTION 1 ADJUST	2 ALIGN	3 CALIBRATE	4 CHECK OUT	5 TROUBLESHOOT	6 CLEAN	7 DISASSEMBLE/ASSEMBLE	8 INSPECT	9 LUBRICATE	10 OPERATE	11 REMOVE/REPLACE	12 REPAIR	13 SERVICE	NOTES
	1 7 5	MLG Tire						I	I			●			I	O	●	
	1 7 5 1	Valve Cover										●			●			
	1 7 5 2	Valve Core										●			I			
	1 1 1 13	Axle						I			I	I			I			

Figure E-3 (concluded)

3 of 3

APPENDIX K
LEVEL-OF-DETAIL GUIDE

The level-of-detail guide is described in AFHRL-TR-73-43 as a statement of how detailed the information provided in a technical manual needs to be based on the target audience and what is known about the equipment system. It consists of a set of coverage rules stating what needs to be told the technician and how deeply the technical manual should go into each matter. One might normally expect this guide to be written for a specific subsystem and technical skill. During this effort a specific sample task within a subsystem was being addressed. As a result, the level-of-detail guide was prepared at a greater level of detail than is normally appropriate.

Level-of-Detail Guide

1. Disconnect leveler rod
   Simple statement of steps as they occur in their proper code -
   Example:
   "using pliers, remove the cotter pin"
   "Using wrench, remove nut"
   "Put nut and washer back on leveler rod for safe keeping"

   These steps will be accompanied by a blow-up diagram which (1) shows the location of the rod and (2) details the assembly.

2. Remove valve core and deflate tire
   Simple statement of steps. The appropriate tire pressure which must be reached before proceeding will be specified. The use of the valve core tool and the tire gauge will be taught through training. Cautions will be listed.

3. Remove snapring, hub cap, grease retainer ring, felt grease seal, safety wire, skid detector screws and detector, cotter pin from lock ring, and axle nut.
   Simple statement of steps with suggestions to keep things in order of removal to facilitate installment. Also inspect for wear.

4. Inspect wheel for defects
The specific types of defects likely to be encountered will not be described. They will be covered in training: The JPA will only direct the technician to inspect.

5. Remove axle nut and lock ring
Simple statement. The use of the spanner wrench will be taught in training.

6. All steps up through removal of the tire are listed in a straightforward manner with accompanying illustrations. The washing, lubricating of seals, rings, etc., will be covered in training. However, the material used will be listed in the book.

7. Brake removal and installation
Steps are listed in straightforward manner. The steps dealing with the torque link will be described in somewhat more detail, especially the cues required to align/install/etc., star washer, bolt, and nut. For example, there will be information on such things as how to discern when the bolt is properly installed, when the nut is tight, etc. These steps will also be covered in training. The cautions involving brake removal and installation will be emphasized. Here again cues will be emphasized such as how much of the spacer should be showing when brake is properly installed.

8. Tire installation
The most difficult part of putting the tire back on is the alignment of the rotor and stator discs of the brake with the wheel. This will be mentioned in the book but it will be presented in training. Again, mention will be made of the cues that are visible when there is proper installation.

APPENDIX L
LCOM APPLICATION TO AMST LANDING GEAR WITH FLIGHTLINE SUPPORT EQUPMENT (SE)

INTRODUCTION

This section summarizes the methodology for inclusion of AGE[1] maintenance networks within the framework of AMST landing gear maintenance networks. The effort involved six steps:

1. Selection of AGE pertinent to landing gear maintenance.

2. Determination and validation of maintenance task data for the AGE.

3. Construction of AGE maintenance networks for LCOM simulation.

4. Running the simulations.

5. The correction of input data resulting from evaluation of simulation model output products and rerunning the simulation.

6. The identification of AGE and manpwor requirements necessary to support AMST landing gear maintenance.

METHODOLOGY

The first step in the effort was concerned with identifying the AGE needed to support landing gear maintenance on AMST aircraft. Design decisions during the prototype phase of the study indicated that the landing gear for C-141 aircraft

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[1] The acronym AGE for aerospace ground equipment as used in this section is considered synomous with SE.

would be similar to that used for the AMST. As a result, several bases which maintain C-141 aircraft were each asked to submit a list fo the AGE they used, the number of each type of unit assigned to the base, and the monthly demand rate for each of the units. From these lists, nine different units were initially identified as being pertinent to landing gear maintenance. Two of these units were late ignored in the study; the hydraulic servicing cart was dropped because it was not used for landing gear maintenance, and the hydraulic test stand was dropped because of low usage. Of the seven units selected for the study, the three powered AGE units were: the AM32A-60 Gas Turbine Generator Set, the AF/M27M-1 Hydraulic Jacking Manifold (gasoline powered), and the NF-2 Light Cart. The four non-powered AGE units were the MD-3 nitrogen servicing cart, the 35-ton axle jack, the 30-ton tripod jack, and the 70-ton tripod jack.

A trip to Charleston AFB later revealed that an extended version of the 30-ton tripod jack was used there in lieu of the 70-ton tripod jack so this change was made and data was collected accordingly.

Step two dealt with the collection and validation of maintenance task data for the selected AGE. The initial procedure was to extract the data on the AGE from ABD64-A magnetic computer tapes which are a compilation of AFTO Form 349 reports. AFHRL-TR-77-43, "Predicting Powered Support Equipment and Associated Maintenance Manpwoer Requirements" (Reference L-1) was used as an aid in extracting the data. Tapes for a 6-month period (from around September 1977 to April 1978) were requested from each of five bases. With the assistance of AFHRL, some data were gathered on the generator sets and light carts. It seems that only registered AGE is logged on these tapes and no data were found on the nitrogen carts. The data compiled from the ABD64-A tape extraction process were useful insofar as maintenance personnel listings and task times were concerned.

Following the extraction procedure, scheduled and unscheduled maintenance task flow diagrams were constructed for each of the AGE, both registered and non-registered. Task data such as personnel, resources, and time were entered on the diagrams using available data from the tape extraction and from experienced personnel within the Air Force and DRC. Subsequently, a visit was made to Charleston AFB in order to verify the diagrams and to fill the remaining blanks. Various maintenance shop personnel were interviewed at Charleston including those at dispatching,

gas cart servicing and repair, powered age inspection and servicing, powered age repair, and wheel and tire. The maintenance supervisors and other personnel in these shops were most helpful and informative with the net result that the task flow diagrams for all units were easily completed upon returning. Operational scenario flow diagrams were also completed at that time.

The third step involving construction of AGE maintenance networks for LCOM consisted of two applications. In the first application, the LCOM simulation was to be run using the demand rate for the AGE based upon total aircraft maintenance needs for a given base. In the second application, the AGE demand rate was based upon the particular needs of unscheduled landing gear failures for AMST aircraft. In order to achieve this, it was necessary to integrate the AGE with those of the landing gear.

The basic scheduled and unscheduled maintenance and operating networks for each of the AGE units were constructed from their associated AGE task flow diagrams and prepared in Extended Form 11 format. "Simulating Maintenance Manning for New Weapon Systems," AFHRL-TR-74-97 (Reference L-2) was used as an aid in constructing the networks. The AGE demand rates for this application (Table L-1) were determined from averaging the data received from the five bases. The assigned number of units of each type of age was determined initially by estimating the landing gear maintenance needs of a 52 AMST wing flying about 17 missions per day. This determination was further based on estimation of the downtime probabilities of the AGE and the requirement for periodic maintenance.

The second application of this step uses much the same networks as the first. However, as was noted earlier, they are integrated through their operating scenario into the AMST landing gear unscheduled maintenance networks, since the AGE demand is based upon landing gear failure rates. At present, LCOM is not specifically designed to handle the type of network construction involving SE as used here in that simultaneous landing gear failures, i.e., two failures on one aircraft, can result in multiple demands for the same resource where only one of an AGE type is actually needed. For example, while the AM32A-60 generator can support an entire aircraft, each landing gear failure will call one out. The net result is that there may appear to be a higher demand on AGE than exists in reality. A similar problem is present in the maintenance personnel area. These may be ways of getting around this difficulty, but for this specific scenario, a method has not yet been perceived,

Age Type	Number Assigned	Average Daily Demand Rate Per Unit	Average Daily Dispatches Per Age Type	60 Day*	90 Day*	180 Day*	1 Year*	2 Year*	2 Year* Painting
AM32A-60(A) Generator Set	30	1.33	40	90				8	7
AF/M27M-1 Jacking Manifold	5	.40	2			5		2	2
NF-2 Light Cart	15	.53	8		30			4	4
MD-3 Nitrogen Cart	7	.71	5		14			2	
35 Ton Axle Jack	5	.40	2		10		3		
30 Ton Tripod Jack (Normal)	6+	.17	1		12				
30 Ton Tripod Jack (Extended)	12++	.17	2		22				

\+ Used in pairs for jacking aircraft

++ Used in groups of four for jacking aircraft

* The number of maintenance actions of given types scheduled for all AGE of that class over 180 day scenario.

TABLE L-1 ASSIGNMENT, DEMAND AND SCHEDULED MAINTENANCE

although an unsuccessful attempt was made. For both parts of the step, individual networks for each SE type have been constructed and placed in Extended Form 11 compatible format. Each of these SE networks was developed from maintenance flow diagrams based on the SE unscheduled and periodic maintenance requirements. The SE networks for a fixed demand rate are presented in Figures L-1 - L-6. The networks used in conjunction with the AMST landing gear failure demand are essentially the same, but without the mission call(Z00000) node.

In order to perform the LCOM simulation runs, the fourth step of the effort, it was necessary to build a scenario around the maintenance networks. The scenario is based upon a wing of 52 AMST aircraft in which one-third of the planes fly each day. Aircraft are preflight inspected between 0400 and 1500, takeoff between 0600 and 1700, and fly 5-hour missions . Although SE is available for use around the clock, most of the SE maintenance personnel shops operate only one shift from 0800 to 1600 (based upon Charleston AFB scheduling). This is true of AFSCs 423R5 (powered SE repair), 431Y2 (gas cart service and repair), 427X4 (welding shop), 423X0 (electrical repair) in this model. The remaining AFSCs, 423W5 (powered AGE service and inspect), 431X2 (wheel and tire) and 603X0 (dispatch are on three-shift duty. The simulation scenarios for this model are run for 180-day segments. Each of the scenarios, presented in Figures L-7 and L-8, includes mission or dispatch and periodic maintenance start times, priorities, allowable delay times and frequency of occurrence. An additional important input to the simulation is that of "18" cards for priority specifications. These cards allow for task preempting and expediting, and for overtime allocation in those shops not on three shifts. The initial simulation runs for both scenarios were made with no constraint on manpower; thus, the primary constraints became the task times required to fix the various units and the limiting number of AGE available.

The simulations, based upon landing gear demand, were run with a modified landing gear failure rate. All failures were reduced by a factor of 5; for example, the mean sorties between maintenance action (MSBA) for a 5-hour sortie of the main landing gear was reduced from 145 to 29. The purpose of this reduction was to increase simulation run turnaround times and to reduce computer processing costs by about 50 percent. While the results of this action would naturally reduce the manpower and resource needs for a 180-day period. it was decided that the main objective of the effort, which was to demonstrate the integration of AGE maintenance

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                        H        00010   AM32A-60 GENERATOR SET
  J0101 HTOW01  J0102 D          00010 31      4   C 1D60   1TUG   1603X0
  J0102 Z00000  J0103 S          00010 11
  J0103 HKEEP1  J0104 D          00010 31     30 25L 1D60
  J0104 HTOW01  J0105 D          00010 31
  J0105 HSERV1  J0106 D          00010 31      3   C 1D60   1423W5
  J0106 DCRMTA  J0107 D          00010 31
  J0107 CALLSA  J0108 C          00010 31
  J0108 HREADY        D          00010 31
                        H        00010   AM32A-60 60 DAY PERIODIC
  J0120 HTUG01  J0121 D          00010 31      2   C 1D60   1603X0 1TUG
  J0121 Z00000  J0122 S          00010 11
  J0122 H0160D  J0123 D          00010 31    200 25L 1D60   1423R5
  J0123 HTUG01        D          00010 31
                        H        00010   AM32A-60 2 YEAR PERIODIC
  J0130 HTUG01  J0131 D          00010 31      2   C 1D60   1603X0 1TUG
  J0131 Z00000  J0132 S          00010 11
  J0132 H012YR  J0133 D          00010 31     40 25L 1D60   1423R5
  J0133 HTUG01        D          00010 31
                        H        00010   AM32A-60 2 YEAR CORROSION CONTROL
  J0140 HTUG01  J0141 D          00010 31      2   C 1D60   1603X0 1TUG
  J0141 Z00000  J0142 S          00010 11
  J0142 HPREP1  J0143 D          00010 31    200 25L 1D60   1423R5
  J0143 HTUG01        D          00010 31
                        H        AA000   AM32A-60 GEN SET UNSCHED MAINT
XCALLSA FAA000  AAA01 F      2   AA000 21
  AAA01 AAA000  AAA02 D          AA000 21      2   C 1603X0 1TUG
  AAA02 TAA000  AAA03 D          AA000 21      3 25L 1423W5
  AAA03 MAA000  AAA04 E    .80   AA000 21      4 25L 1423W5
  AAA04 VAA000        D          AA000 21      2 25L 1423W5
  AAA03 RAA000  AAA05 E    .20   AA000 21     22 25L 1423R5
  AAA05 VAA001  AAA06 D          AA000 21      5 25L 1423R5
  AAA06 SHOP   SAA001 D          AA000 21
                        H        AA000   AM32A-60 CHASSIS/ENCLOSURE/MOBILITY
 SAA001 LAAA00 IAAA01 E    .50   AA000 21
 IAAA01 WAAA00        E    .79   AA000 23     34 25L 2423R5
 IAAA01 NAAA00 PAAA00 E    .21   AA000 23     10 25L 1423R5
 IAAA01 QAAA00        D          AA000 21
 PAAA00 PDEPOT        D          AA000 43
                        H        AA000   AM32A-60 ELEC PWR GEN & CONTROL
 SAA001 LAAB00 IAAB01 E    .18   AA000 21
 IAAB01 WAAB00        E    .66   AA000 23     43 25L 2423R5
 IAAB01 KAAB00        E    .03   AA000 23     23 25L 1423R5 1423X0
 IAAB01 NAAB00 PAAB00 E    .31   AA000 23     20 25L 1423R5
 IAAB01 QAAB00        D          AA000 21
 PAAB00 PDEPOT        D          AA000 43
                        H        AA000   AM32A-60 GAS TURBINE ENGINE
 SAA001 LAAE00 IAAE01 E    .32   AA000 21
 IAAE01 WAAE00        E    .85   AA000 23     25 25L 2423R5
 IAAE01 NAAE00 PAAE00 E    .15   AA000 23    160 25L 1423R5
 PAAE00 WAAE01        D          AA000 23     30 25L 2423R5
 IAAE01 QAAE00        D          AA000 21
 PAAE00 PDEPOT        D          AA000 43
```

Figure L-1 AM32A-60 MAINTENANCE NETWORKS

```
                        H        00010   NF-2 LIGHT CART
  J0401 HTOW04  J0402 D          00010 31      3   C 1NF2   1603X0 1TUG
  J0402 Z00000  J0403 S          00010 11
  J0403 HKEEP4  J0404 D          00010 31     50 25L 1NF2
  J0404 HTOW04  J0405 D          00010 31
  J0405 HSERV4  J0406 D          00010 31      4 25L 1NF2   1423W5
  J0406 DCRMTD  J0407 D          00010 31
  J0407 CALLSD  J0408 C          00010 31
  J0408 HREADY        D          00010 31
                        H        00010   NF-2 90 DAY PERIODIC
  J0420 HTUG04  J0421 D          00010 31      3   C 1NF2   1603X0 1TUG
  J0421 Z00000  J0422 S          00010 11
  J0422 H0490D  J0423 D          00010 31    160 25L 1NF2   1423R5
  J0423 HTUG04        D          00010 31
                        H        00010   NF-2 2 YEAR WHEEL BEARING
  J0430 HTUG04  J0431 D          00010 31
  J0431 Z00000  J0432 S          00010 11
  J0432 H042YR  J0433 D          00010 31     40 25L 1NF2   1423R5
  J0433 HTUG04        D          00010 31
                        H        00010   NF-2 2 YEAR CORROSION CONTROL
  J0440 HTUG04  J0441 D          00010 31
  J0441 Z00000  J0442 S          00010 11
  J0442 HPREP4  J0443 D          00010 31    240 25L 1NF2   1423R5
  J0443 HTUG04        D          00010 31
                        H        AC200   NF-2 UNSCHEDULED MAINTENANCE
XCALLSD FAC200  AC201 F      5   AC200 21
  AC201 AAC200  AC202 D          AC200 21      2   C 1423W5
  AC202 TAC200  AC203 D          AC200 21      3 25L 2423W5
  AC203 MAC200  AC204 E    .90   AC200 21      5 25L 2423W5
  AC204 VAC200        D          AC200 21      2 25L 1423W5
  AC203 RAC200  AC205 E    .10   AC200 21     23 25L 2423R5
  AC205 VAC201  AC206 D          AC200 21      5 25L 1423R5
  AC206 SHOP   SAC201 D          AC200 21
                        H        AC200   NF-2 CHASSIS
 SAC201 LAC210 IAC210 E    .19   AC200 21
 IAC210 WAC210        E    .17   AC200 23     85 25L 1423R5
 IAC210 NAC210 PAC210 E    .83   AC200 23     15 25L 1423R5
 IAC210 QAC210        D          AC200 21
 PAC210 PDEPOT        D          AC200 43
                        H        AC200   NF-2 ELECTRICAL
 SAC201 LAC220 IAC220 E    .22   AC200 21
 IAC220 WAC220        E    .85   AC200 23     37 25L 1423R5
 IAC220 NAC220 PAC220 E    .15   AC200 23     52 25L 1423R5
 IAC220 QAC220        D          AC200 21
 PAC220 PDEPOT        D          AC200 43
                        H        AC200   NF-2 ENGINE
 SAC201 LAC230 IAC230 E    .59   AC200 21
 IAC230 WAC230        E    .30   AC200 23     34 25L 1423R5
 IAC230 J00000 IAC231 E    .70   AC200 21
 IAC231 NAC230 PAC230 E    .96   AC200 23     34 25L 1423R5
 IAC231 NAC231 PAC231 E    .04   AC200 23    240 25L 1423R5
 IAC231 QAC230        D          AC200 21
 PAC230 PDEPOT        D          AC200 43
 PAC231 PDEPOT        D          AC200 43
```

Figure L-2 NF-2 MAINTENANCE NETWORKS

```
                        H        00010   MD-3 NITROGEN CART
  J0501 HTOW05  J0502 D          00010 31      4   C 1MD3   1603X0 1TUG
  J0502 Z00000  J0503 S          00010 11
  J0503 HKEEP5  J0504 D          00010 31     10 25L 1MD3
  J0504 HTOW05  J0505 D          00010 31
  J0505 HSERV5  J0506 D          00010 31      2 25L 1MD3   1431Y2
  J0506 CALLPE  J0507 C          00010 31
 CALLPE HRECHG         A    .33  00010 31      7 25L 1MD3   2431Y2
  J0507 DCRMTE  J0508 D          00010 31
  J0508 CALLSE  J0509 C          00010 31
  J0509 HREADY         D         00010 31
                        H        00010   MD-3 90 DAY PERIODIC
  J0520 HTUG05  J0521 D          00010 31      3   C 1MD3   1603X0 1TUG
  J0521 Z00000  J0522 S          00010 11
  J0522 H0590D  J0523 D          00010 31     40 25L 1MD3   1431Y2
  J0523 HTUG05         D         00010 31
                        H        00010   MD-3 2 YEAR PERIODIC
  J0530 HTUG05  J0531 D          00010 31
  J0531 Z00000  J0532 S          00010 11
  J0532 H052YR  J0533 D          00010 31     50 25L 1MD3   1431Y2
  J0533 HTUG05         D         00010 31
                        H        AQB00   MD-3 UNSCHEDULED MAINTENANCE
XCALLSE FAQB00  AQB01 F      15  AQB00 21
  AQB01 AAQB00  AQB02 D          AQB00 21      5   C 1431Y2 1603X0 1TUG
  AQB02 TAQB00  AQB03 D          AQB00 21      3 25L 1431Y2
  AQB03 MAQB00  AQB04 E     .80  AQB00 21     20 25L 1431Y2
  AQB04 VAQB00         D         AQB00 21      2 25L 1431Y2
  AQB03 RAQB00  AQB05 E     .20  AQB00 21     15 25L 1431Y2
  AQB05 VAQB01  AQB06 D          AQB00 21      5 25L 1431Y2
  AQB06 SHOP   SAQB01 D          AQB00 21
                        H        AQB00   MD-3 CHASSIS
 SAQB01 LAQBA0 IAQBA0 E     .30  AQB00 21
 IAQBA0 WAQBA0         D         AQB00 23     20 25L 1427X4
                        H        AQB00   MD-3 CONTROLS & GAUGES
 SAQB01 LAQBC0 IAQBC0 E     .70  AQB00 21
 IAQBC0 WAQBC0         D         AQB00 23    100 25L 1431Y2
 IAQBC0 WAQBC1         D         AQB00 23     40 25L 2431Y2
```

Figure L-3 MD-3 MAINTENANCE NETWORKS

```
                        H        00010   M27M-1 HYDRAULIC JACK MANIFOLD
  J0301 HTOW03  J0302 D          00010 31      3   C 1M27M  1603X0 1TUG
  J0302 Z00000  J0303 S          00010 11
  J0303 HKEEP3  J0304 D          00010 31     30 25L 1M27M
  J0304 HTOW03  J0305 D          00010 31
  J0305 HSERV3  J0306 D          00010 31      4 25L 1M27M  1423W5
  J0306 DCRMTC  J0307 D          00010 31
  J0307 CALLSC  J0308 C          00010 31
  J0308 HREADY        D          00010 31
                        H        00010   M27M-1 180 DAY GAUGE CALIBRATION
  J0320 HTUG03  J0321 D          00010 31      2   C 1M27M  1603X0 1TUG
  J0321 Z00000  J0322 S          00010 11
  J0322 H03180  J0323 D          00010 31    160 25L 1M27M  1423R5
  J0323 HTUG03        D          00010 31
                        H        00010   M27M-1 2 YEAR WHEEL BEARING
  J0330 HTUG03  J0331 D          00010 31
  J0331 Z00000  J0332 S          00010 11
  J0332 H032YR  J0333 D          00010 31     40 25L 1M27M  1423R5
  J0333 HTUG03        D          00010 31
                        H        00010   M27M-1 2 YR CORROSION CONTROL
  J0340 HTUG03  J0341 D          00010 31
  J0341 Z00000  J0342 S          00010 11
  J0342 HPREP3  J0343 D          00010 31    200 25L 1M27M  1423R5
  J0343 HTUG03        D          00010 31
                        H        AT900   M27M-1 UNSCHEDULED MAINTENANCE
XCALLSC FAT900  AT901 F      4   AT900 21
  AT901 AAT900  AT902 D          AT900 21      2   C 1603X0 1TUG   1423W5
  AT902 TAT900  AT903 D          AT900 21      4 25L 1423W5
  AT903 MAT900  AT904 E    .90   AT900 21      5 25L 1423W5
  AT904 VAT900        D          AT900 21      2 25L 1423W5
  AT903 RAT900  AT905 E    .10   AT900 21     25 25L 1423R5
  AT905 VAT901  AT906 D          AT900 21      5 25L 1423R5
  AT906 SHOP   SAT901 D          AT900 21
                        H        AT900   M27M-1 CHASSIS
 SAT901 LAT910 IAT910 E    .18   AT900 21
 IAT910 WAT910        E    .50   AT900 23     20 25L 1423R5
 IAT910 NAT910 PAT910 E    .50   AT900 23     15 25L 1423R5
 IAT910 QAT910        D          AT900 21
 PAT910 PDEPOT        D          AT900 43
                        H        AT900   M27M-1 HYDRAULICS
 SAT901 LAT920 IAT920 E    .49   AT900 21
 IAT920 WAT920        E    .72   AT900 23     22 25L 1423R5
 IAT920 NAT920 PAT920 E    .28   AT900 23     20 25L 1423R5
 IAT920 QAT920        D          AT900 21
 PAT920 PDEPOT        D          AT900 43
                        H        AT900   M27M-1 ENGINE
 SAT901 LAT930 IAT930 E    .33   AT900 21
 IAT930 WAT930        E    .58   AT900 23     25 25L 1423R5
 IAT930 J00000 IAT931 E    .42   AT900 21
 IAT931 NAT930 PAT930 E    .94   AT900 23     27 25L 1423R5
 IAT931 NAT931 PAT931 E    .06   AT900 23    320 25L 1423R5
 IAT931 QAT930        D          AT900 21
 PAT930 PDEPOT        D          AT900 43
 PAT931 PDEPOT        D          AT900 43
```

Figure L-4 M27M-1 MAINTENANCE NETWORKS

```
                        H          00010   35 TON AXLE JACK
  J0801 HEAVE8  J0802 D            00010 31      3   C 1AJ35T 1431X2
  J0802 Z00000  J0803 S            00010 11
  J0803 HKEEP8  J0804 D            00010 31     15 25L 1AJ35T
  J0804 HEAVE8  J0805 D            00010 31
  J0805 HSERV8  J0806 D            00010 31      1   C 1AJ35T 1431X2
  J0806 DCRMTH  J0807 D            00010 31
  J0807 CALLSH  J0808 C            00010 31
  J0808 HREADY        D            00010 31
                        H          00010   AJ35T 90 DAY INSP, CORR CNTL & LUBE
  J0820 HEEVE8  J0821 D            00010 31      2   C 1AJ35T 1431X2
  J0821 Z00000  J0822 S            00010 11
  J0822 H0890D  J0823 D            00010 31     50 25L 1AJ35T 1431X2
  J0823 HEEVE8        D            00010 31
                        H          00010   AJ35T 1 YEAR HYD FLUSH & PARTS INSP
  J0830 HEEVE8  J0831 D            00010 31
  J0831 Z00000  J0832 S            00010 11
  J0832 H081YR  J0833 D            00010 31     40 25L 1AJ35T 1431X2
  J0833 HEEVE8        D            00010 31
                        H          AU100   AJ35T UNSCHEDULED MAINTENANCE
 CALLSH YNMA08        E     .96   AU100 21
 CALLSH YMA008  AU100 E     .04   AU100 21
X AU100 FAU100  AU101 F       1   AU100 21
  AU101 AAU100  AU102 D            AU100 21      2   C 1431X2
  AU102 TAU100  AU103 D            AU100 21      2 25L 1431X2
  AU103 MAU100  AU104 E     .75   AU100 21      5 25L 1431X2
  AU104 VAU100        D            AU100 21      2 25L 1431X2
  AU103 RAU100  AU105 E     .25   AU100 21     20 25L 1431X2
  AU105 VAU101  AU106 D            AU100 21      2 25L 1431X2
  AU106 SHOP   SAU100 D            AU100 21
                        H          AU100   AJ35T (RAM) LIFT ASSEMBLY
 SAU100 LAU110 IAU110 E     .60   AU100 21
 IAU110 WAU110       D            AU100 23     40 25L 1431X2
                        H          AU100   AJ35T RESERVOIR & PUMP ASSY
 SAU100 LAU120 IAU120 E     .30   AU100 21
 IAU120 WAU120       D            AU100 23     30 25L 1431X2
                        H          AU100   AJ35T CHASSIS
 SAU100 LAU130 IAU130 E     .10   AU100 21
 IAU130 WAU130 IAU131 D           AU100 23     35 25L 1431X2
 IAU131 XAU130       D            AU100 23      5 25L 1427X4
```

Figure L-5 35-TON JACK MAINTENANCE NETWORKS

```
                        H          00010   30 TON TRIPOD JACK (NORMAL)
  J0601 HEAVE6  J0602 D            00010 31     3   C 2TJ30N 2431X2
  J0602 Z00000  J0603 S            00010 11
  J0603 HKEEP6  J0604 D            00010 31    30 25L 2TJ30N
  J0604 HEAVE6  J0605 D            00010 31
  J0605 HSERV6  J0606 D            00010 31     2 25L 2TJ30N 1431X2
  J0606 DCRMTF  J0607 D            00010 31
  J0607 CALLSF  J0608 C            00010 31
  J0608 HREADY        D            00010 31
                        H          00010   30 TON TRIPOD JACK (EXTENDED)
  J0701 HEAVE7  J0702 D            00010 31     3   C 4TJ30E 4431X2
  J0702 Z00000  J0703 S            00010 11
  J0703 HKEEP7  J0704 D            00010 31    30 25L 4TJ30E
  J0704 HEAVE7  J0705 D            00010 31
  J0705 HSERV7  J0706 D            00010 31     4 25L 4TJ30E 1431X2
  J0706 DCRMTF  J0707 D            00010 31
  J0707 CALLSG  J0708 C            00010 31
  J0708 HREADY        D            00010 31
                        H          00010   TJ30N 90 DAY INSP, CORR CNTL & INSP
  J0620 HEEVE6  J0621 D            00010 31     2   C 1TJ30N 1431X2
  J0621 Z00000  J0622 S            00010 11
  J0622 H0690D  J0623 D            00010 31    40 25L 1TJ30N 1431X2
  J0623 HEEVE6        D            00010 31
                        H          00010   TJ30E 90 DAY INSP, CORR CNTL & INSP
  J0720 HEEVE7  J0721 D            00010 31     2   C 1TJ30E 1431X2
  J0721 Z00000  J0722 S            00010 11
  J0722 H0790D  J0723 D            00010 31    40 25L 1TJ30E 1431X2
  J0723 HEEVE7        D            00010 31
                        H          AU200   TJ30N&E UNSCHEDULED MAINTENANCE
 CALLSG CALLSF        C           AU200 21
 CALLSF YNMA67        E     .88   AU200 21
 CALLSF YMA067  AU200 E     .12   AU200 21
X AU200 FAU200  AU201 F       1   AU200 21
  AU201 AAU200  AU202 D           AU200 21     2   C 1431X2
  AU202 TAU200  AU203 D           AU200 21     2 25L 1431X2
  AU203 MAU200  AU204 E     .50   AU200 21    10 25L 1431X2
  AU204 VAU200        D           AU200 21     2 25L 1431X2
  AU203 RAU200  AU205 E     .50   AU200 21    20 25L 1431X2
  AU205 VAU201  AU206 D           AU200 21     2 25L 1431X2
  AU206 SHOP   SAU201 D           AU200 21
                        H          AU200   TJ30N&E (RAM) LIFT ASSEMBLY
 SAU201 LAU210 IAU210 E     .60   AU200 21
 IAU210 WAU200        D           AU200 23    40 25L 1431X2
                        H          AU200   TJ30N&E MANIFOLD & HYDRAULIC LINE
 SAU201 LAU220 IAU220 E     .30   AU200 21
 IAU220 WAU220        D           AU200 23    10 25L 1431X2
                        H          AU200   TJ30N&E CHASSIS ASSEMBLY
 SAU201 LAU230 IAU230 E     .10   AU200 21
 IAU230 WAU230 IAU231 D           AU200 23    35 25L 1431X2
 IAU231 XAU230        D           AU200 23    10 25L 1431X2
```

Figure L-6 30-TON JACK MAINTENANCE NETWORKS

```
20                                  HEADER RECORD
LIST180 AGE*** EXOGENOUS AGE DATA INCLUDING DISPATCHES & PERIODIC INSPECT
20   1    3  0600  D60   DSPD60  1 1 0                          .5  3   1999
20   1    2  0630  D60   DSPD60  1 1 0                          .5  3   1999
20   1    3  0700  D60   DSPD60  1 1 0                          .5  3   1999
20   1    2  0730  D60   DSPD60  1 1 0                          .5  3   1999
20   1    3  0800  D60   DSPD60  1 1 0                          .5  3   1999
20   1    2  0830  D60   DSPD60  1 1 0                          .5  3   1999
20   1    3  0900  D60   DSPD60  1 1 0                          .5  3   1999
20   1    2  0930  D60   DSPD60  1 1 0                          .5  3   1999
20   1    3  1000  D60   DSPD60  1 1 0                          .5  3   1999
20   1    2  1030  D60   DSPD60  1 1 0                          .5  3   1999
20   1    3  1100  D60   DSPD60  1 1 0                          .5  3   1999
20   1    2  1130  D60   DSPD60  1 1 0                          .5  3   1999
20   1    3  1200  D60   DSPD60  1 1 0                          .5  3   1999
20   1    2  1230  D60   DSPD60  1 1 0                          .5  3   1999
20   1    3  1300  D60   DSPD60  1 1 0                          .5  3   1999
20   1    2  1330  D60   DSPD60  1 1 0                          .5  3   1999
20   1    1  0800  D60   PE160D  1 1 0                          8D  5   2999
20   1    1  1000  NF2   DSPNF2  1 1 0                          .5  3   1999
20   1    1  1100  NF2   DSPNF2  1 1 0                          .5  3   1999
20   1    1  1200  NF2   DSPNF2  1 1 0                          .5  3   1999
20   1    1  1300  NF2   DSPNF2  1 1 0                          .5  3   1999
20   1    1  1400  NF2   DSPNF2  1 1 0                          .5  3   1999
20   1    1  1500  NF2   DSPNF2  1 1 0                          .5  3   1999
20   1    1  1600  NF2   DSPNF2  1 1 0                          .5  3   1999
20   1    1  1700  NF2   DSPNF2  1 1 0                          .5  3   1999
20   1    1  1200  M27M  DM27M   1 1 0                          .5  3   1999
20   1    1  1800  M27M  DM27M   1 1 0                          .5  3   1999
20   1    1  0730  MD3   DSPMD3  1 1 0                          .5  3   1999
20   1    1  0930  MD3   DSPMD3  1 1 0                          .5  3   1999
20   1    1  1130  MD3   DSPMD3  1 1 0                          .5  3   1999
20   1    1  1330  MD3   DSPMD3  1 1 0                          .5  3   1999
20   1    1  1530  MD3   DSPMD3  1 1 0                          .5  3   1999
20   1    1  0700  AJ35T DAJ35T  1 1 0                          .5  3   1999
20   1    1  1030  AJ35T DAJ35T  1 1 0                          .5  3   1999
20   1    1  1230  TJ30N DTJ30N  2 2 0                          .5  3   2999
20   1    1  1230  TJ30E DTJ30E  4 4 0                          .5  3   2999
20   2    1  1000  D60   PE12YR  1 1 0                         15D  5  24999
20   3    1  0800  NF2   PE490D  1 1 0                          8D  5   6999
20   5    1  0800  NF2   PE42YR  1 1 0                         15D  5  48999
20   6    1  0800  TJ30E PE790D  1 1 0                          8D  5   8999
20   7    1  0800  MD3   PE590D  1 1 0                          8D  5  13999
20  10    1  0800  AJ35T PE890D  1 1 0                          8D  5  18999
20  11    1  0800  TJ30N PE690D  1 1 0                          8D  5  15999
20  13    1  0800  M27M  PE3180  1 1 0                          8D  5  36999
20  13    1  0900  D60   PE1PNT  1 1 0                         15D  7  24999
20  15    1  0800  AJ35T PE81YR  1 1 0                          8D  5  73999
20  17    1  0800  M27M  PE32YR  1 1 0                         15D  5 146999
20  23    1  0800  M27M  PE3PNT  1 1 0                         15D  7 146999
20  25    1  0800  NF2   PE4PNT  1 1 0                         15D  7  48999
20  27    1  0800  MD3   PE52YR  1 1 0                         15D  5 104999
```

This data may be decoded using AFMSMET Report 78-1 "LCOM II Simulation Software Users Reference Guide" of 1 May 1978.

Figure L-7 SCENARIO FOR FIXED DEMAND

LOG DATA FILE GENERATED FOR 180. DAYS. IDENT = LGHGE LANDING GEAR : AGE CON

BINCW MISSION SCENARIO

20	1	1	0600	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	0700	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	0800	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	0900	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	0930	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1000	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1030	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1100	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1130	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1200	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1230	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1300	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1330	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1400	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1500	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1600	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	1700	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	1999
20	1	1	0800	XD60	PE160D	1	1	0	.1	0	.5	60	5	2999
20	2	1	1000	XD60	PE12WP	1	1	0	.1	0	.5	150	5	12999
20	2	1	1700	AMST	NOFLT	1	1	0	5.0H	.5H	2.0H	3.0H	3	2999
20	3	1	0800	XNF2	PE49OD	1	1	0	.1	0	.5	60	5	6999
20	5	1	0800	XNF2	PE42WP	1	1	0	.1	0	.5	150	5	40999
20	6	1	0800	XTJ30E	PE79OD	1	1	0	.1	0	.5	60	5	1999
20	7	1	0800	XMD3	PE59OD	1	1	0	.1	0	.5	60	5	12999
20	10	1	0800	XAJ35T	PE89OD	1	1	0	.1	0	.5	60	5	18999
20	11	1	0800	XTJ30N	PE69OD	1	1	0	.1	0	.5	60	5	15999
20	13	1	0600	XM27M	PE318O	1	1	0	.1	0	.5	60	5	26999
20	13	1	0900	XD60	PE1PNT	1	1	0	.1	0	.5	150	7	24999
20	15	1	0800	XAJ35T	PE21WP	1	1	0	.1	0	.5	60	5	73999
20	17	1	0800	XM27M	PE32WP	1	1	0	.1	0	.5	150	5	140999
20	23	1	0800	XM27M	PE3PNT	1	1	0	.1	0	.5	150	7	146999
20	25	1	0800	XNF2	PE4PNT	1	1	0	.1	0	.5	150	7	48999
20	27	1	0800	XMD3	PE52WP	1	1	0	.1	0	.5	150	5	104999

This data may be decoded using AFMSMET Report 78-1 "LCOM II Simulation Software Users Reference Guide" of 1 May 1978.

Figure L-8 AGE SCENARIO FOR LANDING GEAR FAILURE DEMAND

networks within an aircraft maintenance scenario, was still achieved. The original MSBMAs of the landing gear system were reinstated for the final simulations in order to determine the manpower and resource needs as well as provide for a comparison with Reliability and Maintainability (R&M) model mean value outputs. Results of the initial runs indicated (a) for the constant demand scenario, an overall mission success of 67 percent, and (b) for the landing gear demand scenario, a 100 percent-misssion accomplishment.

The fifth step in the effort involved analyzing the output products of each successive simulation run and making changes to the input data in order to create the desired results. The apparent difference between the mission success of the two scenarios is due to the fact that the demand rates of the two are different. While in one case the success is far below that desired, because of an apparent insufficiency of manpower or resources available, in the other, there may be an overabundance of personnel and resources allocated to landing gear and AGE maintenance. In the following paragraphs, the two scenarios are analyzed separately, although it is pointed out that changes made in one with respect to task times, task probabilities, or failure rates are also entered into the other.

On its initial run, the constant demand scenario simulation called AGE indicated an overall 65-percent mission success. Analysis of the output products indicated that it was only the dispatch missions on the "D60" generators and "NF2" light carts that were not totally successful Further analysis of output products showed that post-sortie times for these two units w greater than 24 hours. Since there are 40 demands per on 30 D60 units with a failure expected every two demands, it is not surprising that the average 25-hour post-sorties time would yield the results obtained. Some of this known time is probably due to the fact that repair personnel, AFSC 423R5, work only one shift, so that any maintenance task not completed by 1600 must wait overnight before work is resumed. The 12 percent unsatisfied demand for these AFSCs lends further credence to this. For the second run, the mission scenario was changed slightly to permit a 1-hour delay (originally 30 minutes) on a dispatch call to see if this reduced the number of mission aborts. While the mission success percentage for the D60 went up only .03 percent, the additional half-hour allowed the NF12 enough extra time for repair in the shop for its mission success went up to 100 percent. Average post-sortie, or downtime for the D-60 increased slightly, while for the NF2, it went down to 17 hours.

The next modification to the AGE data input was to change the D60 failure rate from every two demands to every three. Mission success rose to 62 percent for D60 dispatches as a result of this change. However, this value was still not satisfactory; so as an experiment, the 1600 to 2400 shift was activated with two 423R5s in the repair shop. The result, was that dispatch success increased again; this time to 69 percent. This value was still unsatisfactorily low, so a further analysis of the input data was made. It is pointed out here that the input analysis of the input data was made. It is pointed out here that the input networks were constructed [illegible] data collected during a visit to Charleston AFB. [illegible] task times and failure rates were based upon esti[illegible] made by the maintenance personnel in the appropriate [illegible]ops on base. The demand rate was also based upon Charleston's demand. Since there seemed to be enough units there to meet all maintenance demands, it become necessary to look further into the task times and probabilities for the D60. Several possible areas were considered for modification: (a) the probabilities of flight line maintenance versus shop maintenance, (b) the mean flightline maintenance time, and (c) the remove-and-replace task times in the shop. Each of these modifications was made in turn, with increasing success; the mean probability ratio for flightline/shop maintenance was changed from 80/20 to 90/10. Flightline maintenance time was reduced from 24 minutes to 15 minutes and the mean removal task time was reduced from 2.2 hours to 1.1 hours because this time might have been duplicated initially in the shop maintenance times. With all these changes included, the D60 mission success went up to 89 percent as shown in Figures L-18 through L-20. At this point, it was deceided that further manipulations of the maintenance data would serve no useful purpose, and runs for this scenario were concluded.

The scenario based upon AMSI landing gear maintenance demand is called "LGAGE." The first simulation run was made after the third "AGE" run. Results, indicated 100 percent mission accomplishment across the board, as shown in Figures L-21 to L-25. While the 100 percent success may have been affected by the reduced landing gear failure rate, it appeared to be due primarily to the unconstrained number of personnel, the more than adequate supply of AGE resources, and only 17 flights per day. Looking at the Personnel report, Figure L-22, it can be seen that personnel utilization was 4 percent at most. An analysis of manpower demand by hour over the 180-day scenario was conducted using the Manpower Martix output products of the run. For the next run, the number of personnel was limited to from one to four per shift for a

RUN NUMBER AGE 6 P E R F O R M A N C E S U M M A R Y PERIOD FROM 0. TO 100.0 LEVEL 2

OPERATIONS	TOTAL	DSP060	PE160D	PE12YR	PE1PNT	DSPMD3	PE590D	PE52YR	DM27M	PE3180	PE32YR
1 NUMBER OF MISSIONS REQUESTED	10655.00	7200.00	90.00	8.00	7.00	900.00	14.00	2.00	360.00	5.00	2.00
2 NUMBER ACCOMPLISHED	9843.00	6388.00	90.00	8.00	7.00	900.00	14.00	2.00	360.00	5.00	2.00
3 PERCENT ACCOMPLISHED	92.38	88.72	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
6 NUMBER OF SORTIES REQUESTED	11015.00	7200.00	90.00	8.00	7.00	900.00	14.00	2.00	360.00	5.00	2.00
7 NUMBER ACCOMPLISHED	10203.00	6388.00	90.00	8.00	7.00	900.00	14.00	2.00	360.00	5.00	2.00
8 PERCENT ACCOMPLISHED	92.63	88.72	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
T1 NUMBER OF WEATHER CANCELS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T2 NUMBER OF WEATHER DELAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T3 NUMBER OF ALERT REPLENISHMENT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T4 NUMBER OF ATTRITIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T5 NUMBER OF RAM REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T6 NUMBER OF AIR ABORTS(TOTAL)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

OPERATIONS	TOTAL	PE3PNT	DSPNF2	PE490D	PE42YR	PE4PNT	DAJ35T	PE490D	PE41YR	DTJ3RM	PE690D
1 NUMBER OF MISSIONS REQUESTED	10655.00	2.00	1440.00	30.00	4.00	4.00	360.00	10.00	3.00	90.00	12.00
2 NUMBER ACCOMPLISHED	9843.00	2.00	1440.00	30.00	4.00	4.00	360.00	10.00	3.00	90.00	12.00
3 PERCENT ACCOMPLISHED	92.38	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
6 NUMBER OF SORTIES REQUESTED	11015.00	2.00	1440.00	30.00	4.00	4.00	360.00	10.00	3.00	100.00	12.00
7 NUMBER ACCOMPLISHED	10203.00	2.00	1440.00	30.00	4.00	4.00	360.00	10.00	3.00	100.00	12.00
8 PERCENT ACCOMPLISHED	92.63	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
T1 NUMBER OF WEATHER CANCELS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T2 NUMBER OF WEATHER DELAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T3 NUMBER OF ALERT REPLENISHMENT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T4 NUMBER OF ATTRITIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T5 NUMBER OF RAM REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T6 NUMBER OF AIR ABORTS(TOTAL)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

OPERATIONS	TOTAL	DTJ30E	PE790D	OTHER
1 NUMBER OF MISSIONS REQUESTED	10655.00	90.00	22.00	0.
2 NUMBER ACCOMPLISHED	9843.00	90.00	22.00	0.
3 PERCENT ACCOMPLISHED	92.38	100.00	100.00	0.
6 NUMBER OF SORTIES REQUESTED	11015.00	360.00	22.00	0.
7 NUMBER ACCOMPLISHED	10203.00	360.00	22.00	0.
8 PERCENT ACCOMPLISHED	92.63	100.00	100.00	0.
T1 NUMBER OF WEATHER CANCELS	0.	0.	0.	0.
T2 NUMBER OF WEATHER DELAYS	0.	0.	0.	0.
T3 NUMBER OF ALERT REPLENISHMENT	0.	0.	0.	0.
T4 NUMBER OF ATTRITIONS	0.	0.	0.	0.
T5 NUMBER OF RAM REPAIRS	0.	0.	0.	0.
T6 NUMBER OF AIR ABORTS(TOTAL)	0.	0.	0.	0.

Figure L-18 FINAL AGE SIMULATION

RUN NUMBER AGE 6 PERFORMANCE SUMMARY PERIOD FROM 0. TO 180.0 LEVEL 2

	AIRCRAFT	TOTAL	XAJ35T	XD60	XMD3	XM27M	XNF2	XTJ30E	XTJ30N	OTHER
13	NUMBER OF AIRCRAFT AUTH.(EOP)	80.00	6.00	30.00	7.00	5.00	15.00	12.00	6.00	0.
14	NUMBER OF AIRCRAFT-DAYS AVAIL	14400.00	900.00	5400.00	1260.00	900.00	2700.00	2160.00	1080.00	0.
15	PCT SORTIES(INCL ALERT)	.30	.17	.50	.30	.17	.23	.07	.07	0.
16	PCT UNSCHED MAINTENANCE	1.06	.14	2.16	.67	.63	.65	.03	.03	0.
17	PCT SCHED MAINTENANCE	12.80	4.02	21.71	6.98	7.28	14.29	2.98	2.98	0.
18	PCT NORS	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	PCT MISSION WAIT STATUS	.32	.35	.34	.31	.35	.46	.15	.15	0.
20	PCT SERVICE + WAITING	20.16	.00	36.99	10.23	20.41	21.95	.00	.00	0.
21	PCT OPERATIONALLY READY	65.38	95.32	38.30	81.59	70.97	62.42	96.76	96.84	0.
22	AVG. AC POST SORTIE TIME(HRS)	10.35	2.11	10.64	5.47	16.39	15.24	3.80	3.66	0.
23	AVG. NO. OF SORTIES/ A/C /DAY	.71	.41	1.20	.73	.41	.55	.18	.18	0.
24	FLYING HOURS	1021.12	37.33	649.82	91.67	36.93	147.92	38.23	19.22	0.
17	NUMBER OF FCF TASKS FLOWN	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	AVG. AC PRESORTIE TIME(HRS)	.37	.30	.48	.40	.38	.38	.29	.29	0.

	PERSONNEL	TOTAL	423R5	423W5	423X8	427X4	431X2	431Y2	603X0	OTHER
27	MANHOURS AVAILABLE (100)	2044.80	316.80	432.00	43.20	28.80	432.00	144.00	648.00	0.
28	PERCENT UTILIZATION	9.02	13.48	11.05	0.	.28	2.38	6.19	11.51	0.
29	MANHOURS USED (100)	184.34	42.71	47.75	0.	.07	10.27	8.92	74.61	0.
30	PCT UNSCHED MAINTENANCE	24.19	36.67	44.77	0.	188.88	5.34	24.53	6.35	0.
31	PCT SCHED MAINTENANCE	75.81	63.33	55.23	0.	0.	94.66	75.47	93.68	0.
33	NUMBER OF MEN DEMANDED	42555.00	977.00	18104.00	0.	4.00	2945.00	1730.00	28795.00	0.
34	PCT AVAILABLE (PRIME)	99.26	87.82	99.98	0.	75.00	100.00	88.96	100.00	0.
35	PCT AVAILABLE (SUBST.)	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	PCT PROV. BY EXPEDITE	.00	.20	0.	0.	0.	0.	0.	0.	0.
37	PCT PROV. BY PREEMPTION	.02	.82	0.	0.	0.	0.	0.	0.	0.
38	PCT DEMANDS NOT SATIS.	.71	11.16	.02	0.	25.00	0.	11.04	0.	0.
39	OVERTIME MANHOURS USED (100)	.09	.04	0.	0.	0.	0.	.05	0.	0.
40	SIMULATED MH PER FLYING HOUR	18.05	4.18	4.68	0.	.01	1.01	.87	7.31	0.

	SHOP REPAIR	TOTAL	AAA08	AAB08	AAE98	AC218	AC228	AC238	AT918	AT928	AT938	AQBA8
44	NO. OF REPARABLE GENERATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	PCT BASE REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	PCT DEPOT REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	AVERAGE BASE REPAIR CYCLE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	PCT ACTIVE REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	PCT WHITE SPACE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	NO. OF ITEMS IN REPAIR (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	NO. OF ITEMS BACKLOGGED (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Figure L-19 FINAL AGE SIMULATION

RUN NUMBER AGE 6 P E R F O R M A N C E S U M M A R Y PERIOD FROM 0. TO 100.0 LEVEL 2

	S H O P R E P A I R	TOTAL	AQ8C0	AU110	AU120	AU130	AU210	AU220	AU230	OTHER
44	NO. OF REPARABLE GENERATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	PCT BASE REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	PCT DEPOT REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	AVERAGE BASE REPAIR CYCLE	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	PCT ACTIVE REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	PCT WHITE SPACE	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	NO. OF ITEMS IN REPAIR (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	NO. OF ITEMS BACKLOGGED (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.

	S U P P L Y	TOTAL	AAA00	AAB00	AAE00	AC210	AC220	AC230	AT910	AT920	AT930	AQ8A0
54	TOT DOLLAR INVEST.(1000)(EOP)	5100.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
55	FILL RATE PERCENT	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.
56	NUMBER OF BACKORDER-DAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	NUMBER OF UNITS DEMANDED	208.00	108.00	29.00	51.00	4.00	3.00	7.00	2.00	2.00	2.00	0.
58	PCT OFF-THE-SHELF	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.
59	PCT EXPEDITED REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	PCT PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	NUMBER OF CANNIBALIZATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	S U P P L Y	TOTAL	AQ8C0	AU110	AU120	AU130	AU210	AU220	AU230	OTHER
54	TOT DOLLAR INVEST.(1000)(EOP)	5100.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	0.
55	FILL RATE PERCENT	100.00	0.	0.	0.	0.	0.	0.	0.	0.
56	NUMBER OF BACKORDER-DAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	NUMBER OF UNITS DEMANDED	208.00	0.	0.	0.	0.	0.	0.	0.	0.
58	PCT OFF-THE-SHELF	100.00	0.	0.	0.	0.	0.	0.	0.	0.
59	PCT EXPEDITED REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	PCT PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	NUMBER OF CANNIBALIZATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.

	E Q U I P M E N T	TOTAL	AJ35T	D60	MD3	M27M	NF2	TJ30E	TJ30N	TUG	OTHER
68	TOT DOLLAR INVEST.(1000)(EOP)	3600.00	100.00	600.00	140.00	100.00	300.00	240.00	120.00	2000.00	0.
69	EQUIPMENT HOURS AUTH. (100)	7776.00	216.00	1296.00	302.40	216.00	648.00	518.40	259.20	4320.00	0.
70	EQUIPMENT HOURS AVAIL. (100)	7776.00	216.00	1296.00	302.40	216.00	648.00	518.40	259.20	4320.00	0.
71	PCT USED-UNSCHED MAINT	.06	0.	0.	0.	0.	0.	0.	0.	.11	0.
72	PCT USED-SCHED MAINT	6.65	4.02	21.71	6.90	7.28	14.29	3.82	3.04	1.62	0.
73	PCT UNUSED	93.29	95.98	78.29	93.10	92.72	85.71	96.18	96.96	98.27	0.
74	NUMBER OF BACKORDER-DAYS	.12	0.	0.	0.	0.	0.	.12	0.	0.	0.
75	NUMBER OF UNITS DEMANDED	62947.00	1479.00	25867.00	3943.00	1467.00	5874.00	2586.00	936.00	20795.00	0.
76	PCT AVAILABLE	99.98	100.00	100.00	100.00	100.00	100.00	99.42	100.00	100.00	0.
77	PCT PROV. BY EXPEDITE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
78	PCT PROV. BY PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
79	PCT DEMANDS NOT SATIS.	.02	0.	0.	0.	0.	0.	.58	0.	0.	0.
80	EQUIP HOURS BACKLOG(100)(EOP)	.00	0.	0.	.00	0.	0.	0.	0.	0.	0.

Figure L-20 FINAL AGE SIMULATION

RUN NUMBER LGAGE5 PERFORMANCE SUMMARY PERIOD FROM 0. TO 100.0 LEVEL 2

OPERATIONS	TOTAL	NCFLT	PE16MO	PE12YR	PE1PNT	PE59MO	PE52YR	PE31MO	PE32YR	PE3PNT	PE49.0
1 NUMBER OF MISSIONS REQUESTED	3335.00	3120.00	90.00	8.00	7.00	14.00	2.00	5.00	2.00	2.00	30.00
2 NUMBER ACCOMPLISHED	3335.00	3120.00	90.00	8.00	7.00	14.00	2.00	5.00	2.00	2.00	30.00
3 PERCENT ACCOMPLISHED	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
6 NUMBER OF SORTIES REQUESTED	3335.00	3120.00	90.00	8.00	7.00	14.00	2.00	5.00	2.00	2.00	30.00
7 NUMBER ACCOMPLISHED	3335.00	3120.00	90.00	8.00	7.00	14.00	2.00	5.00	2.00	2.00	30.00
8 PERCENT ACCOMPLISHED	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
T1 NUMBER OF WEATHER CANCELS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T2 NUMBER OF WEATHER DELAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T3 NUMBER OF ALERT REPLENISHMENT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T4 NUMBER OF ATTRITIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T5 NUMBER OF RAM REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T6 NUMBER OF AIR ABORTS(TOTAL)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

OPERATIONS	TOTAL	PE42YR	PE4PNT	PE89MO	PE81YR	PE69MO	PE79MO	OTHER
1 NUMBER OF MISSIONS REQUESTED	3335.00	4.00	4.00	10.00	3.00	22.00	12.00	0.
2 NUMBER ACCOMPLISHED	3335.00	4.00	4.00	10.00	3.00	22.00	12.00	0.
3 PERCENT ACCOMPLISHED	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.
6 NUMBER OF SORTIES REQUESTED	3335.00	4.00	4.00	10.00	3.00	22.00	12.00	0.
7 NUMBER ACCOMPLISHED	3335.00	4.00	4.00	10.00	3.00	22.00	12.00	0.
8 PERCENT ACCOMPLISHED	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.
T1 NUMBER OF WEATHER CANCELS	0.	0.	0.	0.	0.	0.	0.	0.
T2 NUMBER OF WEATHER DELAYS	0.	0.	0.	0.	0.	0.	0.	0.
T3 NUMBER OF ALERT REPLENISHMENT	0.	0.	0.	0.	0.	0.	0.	0.
T4 NUMBER OF ATTRITIONS	0.	0.	0.	0.	0.	0.	0.	0.
T5 NUMBER OF RAM REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.
T6 NUMBER OF AIR ABORTS(TOTAL)	0.	0.	0.	0.	0.	0.	0.	0.

AIRCRAFT	TOTAL	AMST	XAJ35T	XD60	XMD3	XM27M	XMF2	XTJ38E	XTJ38M	OTHER
13 NUMBER OF AIRCRAFT AUTH.(ECP)	132.00	52.00	5.00	38.00	7.00	5.00	15.00	12.00	6.00	0.
14 NUMBER OF AIRCRAFT-DAYS AVAIL	23760.00	9360.00	900.00	5400.00	1260.00	900.00	2700.00	2160.00	1080.00	0.
15 PCT SORTIES(INCL ALERT)	2.75	6.97	.01	.01	.01	.00	.01	.00	.02	0.
16 PCT UNSCHED MAINTENANCE	.30	.75	0.	0.	0.	0.	0.	0.	0.	0.
17 PCT SCHED MAINTENANCE	1.89	3.45	.30	1.56	.26	.54	.95	.28	.22	0.
18 PCT NORS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19 PCT MISSION WAIT STATUS	.08	.19	.02	.12	.01	.01	.01	.01	.01	0.
20 PCT SERVICE + WAITING	1.96	3.19	.00	2.33	.00	.67	1.28	.00	.00	0.
21 PCT OPERATIONALLY READY	93.02	85.45	99.68	96.08	99.73	98.78	97.75	99.79	99.77	0.
22 AVG. AC POST SORTIE TIME(HRS)	5.21	3.32	4.74	47.81	4.53	28.80	37.85	4.46	4.47	0.
23 AVG. NO. OF SORTIES/ A/C /DAY	.14	.33	.01	.02	.01	.01	.01	.01	.01	0.
24 FLYING HOURS	15871.60	15650.69	1.30	10.51	1.60	.90	3.80	2.20	1.20	0.
T7 NUMBER OF ECP TASKS FLOWN	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T8 AVG. AC PRESORTIE TIME(HRS)	1.89	2.00	.20	.20	.30	.20	.30	.20	.20	0.

Figure L-21 INITIAL LGAGE SIMULATION

RUN NUMBER LGAGE5 PERFORMANCE SUMMARY PERIOD FROM 0. TO 180.0 LEVEL 2

PERSONNEL	TOTAL	423R5	423W5	423X8	4233W	42334	42353	42354	427X4	431X2	431Y2
27 MANHOURS AVAILABLE (100)	20883.83	720.00	2160.00	720.00	720.00	720.00	720.00	720.00	720.00	2160.00	720.00
28 PERCENT UTILIZATION	1.00	4.01	.31	0.	1.42	.93	2.26	3.56	0.	.30	.12
29 MANHOURS USED (100)	208.54	28.85	6.64	0.	10.20	6.69	16.26	25.63	0.	6.57	.90
30 PCT UNSCHED MAINTENANCE	52.63	6.99	48.70	0.	100.00	100.00	100.00	100.00	0.	5.00	3.30
31 PCT SCHED MAINTENANCE	47.37	93.01	51.30	0.	0.	0.	0.	0.	0.	94.92	96.70
33 NUMBER OF MEN DEMANDED	22480.00	245.00	2069.00	0.	677.00	511.00	959.00	1442.00	0.	1642.00	74.00
34 PCT AVAILABLE (PRIME)	92.72	97.96	100.00	0.	63.37	34.83	62.67	71.64	0.	100.00	97.14
35 PCT AVAILABLE (SUBST.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36 PCT PROV. BY EXPEDITE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
37 PCT PROV. BY PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
38 PCT DEMANDS NOT SATIS.	7.28	2.04	0.	0.	36.63	65.17	37.33	28.36	0.	0.	2.86
39 OVERTIME MANHOURS USED (100)	.41	.04	0.	0.	.07	.05	.09	.10	0.	0.	0.
40 SIMULATED MH PER FLYING HOUR	1.33	.10	.04	0.	.07	.04	.10	.16	0.	.44	.1

PERSONNEL	TOTAL	4313R	4313W	43131	4315R	4315W	43151	53135	53150	53154	53155
27 MANHOURS AVAILABLE (100)	20880.00	720.00	720.00	720.00	720.00	720.00	2160.00	720.00	720.00	721.60	720.00
28 PERCENT UTILIZATION	1.00	.01	.17	1.01	.74	.23	3.29	.00	.06	.75	.75
29 MANHOURS USED (100)	208.54	.06	1.23	7.27	5.31	1.63	70.99	.42	.43	5.40	5.42
30 PCT UNSCHED MAINTENANCE	52.63	100.00	100.00	100.00	100.00	100.00	25.41	100.00	100.00	100.00	100.00
31 PCT SCHED MAINTENANCE	47.37	0.	0.	0.	0.	0.	74.59	0.	0.	0.	0.
33 NUMBER OF MEN DEMANDED	22480.00	2.00	93.00	440.00	386.00	135.00	10541.00	2.00	19.00	269.00	271.00
34 PCT AVAILABLE (PRIME)	92.72	100.00	94.62	76.12	62.44	95.56	100.00	100.00	100.00	96.65	96.68
35 PCT AVAILABLE (SUBST.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36 PCT PROV. BY EXPEDITE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
37 PCT PROV. BY PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
38 PCT DEMANDS NOT SATIS.	7.28	0.	5.38	23.88	37.56	4.44	0.	0.	0.	3.35	3.32
39 OVERTIME MANHOURS USED (100)	.41	0.	0.	.04	.03	0.	0.	0.	0.	0.	0.
40 SIMULATED MH PER FLYING HOUR	1.33	.08	.01	.05	.03	.01	.45	.00	.00	.43	.03

PERSONNEL	TOTAL	603X0	OTHER
27 MANHOURS AVAILABLE (100)	20880.00	2160.00	0.
28 PERCENT UTILIZATION	1.00	.42	0.
29 MANHOURS USED (100)	208.54	9.03	0.
30 PCT UNSCHED MAINTENANCE	52.63	6.02	0.
31 PCT SCHED MAINTENANCE	47.37	93.98	0.
33 NUMBER OF MEN DEMANDED	22480.00	2699.00	0.
34 PCT AVAILABLE (PRIME)	92.72	100.00	0.
35 PCT AVAILABLE (SUBST.)	0.	0.	0.
36 PCT PROV. BY EXPEDITE	0.	0.	0.
37 PCT PROV. BY PREEMPTION	0.	0.	0.
38 PCT DEMANDS NOT SATIS.	7.28	0.	0.
39 OVERTIME MANHOURS USED (100)	.41	0.	0.
40 SIMULATED MH PER FLYING HOUR	1.33	.46	0.

Figure L-22 INITIAL LGAGE SIMULATION

RUN NUMBER LGAGE5 PERFORMANCE SUMMARY PERIOD FROM 0. TO 100.0 LEVEL 2

SHOP REPAIR	TOTAL	OTHERS	AAA00	AAB00	AAE00	AC210	AC220	AC230	AT910	AT920	AT930
44 NO. OF REPAIRABLE GENERATIONS	688.00	0.	1.00	1.00	0.	1.00	0.	1.00	1.00	0.	0.
45 PCT BASE REPAIR	100.00	0.	100.00	100.00	0.	100.00	0.	100.00	100.00	0.	0.
46 PCT DEPOT REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47 AVERAGE BASE REPAIR CYCLE	10.88	0.	60.73	0.	0.	0.	0.	0.	60.65	0.	0.
48 PCT ACTIVE REPAIR	100.00	0.	100.00	0.	0.	0.	0.	0.	100.00	0.	0.
49 PCT WHITE SPACE	.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50 NO. OF ITEMS IN REPAIR (ECP)	57.00	0.	0.	1.00	0.	1.00	0.	1.00	0.	0.	0.
51 NO. OF ITEMS BACKLOGGED (ECP)	1.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

SHOP REPAIR	TOTAL	13AA0	13AB0	13AC0	13AD0	13BA0	13BB0	13BC0	13CA0	13DA0	13DB0
44 NO. OF REPAIRABLE GENERATIONS	688.00	21.00	54.00	11.00	14.00	2.00	54.00	3.00	17.00	7.00	275.00
45 PCT BASE REPAIR	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
46 PCT DEPOT REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47 AVERAGE BASE REPAIR CYCLE	13.88	.12	.46	60.00	60.10	60.45	2.64	60.01	11.56	60.01	4.27
48 PCT ACTIVE REPAIR	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
49 PCT WHITE SPACE	.00	0.	0.	0.	0.	.00	0.	.00	0.	.00	.00
50 NO. OF ITEMS IN REPAIR (ECP)	57.00	0.	1.00	2.00	6.00	0.	2.00	0.	1.00	0.	21.00
51 NO. OF ITEMS BACKLOGGED (ECP)	1.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.00

SHOP REPAIR	TOTAL	13CC0	13EA0	13EB0	13FA0	13FB0	13GA0	13GA0	13GB0	13GB0	13GD0
44 NO. OF REPAIRABLE GENERATIONS	688.00	39.00	12.00	35.00	1.00	3.00	0.	34.00	0.	48.00	42.00
45 PCT BASE REPAIR	100.00	100.00	100.00	100.00	100.00	100.00	0.	100.00	0.	100.00	100.00
46 PCT DEPOT REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47 AVERAGE BASE REPAIR CYCLE	10.88	2.26	60.10	3.64	60.01	60.00	0.	.16	0.	57.92	.09
48 PCT ACTIVE REPAIR	100.00	100.00	100.00	100.00	100.00	100.00	0.	100.00	0.	100.00	100.00
49 PCT WHITE SPACE	.00	0.	.00	0.	0.	0.	0.	0.	0.	.00	0.
50 NO. OF ITEMS IN REPAIR (ECP)	57.00	1.00	5.00	0.	0.	1.00	0.	0.	0.	12.00	0.
51 NO. OF ITEMS BACKLOGGED (ECP)	1.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

SHOP REPAIR	TOTAL	13GE0	OTHER
44 NO. OF REPAIRABLE GENERATIONS	688.00	19.00	0.
45 PCT BASE REPAIR	100.00	100.00	0.
46 PCT DEPOT REPAIR	0.	0.	0.
47 AVERAGE BASE REPAIR CYCLE	10.88	60.12	0.
48 PCT ACTIVE REPAIR	100.00	100.00	0.
49 PCT WHITE SPACE	.00	0.	0.
50 NO. OF ITEMS IN REPAIR (ECP)	57.00	3.00	0.
51 NO. OF ITEMS BACKLOGGED (ECP)	1.00	0.	0.

Figure L-23 INITIAL LGAGE SIMULATION

RUN NUMBER LGAGE5 P E R F O R M A N C E S U M M A R Y PERIOD FROM 0. TO 100.0 LEVEL 2

S U P P L Y	TOTAL	OTHERS	AAA00	AAB00	AAE00	AC210	AC220	AC230	AT910	AT920	AT930
54 TOT DOLLAR INVEST.(1000)(EOP)	9000.00	0.	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
55 FILL RATE PERCENT	100.00	0.	100.00	100.00	100.00	100.00	0.	100.00	100.00	0.	0.
56 NUMBER OF BACKORDER-DAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57 NUMBER OF UNITS DEMANDED	706.00	0.	10.00	6.00	4.00	1.00	0.	1.00	1.00	0.	0.
58 PCT OFF-THE-SHELF	100.00	0.	100.00	100.00	100.00	100.00	0.	100.00	100.00	0.	0.
59 PCT EXPECITED REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60 PCT PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61 PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62 NUMBER OF CANNIBALIZATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63 NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

S U P P L Y	TOTAL	13AA0	13AB0	13AC0	13AD0	13AE0	13BA0	13BC0	13CA0	13DA0	13DB0
54 TOT DOLLAR INVEST.(1000)(EOP)	9000.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
55 FILL RATE PERCENT	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	101.00
56 NUMBER OF BACKORDER-DAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57 NUMBER OF UNITS DEMANDED	706.00	21.00	54.00	11.00	14.00	2.00	54.00	3.00	17.00	7.00	275.00
58 PCT OFF-THE-SHELF	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
59 PCT EXPECITED REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60 PCT PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61 PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62 NUMBER OF CANNIBALIZATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63 NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

S U P P L Y	TOTAL	13DC0	13EA0	13EB0	13FA0	13FB0	13GA0	13GA0	13GB0	13GB0	13GD0
54 TOT DOLLAR INVEST.(1000)(EOP)	9000.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	306.00
55 FILL RATE PERCENT	100.00	100.00	100.00	100.00	100.00	100.00	0.	100.00	0.	100.00	101.00
56 NUMBER OF BACKORDER-DAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57 NUMBER OF UNITS DEMANDED	706.00	39.00	12.00	35.00	1.00	3.00	0.	34.00	0.	40.00	42.00
58 PCT OFF-THE-SHELF	100.00	100.00	100.00	100.00	100.00	100.00	0.	100.00	0.	100.00	100.00
59 PCT EXPECITED REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60 PCT PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61 PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62 NUMBER OF CANNIBALIZATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63 NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

S U P P L Y	TOTAL	13GE0	OTHER
54 TOT DOLLAR INVEST.(1000)(EOP)	9000.00	300.00	0.
55 FILL RATE PERCENT	100.00	100.00	0.
56 NUMBER OF BACKORDER-DAYS	0.	0.	0.
57 NUMBER OF UNITS DEMANDED	706.00	19.00	0.
58 PCT OFF-THE-SHELF	100.00	100.00	0.
59 PCT EXPECITED REPAIR	0.	0.	0.
60 PCT PREEMPTION	0.	0.	0.
61 PCT DEMANDS NOT SATIS.	0.	0.	0.
62 NUMBER OF CANNIBALIZATIONS	0.	0.	0.
63 NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.

Figure L-24 INITIAL LGAGE SIMULATION

RUN NUMBER LGAGE5 PERFORMANCE SUMMARY PERIOD FROM 0. TO 10[illegible] LEVEL 2

	EQUIPMENT	TOTAL	AJ35T	D66	M03	M27M	NF2	TJ3DE	TJ3DN	TUG	OTHER
68	TOT DOLLAR INVEST.(1070)(EOP)	5600.00	100.00	600.00	140.00	100.00	300.00	240.00	120.00	4800.00	0.
69	EQUIPMENT HOURS AUTH. (100)	12096.00	216.00	1296.00	382.40	216.00	648.00	516.40	259.20	8640.00	0.
70	EQUIPMENT HOURS AVAIL. (100)	12096.00	216.00	1296.00	382.40	216.00	648.00	516.40	259.20	8640.00	0.
71	PCT USED-UNSCHED MAINT	.34	1.51	1.39	.20	.72	1.12	1.21	1.21	.11	0.
72	PCT USED-SCHED MAINT	.46	.89	2.14	.37	.85	1.37	.69	.62	.10	0.
73	PCT UNUSED	99.21	97.60	96.47	99.43	98.43	97.51	98.10	98.17	99.90	0.
74	NUMBER OF BACKORDER-DAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
75	NUMBER OF UNITS DEMANDED	10924.00	771.00	3546.00	195.00	341.00	1386.00	1322.00	664.00	2699.00	0.
76	PCT AVAILABLE	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.
77	PCT PROV. BY EXPEDITE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
78	PCT PROV. BY PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
79	PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80	EQUIP HOURS BACKLOG(100)(EOP)	.02	0.	.02	0.	0.	.00	0.	0.	0.	0.

Figure L-25 INITIAL LGAGE SIMULATION

shop, depending upon the AFSC. The run was made and the output results indicated a mean utilization of 19 percent, with a maximum of 51 percent. This seemed satisfactory in light of the fact that some of the work centers required a set number of people for a job that is not performed often. Also, increasing utilization by decreasing the number of people would lead to an inability to perform maintenance during peak demand times, resulting in a much higher mission abort rate. Twelve AMST missions were not accomplished, yielding a 99 percent mission success overall. Figures L-26 - to L-30 illustrate the results of this run.

A final LGAGE simulation, with MSBMA values for the landing gear set to their true (original) values, was not made prior to updating of LCOM to version 3.0.

Toward the end of this effort, a study was conducted which compared manpower and AGE utilization requirements of a given scenarios for the LCOM and R&M models. The study required constructing a maintenance network which could be fully utilized by both R&M and LCOM models for comparative purposes. This network focused on the AMST landing gear maintenance with flightline AGE useage but no AGE maintenance. The LCOM simulation RMLCOM was run using the network and both manpower and support equipment data were output from the post processor programs. A short program, called TIMETOIL, was written to extract AGE usage time against each type of AGE from the voluminous data produced by LCOM. In order to extract flightline AGE data from the R&M model, two changes to the model program were necessary. The first change involved (a) calculating usage time on the flightline in a manner similar to that used for calculating personnel utilization time and (b) formatting a presentation for the output data. This change is now designed to handle any flightline resource that might turn up in Extended Form 11 networks.

The second change implemented in the R&M model program was specific to the effort, wherein there are different possible combinations of AGE for each of possible landing gear failures. In LCOM, this parrallelism is handled through node probabilities. Since parallelism is not within the designed scope of the R&M model, a "work around" was conceived such that additional or parallel subsystems having only flightline tasks were permitted, and each subsystem of a set was used to model an AGE combination for the given failure type. For example, a main landing gear failure required one of five AGE combinations (e.g., a D-60 or D-60 and an NF-2) for flightline maintenance. Thus five main

RUN NUMBER LGAGE6 — P E R F O R M A N C E S U M M A R Y — PERIOD FROM 0. TO 168.00 — LEVEL 2

OPERATIONS	TOTAL	ADEQ	PE16BD	PE12YR	PE1PNT	PE59BD	PE52YR	PE31BD	PE32YR	PE3PNT	PE43.D
1 NUMBER OF MISSIONS REQUESTED	3335.00	3126.66	93.30	8.00	7.00	14.00	2.00	5.00	2.00	2.00	3[illegible]
2 NUMBER ACCOMPLISHED	3323.00	3116.00	93.00	8.00	7.00	14.00	2.00	5.00	2.00	2.00	3[illegible]
3 PERCENT ACCOMPLISHED	93.64	99.62	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
6 NUMBER OF SORTIES REQUESTED	3335.00	3126.66	93.00	8.00	7.00	14.00	2.00	5.00	2.00	2.00	3[illegible]
7 NUMBER ACCOMPLISHED	3323.00	3116.00	93.00	8.00	7.00	14.00	2.00	5.00	2.00	2.00	3[illegible]
8 PERCENT ACCOMPLISHED	93.64	99.62	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
T1 NUMBER OF WEATHER CANCELS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T2 NUMBER OF WEATHER DELAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T3 NUMBER OF ALERT REPLENISHMENT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T4 NUMBER OF ATTRITIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T5 NUMBER OF RAM REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T6 NUMBER OF AIR ABORTS(TOTAL)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

OPERATIONS	TOTAL	PE42YR	PE4PNT	PE29BD	PE81YR	PE69BD	PE79BD	OTHER
1 NUMBER OF MISSIONS REQUESTED	3335.00	4.00	4.00	10.00	3.00	22.00	12.00	0.
2 NUMBER ACCOMPLISHED	3323.00	4.00	4.00	10.00	3.00	22.00	12.00	0.
3 PERCENT ACCOMPLISHED	99.64	100.00	100.00	100.00	100.00	100.00	100.00	0.
6 NUMBER OF SORTIES REQUESTED	3335.00	4.00	4.00	10.00	3.00	22.00	12.00	0.
7 NUMBER ACCOMPLISHED	3323.00	4.00	4.00	10.00	3.00	22.00	12.00	0.
8 PERCENT ACCOMPLISHED	99.64	100.00	100.00	100.00	100.00	100.00	100.00	0.
T1 NUMBER OF WEATHER CANCELS	0.	0.	0.	0.	0.	0.	0.	0.
T2 NUMBER OF WEATHER DELAYS	0.	0.	0.	0.	0.	0.	0.	0.
T3 NUMBER OF ALERT REPLENISHMENT	0.	0.	0.	0.	0.	0.	0.	0.
T4 NUMBER OF ATTRITIONS	0.	0.	0.	0.	0.	0.	0.	0.
T5 NUMBER OF RAM REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.
T6 NUMBER OF AIR ABORTS(TOTAL)	0.	0.	0.	0.	0.	0.	0.	0.

AIRCRAFT	TOTAL	AMSA	JA135T	XD63	XMD3	XM27M	XNF2	XTJ3CE	XTJ3CM	OTHER
13 NUMBER OF AIRCRAFT AUTH.(ECP)	132.00	52.00	5.00	30.00	7.00	5.00	15.00	12.00	6.00	0.
14 NUMBER OF AIRCRAFT-DAYS AVAIL	23760.00	9361.00	900.00	5400.00	1260.00	900.00	2700.00	2160.00	1080.00	0.
15 PCT SORTIES(INCL ALERT)	2.74	6.54	.01	.01	.01	.00	.01	.00	.00	0.
16 PCT UNSCHED MAINTENANCE	.35	.88	0.	0.	0.	0.	0.	0.	0.	0.
17 PCT SCHED MAINTENANCE	1.68	3.45	.25	1.53	.24	.58	.93	.18	.19	0.
18 PCT NCMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19 PCT MISSION MAIN STATUS	.07	.15	.02	.02	.01	.01	.01	.01	.01	0.
20 PCT SERVICE + WAITING	3.42	7.14	.28	1.99	.00	.67	1.10	.00	.04	0.
21 PCT OPERATIONALLY READY	91.54	81.44	99.68	96.44	99.75	98.73	97.67	99.80	99.79	0.
22 AVG. SC FCST SORTIE TIME(HRS)	7.65	6.15	4.69	43.32	4.18	29.77	35.74	4.62	3.93	0.
23 AVG. NO. OF SORTIES/ A/C /DAY	.14	.33	.01	.02	.01	.01	.01	.01	.01	0.
24 FLYING HOURS	15811.75	15554.24	1.36	16.51	1.68	.98	3.88	2.20	1.20	0.
17 NUMBER OF FCF TASKS FLOWN	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18 AVG. NO PRESORTIE TIME(HRS)	2.21	2.14	.20	.28	.30	.26	.30	.28	.23	0.

Figure L-26 CONSTRAINED LGAGE SIMULATION

RUN NUMBER LGAGEE — P E R F O R M A N C E S U M M A R Y — PERIOD FROM 0. TO 18.0 — LEVEL 2

	P E R S O N N E L	TOTAL	A2325	A2345	A2348	A2338	A2334	A2350	A2356	A2748	A3142	A3142
27	MANHOURS AVAILABLE (100)	1166.40	57.64	172.80	14.40	43.20	28.80	43.20	57.60	14.47	172.80	26.60
28	PERCENT UTILIZATION	19.20	51.45	3.92	.16	27.76	26.56	44.62	48.12	0.	3.99	3.46
29	MANHOURS USED (100)	223.94	29.41	6.78	.82	11.99	7.65	19.28	27.72	0.	6.89	1.00
30	PCT UNSCHED MAINTENANCE	55.71	10.66	44.68	138.00	180.00	180.00	180.00	180.00	0.	8.64	23.86
31	PCT SCHED MAINTENANCE	44.29	89.94	55.32	0.	0.	0.	0.	0.	0.	91.36	77.80
33	NUMBER OF MEN DEMANDED	23564.00	284.00	2893.00	1.00	786.00	989.00	1386.00	1675.00	0.	1795.00	78.66
34	PCT AVAILABLE (PRIME)	74.83	65.56	99.28	100.00	51.65	22.36	50.37	57.02	0.	82.62	80.00
35	PCT AVAILABLE (SUBST.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	PCT PROV. BY EXPEDITE	4.45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
37	PCT PROV. BY PREEMPTION	1.41	2.11	0.	0.	0.	0.	0.	0.	0.	0.	0.
38	PCT DEMANDS NOT SATIS.	19.26	12.32	.72	0.	48.35	77.64	49.63	42.98	0.	17.38	20.80
39	OVERTIME MANHOURS USED (100)	7.11	.58	0.	0.	1.25	.69	1.44	1.70	0.	0.	.01
40	SIMULATED MH PER FLYING HOUR	1.43	.19	.04	.00	.00	.05	.12	.10	0.	.04	.01

	P E R S O N N E L	TOTAL	A3138	A3138	A3131	A3150	A3150	A3151	A3135	A3150	A3154	A3155
27	MANHOURS AVAILABLE (100)	1166.40	14.40	14.40	28.80	28.80	14.40	172.80	14.40	14.40	28.80	28.80
28	PERCENT UTILIZATION	19.20	.65	18.63	38.87	17.83	18.18	86.89	.21	2.33	22.82	22.42
29	MANHOURS USED (100)	223.94	.19	1.50	8.66	4.98	2.93	72.73	.03	.34	6.57	6.60
30	PCT UNSCHED MAINTENANCE	55.71	180.00	168.00	100.00	180.00	180.00	27.50	180.00	180.00	180.00	180.00
31	PCT SCHED MAINTENANCE	44.29	0.	0.	0.	0.	0.	72.42	0.	0.	0.	0.
33	NUMBER OF MEN DEMANDED	23564.00	2.00	185.00	533.00	351.00	158.00	1617.00	3.00	15.00	326.00	329.00
34	PCT AVAILABLE (PRIME)	74.83	100.00	69.81	59.47	53.56	71.52	73.43	100.00	80.00	73.31	73.56
35	PCT AVAILABLE (SUBST.)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	PCT PROV. BY EXPEDITE	4.45	0.	0.	0.	0.	0.	9.86	0.	0.	0.	0.
37	PCT PROV. BY PREEMPTION	1.41	0.	0.	0.	0.	0.	3.58	0.	0.	0.	0.
38	PCT DEMANDS NOT SATIS.	19.26	0.	30.19	40.53	46.44	28.48	13.61	0.	20.00	26.69	26.44
39	OVERTIME MANHOURS USED (100)	7.11	.00	.02	.96	.35	.03	0.	0.	.01	.04	.04
40	SIMULATED MH PER FLYING HOUR	1.43	.01	.01	.06	.03	.01	.47	.00	.00	.04	.04

	P E R S O N N E L	TOTAL	E83X6	OTHER
27	MANHOURS AVAILABLE (100)	1166.40	172.80	0.
28	PERCENT UTILIZATION	19.20	5.63	0.
29	MANHOURS USED (100)	223.94	9.74	0.
30	PCT UNSCHED MAINTENANCE	55.71	5.16	0.
31	PCT SCHED MAINTENANCE	44.29	94.84	0.
33	NUMBER OF MEN DEMANDED	23564.00	2881.00	0.
34	PCT AVAILABLE (PRIME)	74.86	98.62	0.
35	PCT AVAILABLE (SUBST.)	0.	0.	0.
36	PCT PROV. BY EXPEDITE	4.45	0.	0.
37	PCT PROV. BY PREEMPTION	1.41	0.	0.
38	PCT DEMANDS NOT SATIS.	19.26	1.98	0.
39	OVERTIME MANHOURS USED (100)	7.11	0.	0.
40	SIMULATED MH PER FLYING HOUR	1.43	.06	0.

Figure L-27 CONSTRAINED LGAGE SIMULATION

RUN NUMBER LGAGEE — P E R F O R M A N C E S U M M A R Y — PERIOD FROM 0. TO 16. — LEVEL 2

S H O P R E P A I R	TOTAL	OTHERS	AA801	AA838	AE240	AC210	AC226	AC238	A191	A(928	A930
44 NO. OF REPAIRABLE GENERATIONS	759.00	0.	6.00	2.00	1.00	0.	0.	1.00	0.	0.	0.
45 PCT BASE REPAIR	100.00	0.	100.00	100.00	0.	0.	100.00	0.	0.	0.	0.
46 PCT DEPOT REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47 AVERAGE BASE REPAIR CYCLE	9.27	0.	61.21	.76	62.00	0.	0.	60.10	0.	0.	0.
48 PCT ACTIVE REPAIR	100.00	0.	100.00	100.00	100.00	0.	0.	100.00	0.	0.	0.
49 PCT WHITE SPACE	.00	0.	.00	0.	0.	0.	0.	0.	0.	0.	0.
50 NO. OF ITEMS IN REPAIR (ECP)	56.00	0.	2.00	1.00	0.	0.	0.	0.	0.	0.	0.
51 NO. OF ITEMS BACKLOGGED (ECP)	5.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

S H O P R E P A I R	TOTAL	13AP0	13A60	13AC0	13AD0	13BA0	13E80	13BC0	13CA0	13DA0	13DB0
44 NO. OF REPAIRABLE GENERATIONS	759.00	18.00	62.00	4.00	15.00	2.00	46.00	4.00	15.00	5.00	315.00
45 PCT BASE REPAIR	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
46 PCT DEPOT REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47 AVERAGE BASE REPAIR CYCLE	9.27	.34	.52	60.00	60.09	60.19	.47	60.00	4.47	60.00	6.22
48 PCT ACTIVE REPAIR	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
49 PCT WHITE SPACE	.00	0.	0.	0.	.00	.00	0.	0.	0.	.00	.00
50 NO. OF ITEMS IN REPAIR (ECP)	56.00	0.	2.00	2.00	5.00	0.	2.00	2.00	0.	1.00	16.00
51 NO. OF ITEMS BACKLOGGED (ECP)	5.00	0.	1.00	0.	0.	0.	0.	0.	0.	0.	4.00

S H O P R E P A I R	TOTAL	13DC0	13EA0	13E00	13FA0	13FB0	13GA0	13GA0	13GB0	13GB0	13GD0
44 NO. OF REPAIRABLE GENERATIONS	759.00	54.00	6.00	35.00	1.00	3.00	1.00	54.00	0.	35.00	51.00
45 PCT BASE REPAIR	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.	100.00	100.00
46 PCT DEPOT REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47 AVERAGE BASE REPAIR CYCLE	9.27	6.41	60.01	2.13	60.01	60.37	0.	1.45	0.	50.60	.19
48 PCT ACTIVE REPAIR	100.00	100.00	100.00	100.00	100.00	100.00	0.	100.00	0.	100.00	100.00
49 PCT WHITE SPACE	.00	0.	0.	.00	0.	0.	0.	0.	0.	0.	0.
50 NO. OF ITEMS IN REPAIR (BOF)	56.00	0.	1.00	1.00	0.	1.00	1.00	1.00	0.	18.00	1.00
51 NO. OF ITEMS BACKLOGGED (ECP)	5.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

S H O P R E P A I R	TOTAL	13GE0	OTHER
44 NO. OF REPAIRABLE GENERATIONS	759.00	18.00	0.
45 PCT BASE REPAIR	100.00	100.00	0.
46 PCT DEPOT REPAIR	0.	0.	0.
47 AVERAGE BASE REPAIR CYCLE	9.27	60.41	0.
48 PCT ACTIVE REPAIR	100.00	100.00	0.
49 PCT WHITE SPACE	.00	.00	0.
50 NO. OF ITEMS IN REPAIR (ECP)	56.00	7.00	0.
51 NO. OF ITEMS BACKLOGGED (ECP)	5.00	0.	0.

Figure L-28 CONSTRAINED LGAGE SIMULATION

RUN NUMBER LGAGE6 P E R F O R M A N C E S U M M A R Y PERIOD FROM 0. TO 161.0 LEVEL 2

	S U P P L Y	TOTAL	OTHERS	AAA6A	AAB3B	AAE4B	AC21B	AC22A	AC23B	AC51A	AT92A	AT93B
54	TOT DOLLAR INVEST.(1000)(EOP)	9000.00	0.	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
55	FILL RATE PERCENT	100.00	0.	100.00	100.00	100.00	0.	100.00	100.00	0.	0.	0.
56	NUMBER OF BACKORDER-DAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	NUMBER OF UNITS DEMANDED	781.00	0.	18.00	7.00	5.00	0.	1.00	1.00	0.	0.	0.
58	PCT OFF-THE-SHELF	100.00	0.	100.00	100.00	100.00	0.	100.00	100.00	0.	0.	0.
59	PCT EXPEDITED REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	PCT PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	NUMBER OF CANNIBALIZATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	S U P P L Y	TOTAL	13AA6	13AB3	13AC0	13AD8	13BA0	13BB0	13BC0	13CA6	13DA8	13EB3
54	TOT DOLLAR INVEST.(1000)(EOP)	9000.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
55	FILL RATE PERCENT	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
56	NUMBER OF BACKORDER-DAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	NUMBER OF UNITS DEMANDED	781.00	18.00	62.00	4.00	15.00	2.00	46.00	4.00	15.00	5.00	319.00
58	PCT OFF-THE-SHELF	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
59	PCT EXPEDITED REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	PCT PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	NUMBER OF CANNIBALIZATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	S U P P L Y	TOTAL	13CC0	13EA3	13EB8	13FA8	13FB8	13GA8	13GA9	13GB8	13GB9	13GD4
54	TOT DOLLAR INVEST.(1000)(EOP)	9000.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
55	FILL RATE PERCENT	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.	100.00	100.00
56	NUMBER OF BACKORDER-DAYS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	NUMBER OF UNITS DEMANDED	781.00	56.00	6.00	35.00	1.00	3.00	1.00	54.00	0.	35.00	51.00
58	PCT OFF-THE-SHELF	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.	100.00	100.00
59	PCT EXPEDITED REPAIR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	PCT PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	NUMBER OF CANNIBALIZATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
63	NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	S U P P L Y	TOTAL	13GE0	OTHER
54	TOT DOLLAR INVEST.(1000)(EOP)	9000.00	300.00	0.
55	FILL RATE PERCENT	100.00	100.00	0.
56	NUMBER OF BACKORDER-DAYS	0.	0.	0.
57	NUMBER OF UNITS DEMANDED	781.00	16.00	0.
58	PCT OFF-THE-SHELF	100.00	100.00	0.
59	PCT EXPEDITED REPAIR	0.	0.	0.
60	PCT PREEMPTION	0.	0.	0.
61	PCT DEMANDS NOT SATIS.	0.	0.	0.
62	NUMBER OF CANNIBALIZATIONS	0.	0.	0.
63	NO. ITEMS ON BACKORDER (EOP)	0.	0.	0.

Figure L-29 CONSTRAINED LGAGE SIMULATION

RUN NUMBER LGAGE6 PERFORMANCE SUMMARY PERIOD FROM 0. TO 16[illegible] LEVEL 2

	EQUIPMENT	[illegible]	A[illegible]5[illegible]	D6[illegible]	MC3	M27N	NF2	[illegible]30E	[illegible]30N	[illegible]	OTHER
68	TOT DOLLAR INVEST.(1000)(EOP)	5600.00	100.00	600.00	140.00	100.00	300.00	240.00	120.00	4000.00	0.
69	EQUIPMENT HOURS AUTH. (100)	12296.00	216.00	1296.00	302.40	216.00	648.00	518.40	259.20	8640.00	0.
70	EQUIPMENT HOURS AVAIL. (100)	12096.00	216.00	1296.00	302.40	216.00	648.00	518.40	259.20	8640.00	0.
71	PCT USED-UNSCHED MAINT	.37	1.82	1.55	.27	.72	1.22	1.21	1.21	.11	0.
72	PCT USED-SCHED MAINT	.47	.99	2.17	.36	.88	1.41	.69	.60	.11	0.
73	PCT UNUSED	99.17	97.19	96.29	99.37	98.39	97.37	98.11	98.20	99.89	0.
74	NUMBER OF BACKORDER-DAYS	8.78	0.	0.	0.	0.	0.	6.97	2.71	0.	0.
75	NUMBER OF UNITS DEMANDED	11665.00	855.00	3853.00	206.00	337.00	1531.00	1306.00	656.00	2081.00	0.
76	PCT AVAILABLE	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.
77	PCT PROV. BY EXPEDITE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
78	PCT PROV. BY PREEMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
79	PCT DEMANDS NOT SATIS.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
80	EQUIP HOURS BACKLOG(100)(EOP)	.11	0.	.10	.01	0.	0.	0.	0.	0.	0.

Figure L-30 CONSTRAINED LGAGE SIMULATION

landing gear subsystems were placed in the network. The total task time for each task type (e.g., troubleshoot or remove and replace) was then proportionately subdivided among the five subsystems, based upon the likelihood of a given AGE combination. The use of different support equipment combinations was considered in the shop tasks for this scenario, so that only one of each subsystem type was required for those tasks.

Results of this comparison study are presented in Table L-2 and Table L-3. For the AGE demand, the percent difference in overall usage time between the two models is less that 4 percent of the total. The primary reason for the differences in the two models appears to be due to the random nature of the Logistics Composite Model in failure selection and the probability distribution of the maintenance task times.

Table L-2

COMPARISON OF AGE USAGE (FLIGHTLINE)
BETWEEN LCOM AND R&M

Unit	HRS/KFH LCOM	HRS/KFH R&M	(Δ) (HRS)	Δ% = (LCOM-R&M)/R&M
AJ35T	114.92	137.87	-22.95	-16.65
D60	592.45	609.87	-17.42	-2.86
MD3	27.42	25.18	2.24	8.90
M27M	53.51	51.41	2.10	4.08
NF2	237.50	250.90	-13.40	-5.34
TJ30E	53.51	51.41	2.10	4.08
TJ30N	53.51	51.41	2.10	4.08
TOTALS	1132.82	1178.05	-45.23	-3.84

The results shown in Table L-3 for manpower utilization in maintenance manhours per thousand flight hours (MMH/KFH) show approximately a 5 percent overall difference between the models. The reasons are again primarily those discussed above. The two columns of R&M output data are listed to illustrate the slight changes in workhour needs due to differences between the model which incorporates AGE usage and that which also handles the different AGE combinations. One column lists the number of personnel

Table L-3

COMPARISON OF MANPOWER UTILIZATION
BETWEEN LCOM AND R&M

	AFSC	MMH/KFH LCOM 1	MMH/KFH R&M (Modified for AGE) 2	MMH/KFH R&M (Orig.) 3	Δ % = (1 - 3)/3	Mean # Personnel/ Work Center
1	42330	329.38	348.08	348.08	-5.37	6
2	42334	222.56	257.11	230.19	-3.31	5
3	42350	472.20	524.11	508.96	-7.22	9
4	42354	583.54	626.65	626.65	-6.88	11
5	4313R	0.27	25.32	12.41	-97.82	1
6	4313W	43.38	42.15	42.15	2.93	1
7	43131	244.41	249.23	248.41	-1.61	5
8	4315R	153.25	149.70	147.16	4.14	3
9	4315W	57.86	55.27	55.27	4.68	2
*10	53151	931.67	609.87	609.87	52.77	(16) 11
11	53135	.123	.165	.165	-25.65	1
12	53150	3.35	3.41	3.41	-1.87	1
13	53154	73.27	84.08	84.08	-12.86	2
14	53155	73.39	84.24	84.24	-12.88	2
Totals		3188.65	3059.39	3001.05	6.25	(65) 60

*includes inspection, preflight and post flight tasks in LCOM which are not in R&M - approx. 338.91 MMH/KFH are used - removing this, yields:

10	43151	592.76	609.87		-2.81
		and overall,			
Totals		2849.74	3059.39	3001.05	-5.04

needed for each work center. The total, 60, represents only direct labor personnel performing landing gear maintenance within the scope of the scenario.

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APPENDIX M
SAMPLE TRAINING PLAN

C-141 AIRCRAFT BRAKE AND WHEEL REMOVAL

INTRODUCTION

This training plan presents the content, instructional components, and instructional delivery system appropriate for task-oriented training related to brake and wheel removal/replacement on the C-141 aircraft. The entire training plan was developed employing a modified version of the instructional system development (ISD) process described in Air Force Manual 50-2. The training outlined by this plan is complemented by a task-oriented technical manual which covers the same maintenance operation.

RELATIONSHIP BETWEEN THE ISD PROCESS AND TRAINING PLAN DEVELOPMENT

The total ISD process includes the actual development, implementation, and evaluation/revision of a given training program. Thus, the development of a training plan constitutes only a portion of the ISD process. That portion, commonly termed "training program design," is depicted in the nine-step model presented in Figure M-1. Each of the nine steps and related procedures is discussed in the next section.

STEPS IN TRAINING PLAN DEVELOPMENT

The first step in training plan development is to select the specific task areas for which training will be required. For the C-141 wheel and brake removal/replacement, task areas were identified via an integrated task analysis of an actual C-141 wheel and brake assembly (for this training plan, a modified version of the integrated task analysis procedure described in AFHRL-TR-73-43 was employed). The integrated task analysis also identified and documented each

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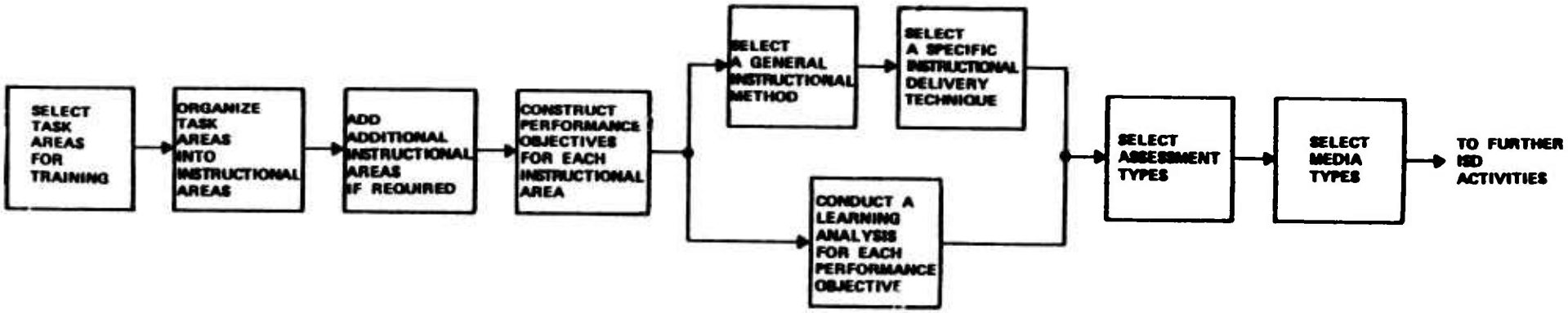

FIGURE M-1

PORTION OF THE ISD PROCESS USED IN THE DEVELOPMENT OF A TRAINING PLAN

of the discrete tasks involved in the removal/replacement operation.

The integrated task analysis of the C-141 wheel and brake removal/replacement revealed 10 task areas. These 10 areas subsumed each of the discrete tasks. Pictorially, the task areas, as well as their relationship to both the removal/replacement operation, and the discrete tasks are shown in Figure M-2.

The second step in training plan development is to categorize each of the task areas into an instructional area. Basically, and instructional area is defined as a group of task areas which, for training purposes, are closely related. For the C-141 brake and wheel removal/replacement, the instructional areas and their related task areas are shown in Figure M-3.

The third step is to add additional instructional areas as appropriate. Additional instructional areas are sometimes required either to complete the overall instructional sequence (e.g., introduction, summary) or to achieve the objectives of task-oriented training (e.g., a special skill required for a task area). For this training plan, three instructional areas were added. The areas and a rationale for the addition of each are as follows:

1. Orientation to Brake and Wheel Removal/Replacement - This instructional area was added to complete the overall instructional sequence. It will be used to introduce the entire brake and wheel removal/replacement operation to the students. In addition, it will provide an opportunity to describe the process of instruction to be used during the entire training program.

2. Use of Special Tools for Brake and Wheel Removal/Replacement - This area was added to achieve the objectives of task-oriented training. It assures that students can both recognize and use those special tools involved in C-141 brake and wheel removal/replacement.

3. Wheel and Brake Removal/Replacement on the C-141 Aircraft - This instructional area was added to complete the overall instructional sequence. It assures students an opportunity to demonstrate skill mastery on the actual C-141 aircraft.

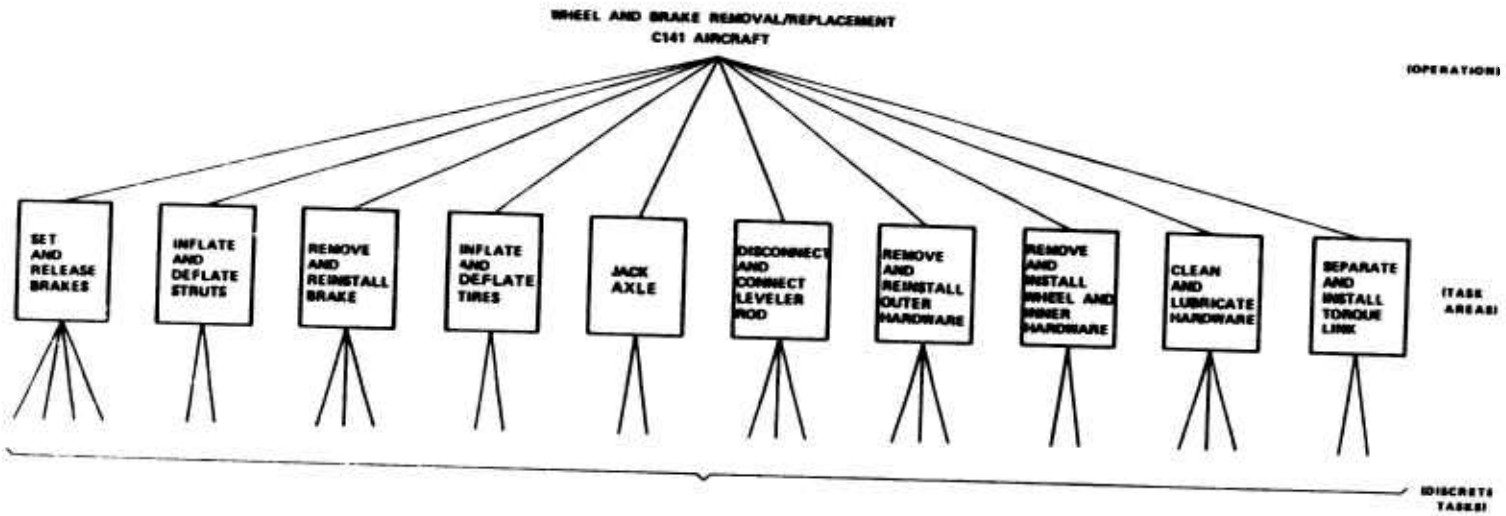

FIGURE M-2

RELATIONSHIP OF C141 BRAKE AND WHEEL REMOVAL/REPLACEMENT TASK AREAS TO BOTH THE OVERALL OPERATION AND THE DISCRETE TASKS

INSTRUCTIONAL AREA	RELATED TASK AREAS
Preparing for C-141 Brake and Wheel Removal/Replacement	* set and release brakes * inflate and deflate struts * jack axle
Removing and Replacing C-141 Wheel	* inflate and deflate tires * disconnect and connect leveler rod * remove and install outer hardware * remove and install wheel&inner hdwr. * clean and lubricate hardware (partial)
Removing and Replacing C-141 Brake	* remove and install brake * separate and install torque link * clean & lubricate hardware (partial)

Figure M-3

Instructional Areas and Related Task Areas

The fourth step in training plan development is to construct one or more performance objectives for each instructional area (See Figure M-4). Briefly, there are two general purposes fo a performance objective (Vaughan, 1977). The first is to communicate to students exactly what is to be learned. The second is to communicate to instructional designers exactly what must be taught. In order to meet both of these purposes, the performance objectives for this training plan were constructed to reflect the criteria outlined by (Mager 1962).

In addition to the Mager criteria, each of the performance objectives was constructed to reflect the application level of Bloom's Taxonomy of Educational Objectives (Bloom et al., 1971). Learning at the level of application will help assure that over job-related performance, rather than simply information recall, is emphasized both in the development and conduct of training. Thus, the training will be better matched to the requirements of the job. The performance objectives for the entire sequence of instruction related to C-141 wheel and brake removal/replacement are presented in Appendix N.

The fifth step in training plan development is to conduct a learning analysis of each performance objective. Briefly, the purpose of a learning analysis is to both state and sequence each of the prerequisite learning (termed enabling objectives) required for successful attainment of a performance objective (Gagne, 1970). It is the enabling objectives which provide the specific focus for both the development of instructional materials and assessments.

As with the construction of performance objectives the content of each learning analysis reflects the levels of learning within Bloom's Taxonomy. This assures that the list of enabling objectives within each analysis is complete (reflects all of the prerequisite [illegible] of learning required by the performance objective[illegible] well as correctly sequenced (in respect to the re[illegible] complexity of Bloom learning types). The learning [illegible]yses for all of the performance objectives within the C-141 brake and wheel removal/replacement training plan are presented in Appendix O.

The sixth step in training plan development is to select the general method by which training will be delivered. Any single method (e.g., computer assisted instruction, teacher led instruction, small group instruction) or array of methods could be selected. Normally, this methodological decision is made based upon the type and complexity of the

INSTRUCTIONAL AREA	SOURCE OF INSTRUCTIONAL AREA	PERFORMANCE OBJECTIVE NUMBER
Orientation to C-141 Brake and Wheel Removal/Replacement	additional (introduction)	1
Use of Special Tools For C-141 Brake and Wheel Removal/Replacement	additional (special skill)	2
Preparing For C-141 Brake and Wheel Removal/Replacement	integrated task analysis	3 (strut inflation/ deflation) 4 (axle jacking) 5 (brake set/ release)
Removing and Replacing C-141 Wheel	integrated task analysis	6
Removing and Replacing C-141 Brace	integrated task analysis	7
Wheel and Brake Removal/Replacement on the C-141 Aircraft	additional (real world skill demonstration)	8

Figure M-4

C-141 Wheel and Brake Removal/Replacement -
Instructional Areas and Related Performance Objectives

performance objectives (and related learning analyses), the ability of the learners, and the environment for training.

For this training plan, the general method of "self-instruction" was selected. This choice was made based upon a number of considerations. First, the complexity of the performance and enabling objectives is not of a level which would preclude presentation via a self-instructional format. Second, recent trends in training include a movement toward valid and predictable instruction which is exportable (i.e., capable of replication at a variety of locations without special facilities or personnel). By definition, validity and predictability are consistently achievable only via highly structured self-instructional approaches to learning. Third, the concept of self-instruction will permit students to spend as much or as little study time as required in order to achieve the goal of mastery learning.

The selection of self-instruction is not intended to remove, or reduce the importance of, the instructor within a training program. Rather, self-instruction permits many of the lower level types of learning to be mastered by a student working independently. Instructional personnel are thus able to devote their expertise to the more crucial aspects of training; e.g., complex skill development, individual student supervision, individual student assessment, and remediation.

The seventh step in training plan development is to select the primary instructional delivery technique which will adequately carry out the general method of instruction. For this training plan, "instructional modules" were chosen as the primary delivery technique. The choice was made because instructional modules are useable by a wide range of students who possess varying abilities to learn, speed in learning, and levels of interest. Further, a given instructional module may include a variety of different media forms reflecting various student interests (a more thorough discussion of instructional modules in general and for this training plan may be found in Appendix P).

The eighth step is to select an assessment type for each performance and enabling objective. The assessment type selected for the performance objective will indicate the manner in which student performance (for purposes of grading) will be judged. The performance objective statement normally indicates the assessment type to be used.

The assessment types selected for the enabling objectives will indicate the format of diagnostic tests (when given before instruction) and/or self-tests (when given following instruction). However, enabling objective assessment items are not used for grading purposes.

The assessment type chosen for a given enabling objective is based upon two constraints. First, that the assessment type can adequately measure the behavior specified in the enabling objective. Second, that any restrictions imposed by the instructional method (in this case self-instruction) or the instructional delivery technique (in this case modules) can be reflected. The enabling objectives and a preliminary choice of assessment type for each presented in Appendix Q.

The ninth and final step in training plan development is to select a media type for each enabling objective.*

As with assessment types, media types are selected in respect to the behavior specified within the objective, as well as, by any restrictions imposed by either the method of instruction or instructional delivery technique. In addition, media type is often a direct product of the abilities and interests of the students who will undertake the instruction.

For the training plan under discussion, a single tentative media type has been selected for each enabling objective. Alternative and/or additional media types may later be chosen in order to satisfy the different learning abilities and interests of different students. The tentative media type selected for each enabling objective is presented in Appendix Q.

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* (Note: Media types are not selected for a performance objective because performance objective is not directly taught. Rather, the behavior specified in the performance objective is the result of the attainment of related enabling objectives.

VALIDATION AND USE OF A TRAINING PLAN

The preceding paragraphs described that portion of the ISD process required to complete the developmetn of a training plan for brake and wheel removal/replacement on the C-141 aircraft. Those paragraphs, as well as the content of Appendices N to Q and constitute the training plan. This training plan for the brake and wheel removal/replacement operation is considered preliminary and should undergo review and revision by three groups of individuals:

1. Instructional designers who can analyze the contents of the plan in respect to accepted standards of instructional design.

2. Equipment user's who can analyze the contents of the plan in respect to the maintenance needs of Air Force work units.

3. Equipment builders who can analyze the contents of the plan in respect to the maintenance requirements of the equipment under consideration.

This validation process would continue until an acceptable degree of consensus on the contents of the training is obtained. At this point, the training plan would be deemed "final."

Upon acceptance of a final training plan, the following ISD activities would be undertaken:

1. Development of the assessment items.

2. Development of the instructional materials.

3. Packaging of instructional materials and assessments into self-instructional modules.

4. Training for the instructors vis-a-vis the use of self-instructional modules as well as the supervision and evaluation of student performance in a self-instructional setting.

5. Design and development of required equipment mockups.

6. Field test and revision of the instruction in order to achieve predictability and consistency.

7. Deployment of training.

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APPENDIX N
TRAINING PLAN PERFORMANCE OBJECTIVES
C141 WHEEL AND BRAKE REMOVAL/REPLACEMENT

PERFORMANCE OBJECTIVE 1:

Given 10 multiple choice items, the student will be able

a. to identify the tasks and task sequence involved in the removal/replacement of a C141 wheel and brake assembly and

b. to recognize situations in which removal/replacement of the wheel and brake assembly is necessary.

To successfully achieve this objective, the student must correctly answer nine of the test items.

PERFORMANCE OBJECTIVE 2:

Given the five special tools required for brake and wheel removal/replacement on the C141 aircraft and mockups of fasteners requiring the tools, the student will

a. select the tool required by each fastener and

b. use each tool to loosen and tighten the related fastener.

To satisfy this objective, the student must follow the tool use and safety procedures outlined in the module.

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PERFORMANCE OBJECTIVE 3:

Given mockups of a high pressure nitrogen servicing cart and of a given C141 main landing gear strut, a height to which the strut is to be raised, and a C141 strut inflation/deflation checklist, the student will be able to inflate and deflate the strut mockup. To successfully achieve this objective, the student must accomplish the following steps:

1. Determine if strut inflation/deflation is required.

2. Set up, operate, and shut down the servicing cart.

3. Ensure that maximum strut extension limits are not exceeded.

4. Ensure that maximum strut servicing limits are not exceeded.

5. Ensure that maximum permitted differential in strut heights are not exceeded.

6. Carry out each of the strut inflation/deflation procedures indicated in the module.

7. Carry out each of the related safety procedures indicated in the module.

PERFORMANCE OBJECTIVE 4:

Given mockups of a C141 main landing gear strut and aircraft jack, and a C141 axle jacking checklist, the student will be able to raise and lower the strut (aircraft). To successfully achieve the objective the student must accomplish each of the following steps:

1. Inspect the jack prior to use.

2. Correctly position the jack.

3. Raise the wheel approximately one inch.

4. Carry out each of the axle jacking procedures indicated in the module.

5. Carry out each of the related safety procedures indicated in the module.

PERFORMANCE OBJECTIVE 5:

Given a brake number, mockups of C141 rudder pedals, hydraulic system control panel, and a C141 brake setting/ releasing checklist, the student will be able to set and release the brakes. To successfully achieve this objective, the student must accomplish the following steps:

1. Pressurize the correct hydraulic system for the given brake.

2. Check that the brakes are actually set.

3. Carry out each of the brake setting/releasing procedures indicated in the module.

4. Carry out each of the related safety procedures indicated in the module.

PERFORMANCE OBJECTIVE 6:

Given mockups of a C141 axle, wheel and related inner and outer hardware incorporating one or more defective parts, and a C141 wheel removal/replacement checklist, the student will be able to remove and replace the wheel/related hardware. To successfully achieve this objective, the student must accomplish the following steps:

1. Inspect all required hardware components and identify/replace and which are defective.

2. Correctly lubricate all required hardware components.

3. Use all tools correctly.

4. Torque wheel to proper tolerances.

5. Verbally indicate cautions and carry them out.

6. Carry out each of the wheel removal/replacement procedures indicated in the module.

7. Carry out each of the related safety procedures indicated in the module.

PERFORMANCE OBJECTIVE 7:

Given mockups of a C141 axle, brake assembly, strut, and torque link incorporating one or more defective parts, a brake removal and replacement checklist, and the instructor acting as a hydraulic specialist, the student will be able to remove and replace the C141 brake assembly/related hardware and recognize/replace all defective parts. To successfully achieve this objective, the student must accomplish the following steps:

1. Request the hydraulic specialist to depressurize the hydraulic system and cap/plug the cap/filler.

2. Use all tools correctly.

3. Inspect all required hardware components and identify/replace any which are defective.

4. Correctly lubricate all required hardware components.

5. Verbally indicate cautions and carry them out.

6. Carry out each of the brake removal/replacement procedures indicated in the module.

7. Carry out each of the related safety procedures indicated in the module.

PERFORMANCE OBJECTIVE 8:

Given an actual C141 aircraft, and related C141 job guide, the student will be able to remove and replace both the wheel and brake assembly. To successfully achieve the objective, the student must accomplish the following steps:

1. Inspect all hardware components and identify/replace any which are defective.

2. Lubricate all required hardware components.

3. Verbally indicate all cautions and carry them out.

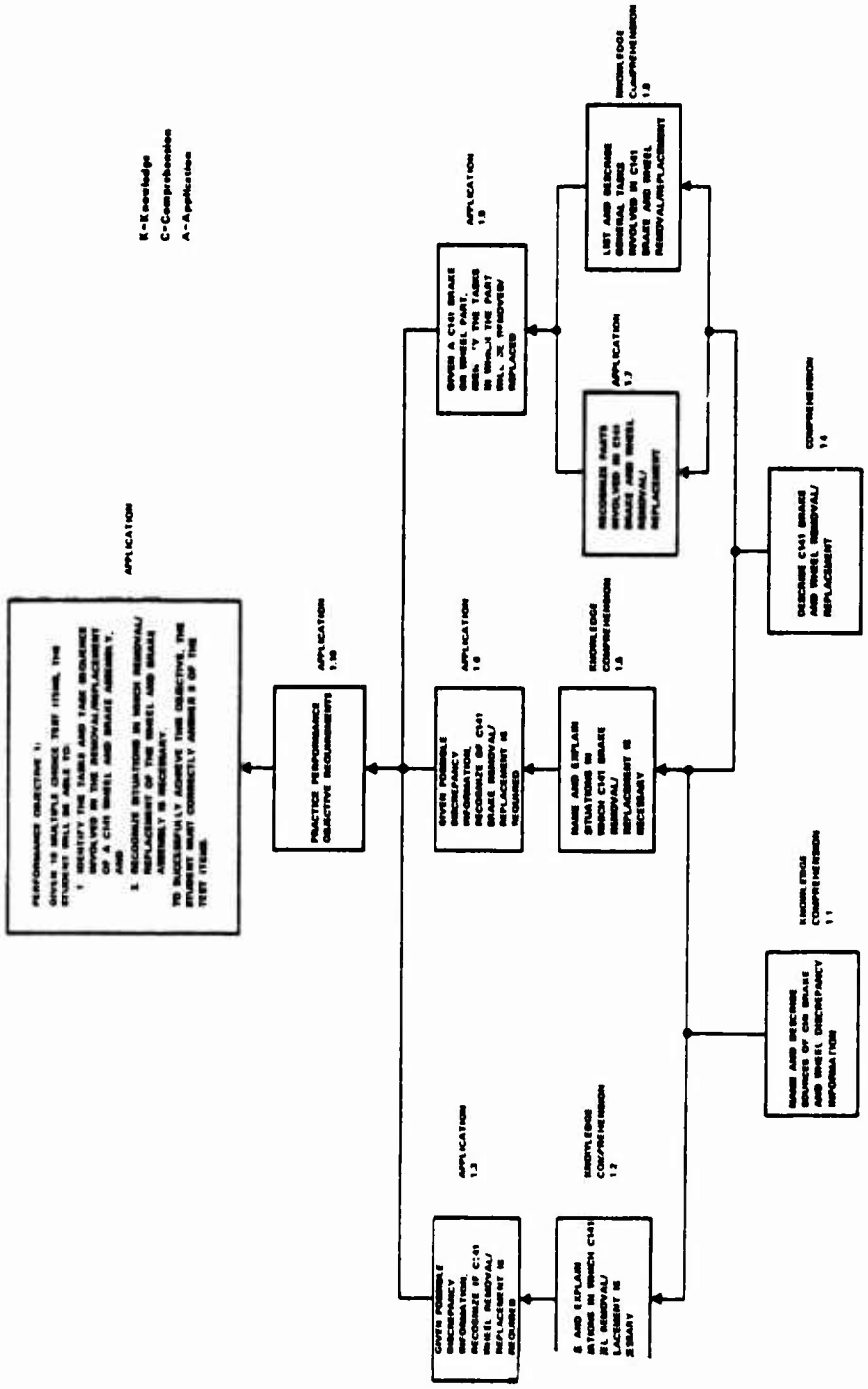
4. Carry out the aircraft procedures for the task as indicated in the module.

5. Carry out each of the related safety procedures as indicated in the module.

APPENDIX O

TRAINING PLAN LEARNING ANALYSES

C141 WHEEL AND BRAKE REMOVAL/REPLACEMENT



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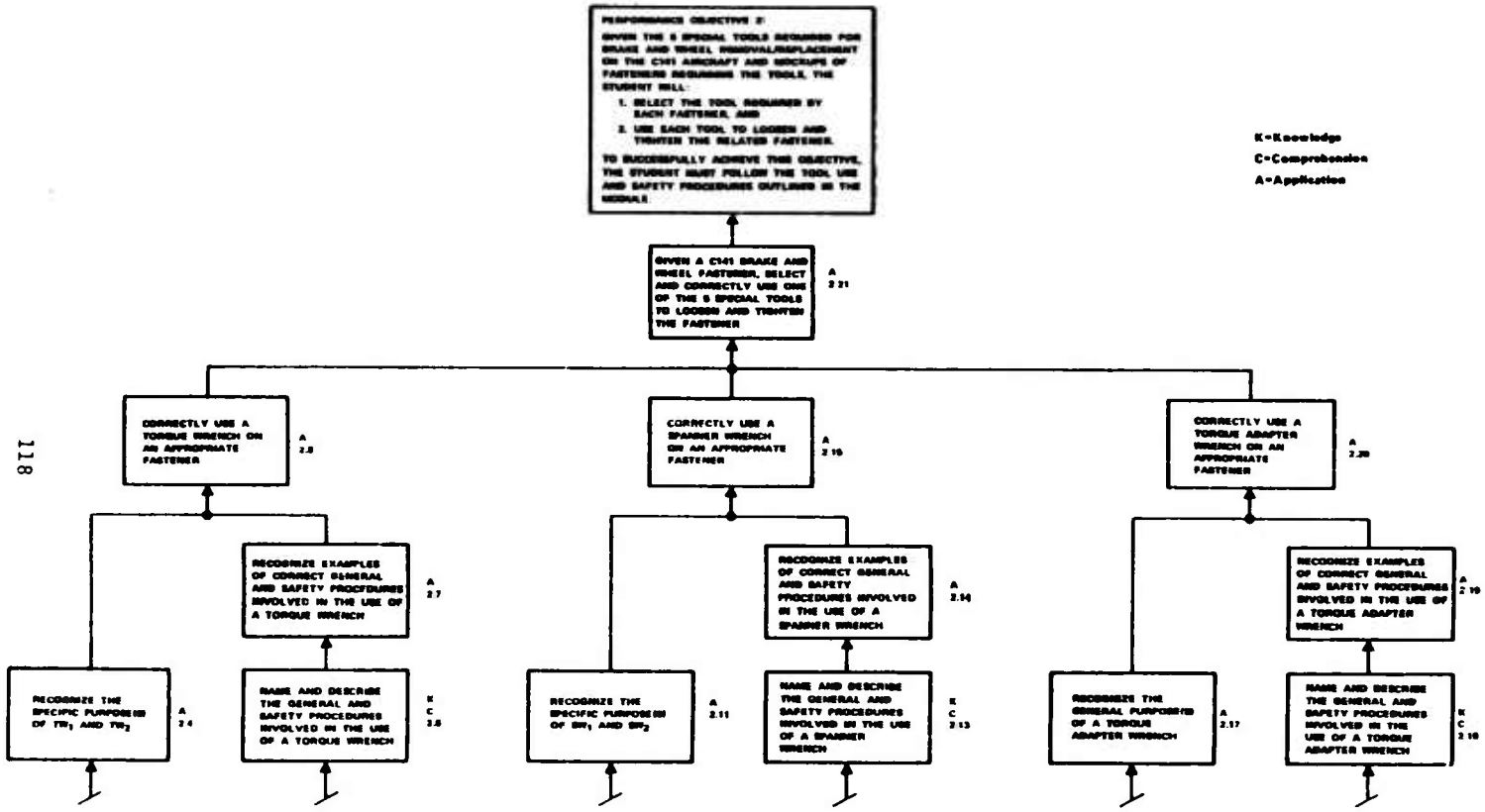
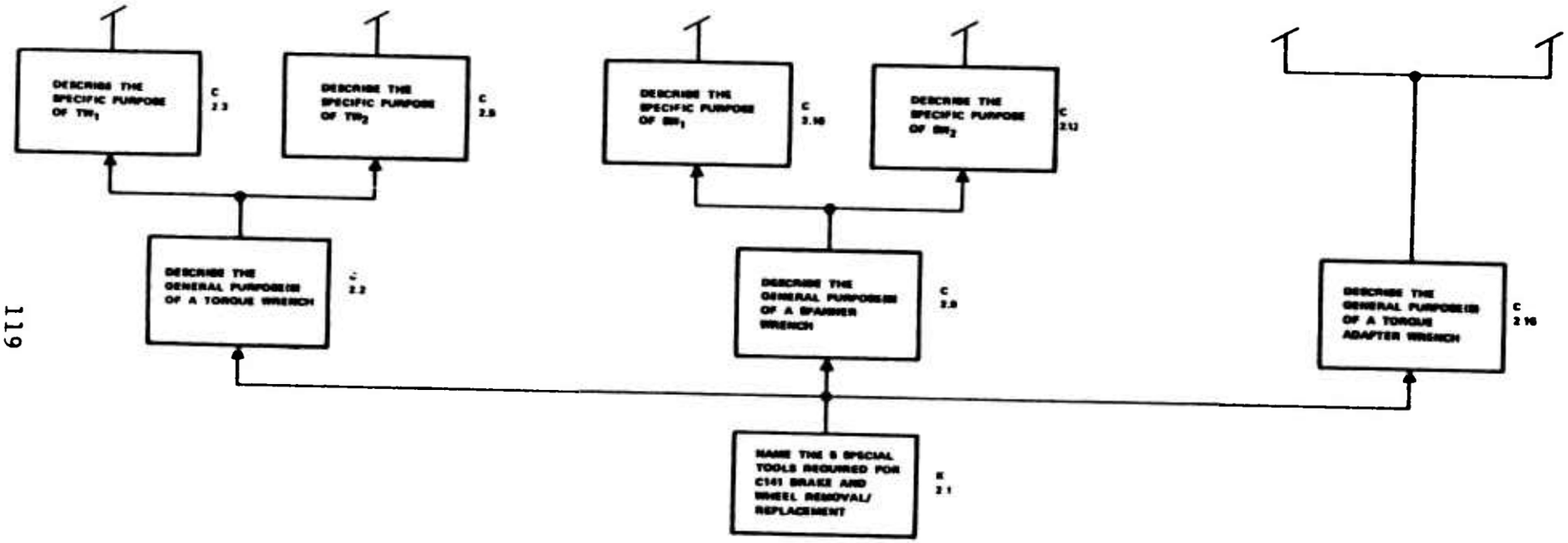
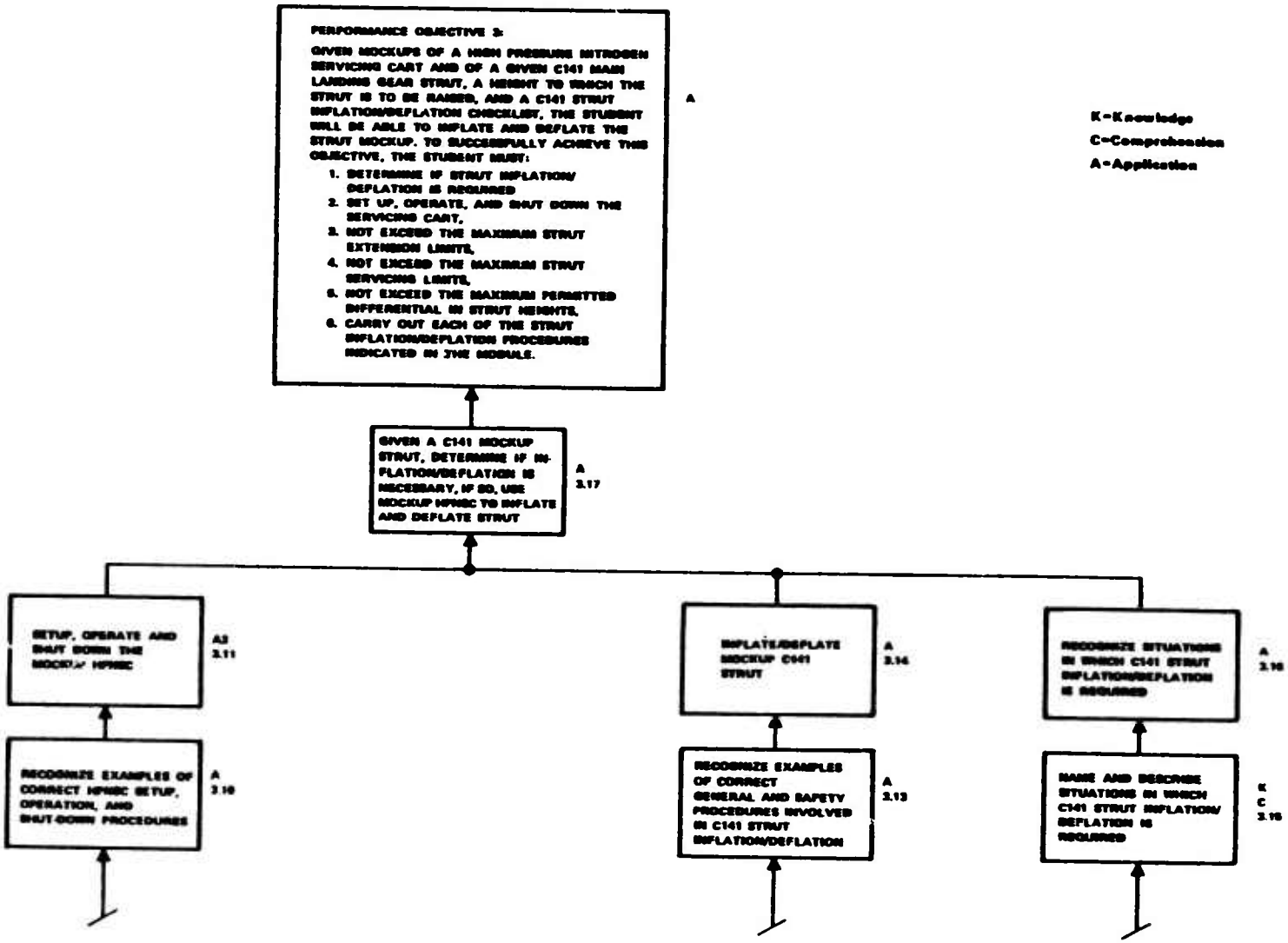
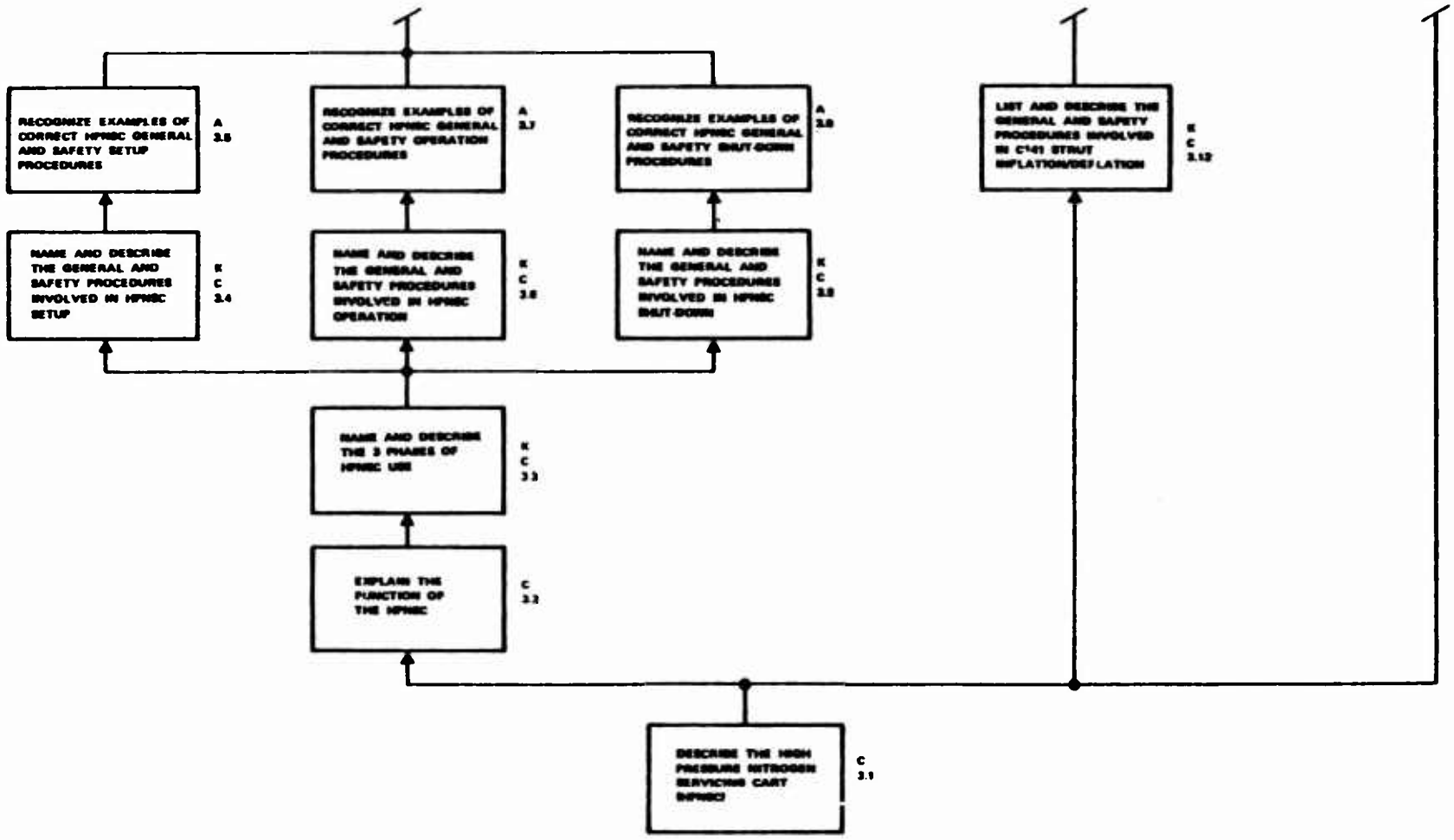
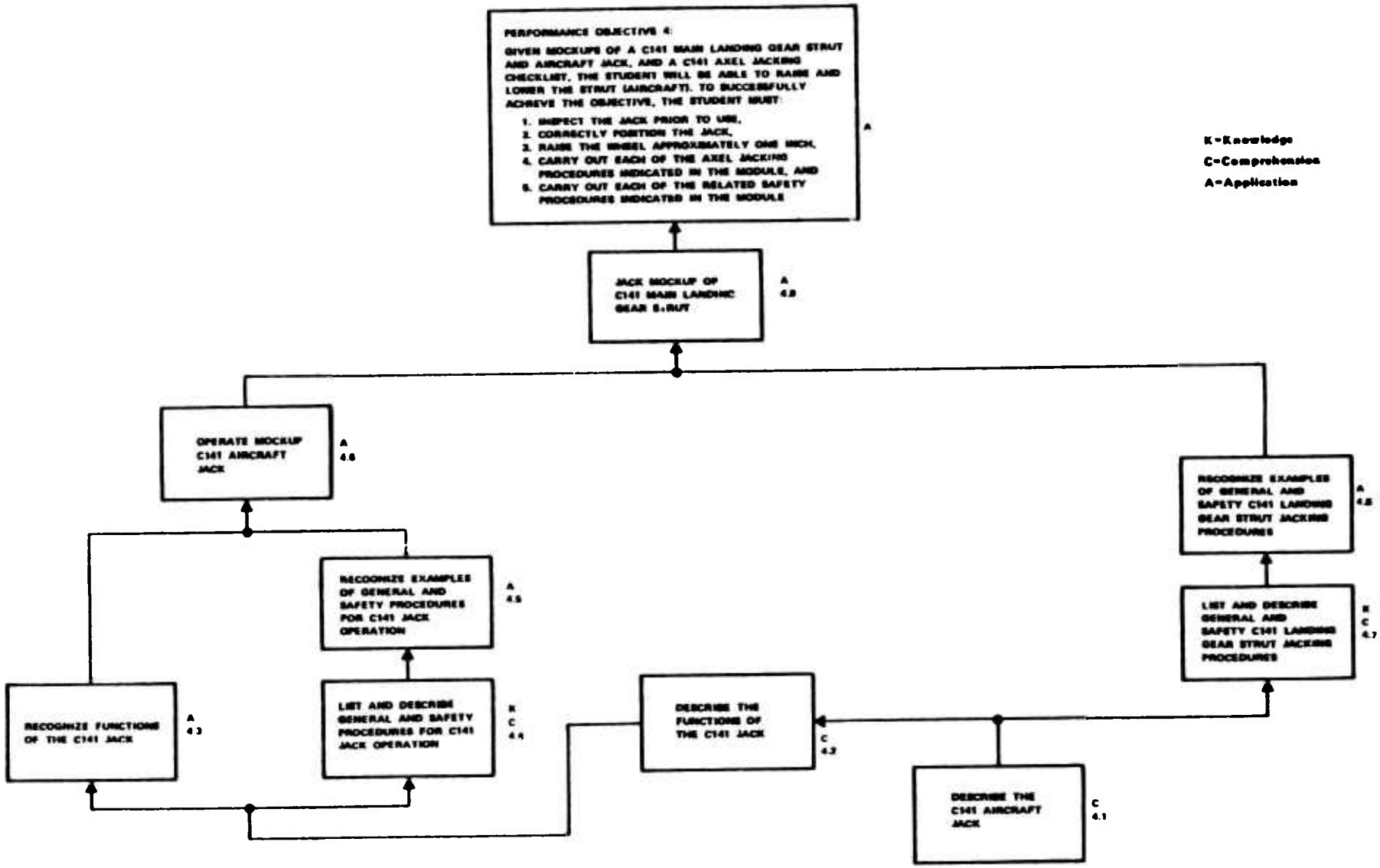
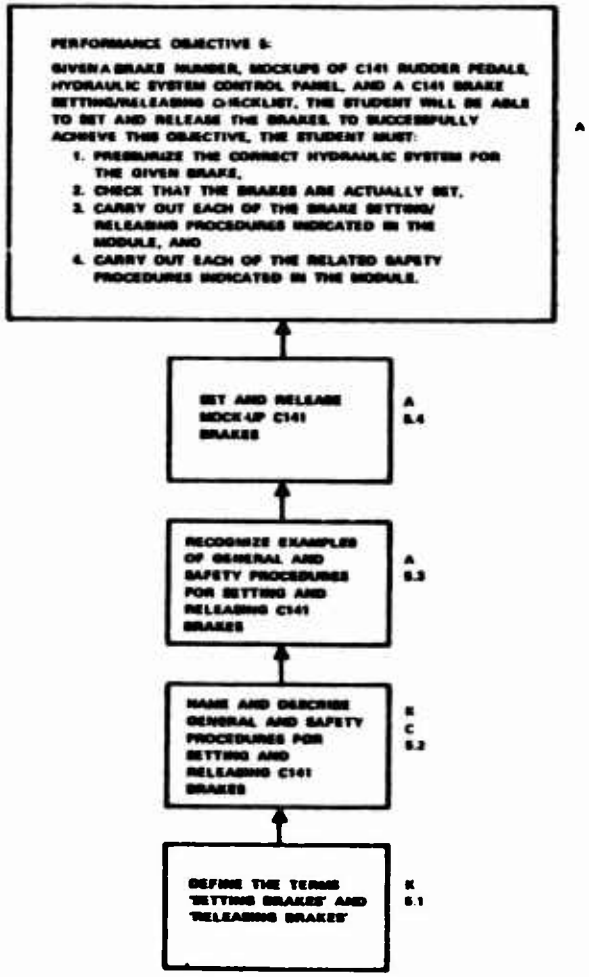

PERFORMANCE OBJECTIVE 2:
GIVEN THE 6 SPECIAL TOOLS REQUIRED FOR BRAKE AND WHEEL REMOVAL/REPLACEMENT ON THE C141 AIRCRAFT AND MOCKUPS OF FASTENERS REQUIRING THE TOOLS, THE STUDENT WILL:
1. SELECT THE TOOL REQUIRED BY EACH FASTENER, AND
2. USE EACH TOOL TO LOOSEN AND TIGHTEN THE RELATED FASTENER.
TO SUCCESSFULLY ACHIEVE THIS OBJECTIVE, THE STUDENT MUST FOLLOW THE TOOL USE AND SAFETY PROCEDURES OUTLINED IN THE MODULE.
GIVEN A C141 BRAKE AND WHEEL FASTENER, SELECT AND CORRECTLY USE ONE OF THE 6 SPECIAL TOOLS TO LOOSEN AND TIGHTEN THE FASTENER
A 2.21
CORRECTLY USE A TORQUE WRENCH ON AN APPROPRIATE FASTENER
A 2.8
CORRECTLY USE A SPANNER WRENCH ON AN APPROPRIATE FASTENER
A 2.15
CORRECTLY USE A TORQUE ADAPTER WRENCH ON AN APPROPRIATE FASTENER
A 2.20
RECOGNIZE EXAMPLES OF CORRECT GENERAL AND SAFETY PROCEDURES INVOLVED IN THE USE OF A TORQUE WRENCH
A 2.7
RECOGNIZE EXAMPLES OF CORRECT GENERAL AND SAFETY PROCEDURES INVOLVED IN THE USE OF A SPANNER WRENCH
A 2.14
RECOGNIZE EXAMPLES OF CORRECT GENERAL AND SAFETY PROCEDURES INVOLVED IN THE USE OF A TORQUE ADAPTER WRENCH
A 2.19
RECOGNIZE THE SPECIFIC PURPOSES OF TW1 AND TW2
A 2.4
NAME AND DESCRIBE THE GENERAL AND SAFETY PROCEDURES INVOLVED IN THE USE OF A TORQUE WRENCH
K C 2.5
RECOGNIZE THE SPECIFIC PURPOSES OF SW1 AND SW2
A 2.11
NAME AND DESCRIBE THE GENERAL AND SAFETY PROCEDURES INVOLVED IN THE USE OF A SPANNER WRENCH
K C 2.13
RECOGNIZE THE GENERAL PURPOSES OF A TORQUE ADAPTER WRENCH
A 2.17
NAME AND DESCRIBE THE GENERAL AND SAFETY PROCEDURES INVOLVED IN THE USE OF A TORQUE ADAPTER WRENCH
K C 2.18
K=Knowledge
C=Comprehension
A=Application


DESCRIBE THE SPECIFIC PURPOSE OF TW_1
C 2.3
DESCRIBE THE SPECIFIC PURPOSE OF TW_2
C 2.5
DESCRIBE THE SPECIFIC PURPOSE OF SW_1
C 2.10
DESCRIBE THE SPECIFIC PURPOSE OF SW_2
C 2.12
DESCRIBE THE GENERAL PURPOSE(S) OF A TORQUE WRENCH
C 2.2
DESCRIBE THE GENERAL PURPOSE(S) OF A SPANNER WRENCH
C 2.9
DESCRIBE THE GENERAL PURPOSE(S) OF A TORQUE ADAPTER WRENCH
C 2.16
NAME THE 5 SPECIAL TOOLS REQUIRED FOR C141 BRAKE AND WHEEL REMOVAL/ REPLACEMENT
K 2.1

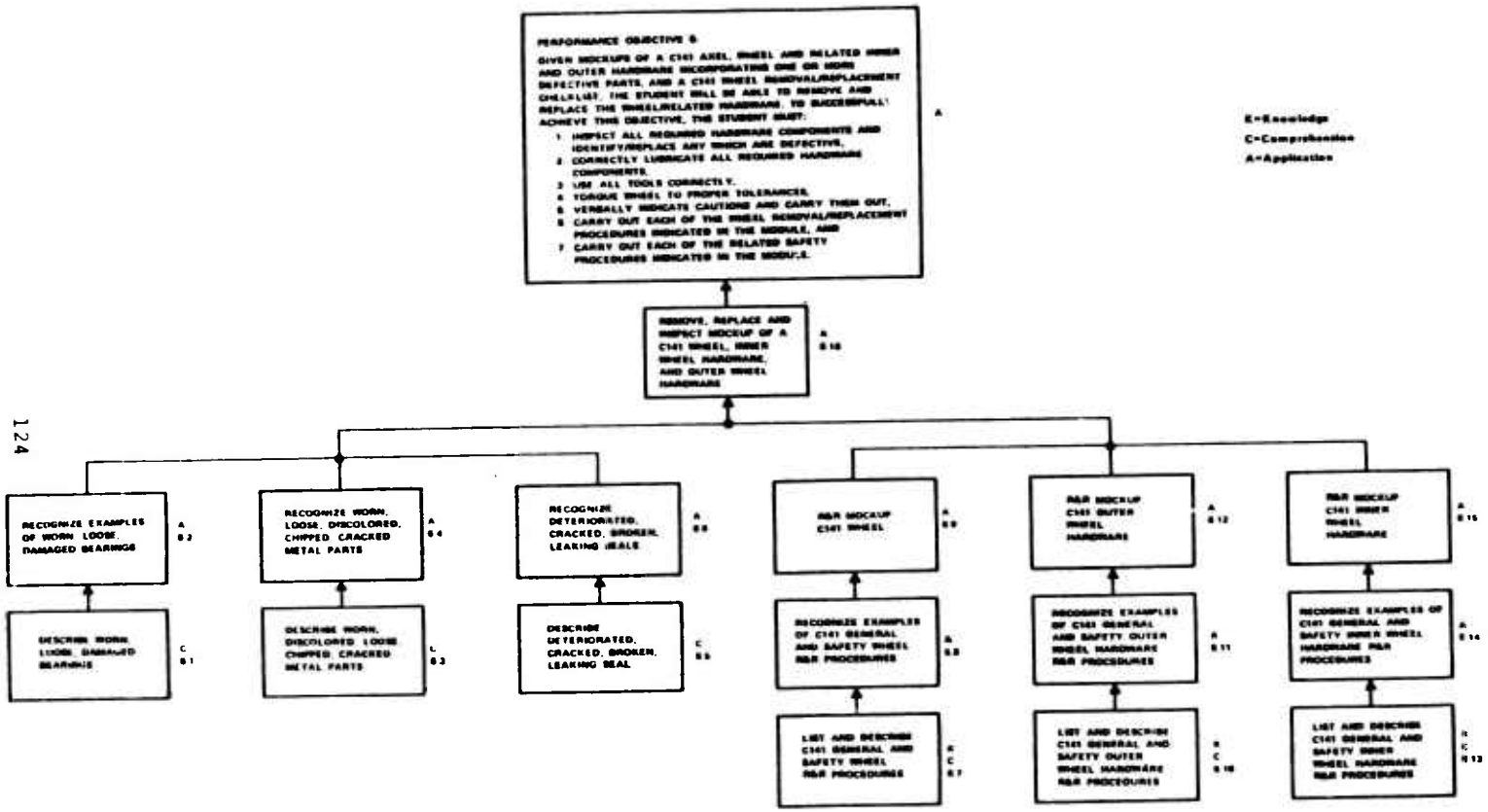

PERFORMANCE OBJECTIVE 3:
GIVEN MOCKUPS OF A HIGH PRESSURE NITROGEN SERVICING CART AND OF A GIVEN C141 MAIN LANDING GEAR STRUT, A HEIGHT TO WHICH THE STRUT IS TO BE RAISED, AND A C141 STRUT INFLATION/DEFLATION CHECKLIST, THE STUDENT WILL BE ABLE TO INFLATE AND DEFLATE THE STRUT MOCKUP. TO SUCCESSFULLY ACHIEVE THIS OBJECTIVE, THE STUDENT MUST:
1. DETERMINE IF STRUT INFLATION/DEFLATION IS REQUIRED
2. SET UP, OPERATE, AND SHUT DOWN THE SERVICING CART,
3. NOT EXCEED THE MAXIMUM STRUT EXTENSION LIMITS,
4. NOT EXCEED THE MAXIMUM STRUT SERVICING LIMITS,
5. NOT EXCEED THE MAXIMUM PERMITTED DIFFERENTIAL IN STRUT HEIGHTS,
6. CARRY OUT EACH OF THE STRUT INFLATION/DEFLATION PROCEDURES INDICATED IN THE MODULE.
A
GIVEN A C141 MOCKUP STRUT, DETERMINE IF INFLATION/DEFLATION IS NECESSARY, IF SO, USE MOCKUP HPNSC TO INFLATE AND DEFLATE STRUT
A 3.17
SETUP, OPERATE AND SHUT DOWN THE MOCKUP HPNSC
A3 3.11
RECOGNIZE EXAMPLES OF CORRECT HPNSC SETUP, OPERATION, AND SHUT-DOWN PROCEDURES
A 3.10
INFLATE/DEFLATE MOCKUP C141 STRUT
A 3.14
RECOGNIZE EXAMPLES OF CORRECT GENERAL AND SAFETY PROCEDURES INVOLVED IN C141 STRUT INFLATION/DEFLATION
A 3.13
RECOGNIZE SITUATIONS IN WHICH C141 STRUT INFLATION/DEFLATION IS REQUIRED
A 3.16
NAME AND DESCRIBE SITUATIONS IN WHICH C141 STRUT INFLATION/DEFLATION IS REQUIRED
K C 3.15
K-Knowledge
C-Comprehension
A-Application

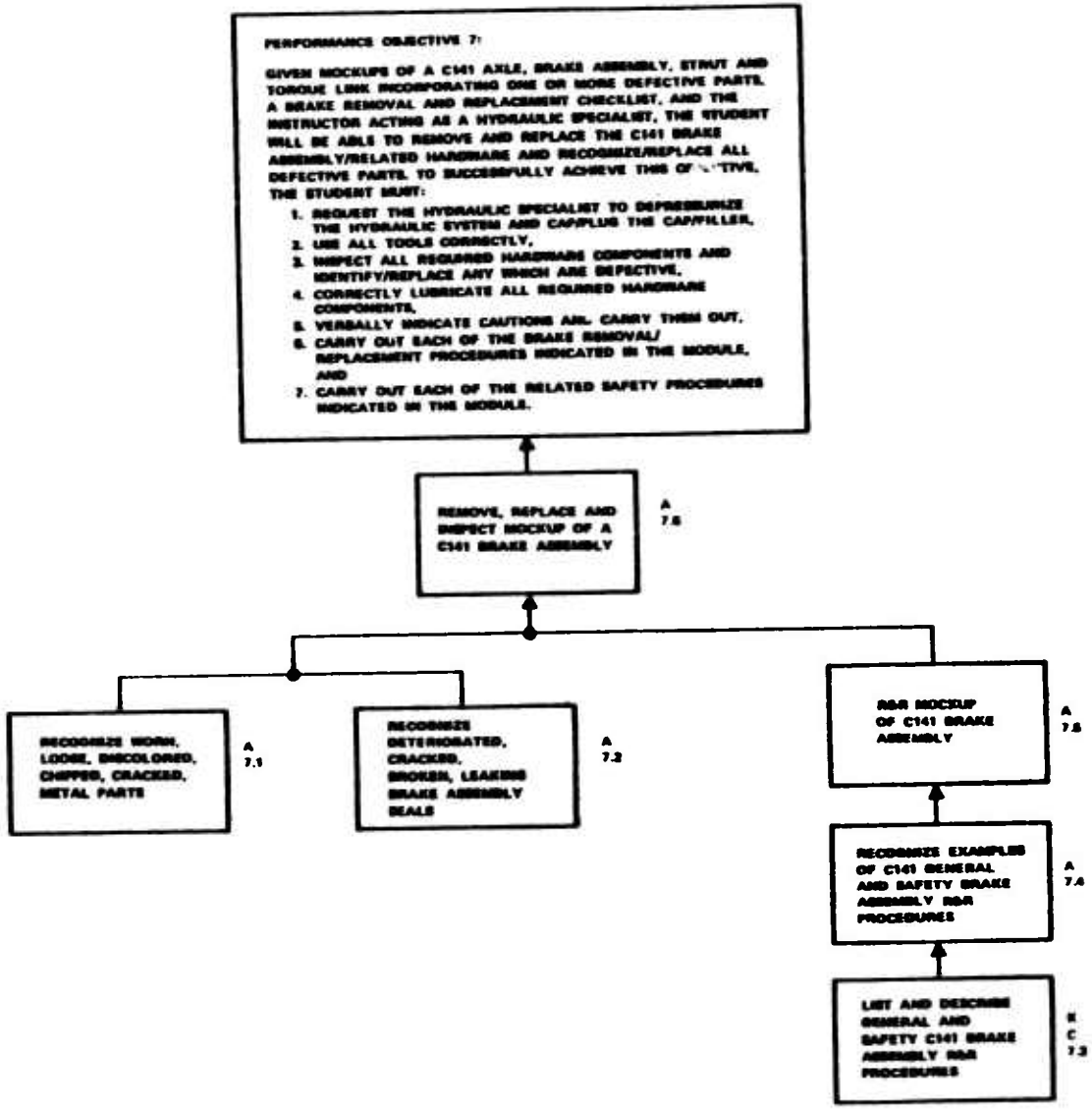

RECOGNIZE EXAMPLES OF CORRECT HPNSC GENERAL AND SAFETY SETUP PROCEDURES
A 3.5
RECOGNIZE EXAMPLES OF CORRECT HPNSC GENERAL AND SAFETY OPERATION PROCEDURES
A 3.7
RECOGNIZE EXAMPLES OF CORRECT HPNSC GENERAL AND SAFETY SHUT-DOWN PROCEDURES
A 3.9
LIST AND DESCRIBE THE GENERAL AND SAFETY PROCEDURES INVOLVED IN C141 STRUT INFLATION/DEFLATION
K C 3.12
NAME AND DESCRIBE THE GENERAL AND SAFETY PROCEDURES INVOLVED IN HPNSC SETUP
K C 3.4
NAME AND DESCRIBE THE GENERAL AND SAFETY PROCEDURES INVOLVED IN HPNSC OPERATION
K C 3.6
NAME AND DESCRIBE THE GENERAL AND SAFETY PROCEDURES INVOLVED IN HPNSC SHUT-DOWN
K C 3.8
NAME AND DESCRIBE THE 3 PHASES OF HPNSC USE
K C 3.3
EXPLAIN THE FUNCTION OF THE HPNSC
C 3.2
DESCRIBE THE HIGH PRESSURE NITROGEN SERVICING CART (HPNSC)
C 3.1


PERFORMANCE OBJECTIVE 4:
GIVEN MOCKUPS OF A C141 MAIN LANDING GEAR STRUT AND AIRCRAFT JACK, AND A C141 AXEL JACKING CHECKLIST, THE STUDENT WILL BE ABLE TO RAISE AND LOWER THE STRUT (AIRCRAFT). TO SUCCESSFULLY ACHIEVE THE OBJECTIVE, THE STUDENT MUST:
1. INSPECT THE JACK PRIOR TO USE,
2. CORRECTLY POSITION THE JACK,
3. RAISE THE WHEEL APPROXIMATELY ONE INCH,
4. CARRY OUT EACH OF THE AXEL JACKING PROCEDURES INDICATED IN THE MODULE, AND
5. CARRY OUT EACH OF THE RELATED SAFETY PROCEDURES INDICATED IN THE MODULE
A
JACK MOCKUP OF C141 MAIN LANDING GEAR STRUT
A 4.8
OPERATE MOCKUP C141 AIRCRAFT JACK
A 4.6
RECOGNIZE EXAMPLES OF GENERAL AND SAFETY PROCEDURES FOR C141 JACK OPERATION
A 4.5
RECOGNIZE FUNCTIONS OF THE C141 JACK
A 4.3
LIST AND DESCRIBE GENERAL AND SAFETY PROCEDURES FOR C141 JACK OPERATION
K C 4.4
DESCRIBE THE FUNCTIONS OF THE C141 JACK
C 4.2
DESCRIBE THE C141 AIRCRAFT JACK
C 4.1
LIST AND DESCRIBE GENERAL AND SAFETY C141 LANDING GEAR STRUT JACKING PROCEDURES
K C 4.7
RECOGNIZE EXAMPLES OF GENERAL AND SAFETY C141 LANDING GEAR STRUT JACKING PROCEDURES
A 4.8
K=Knowledge
C=Comprehension
A=Application

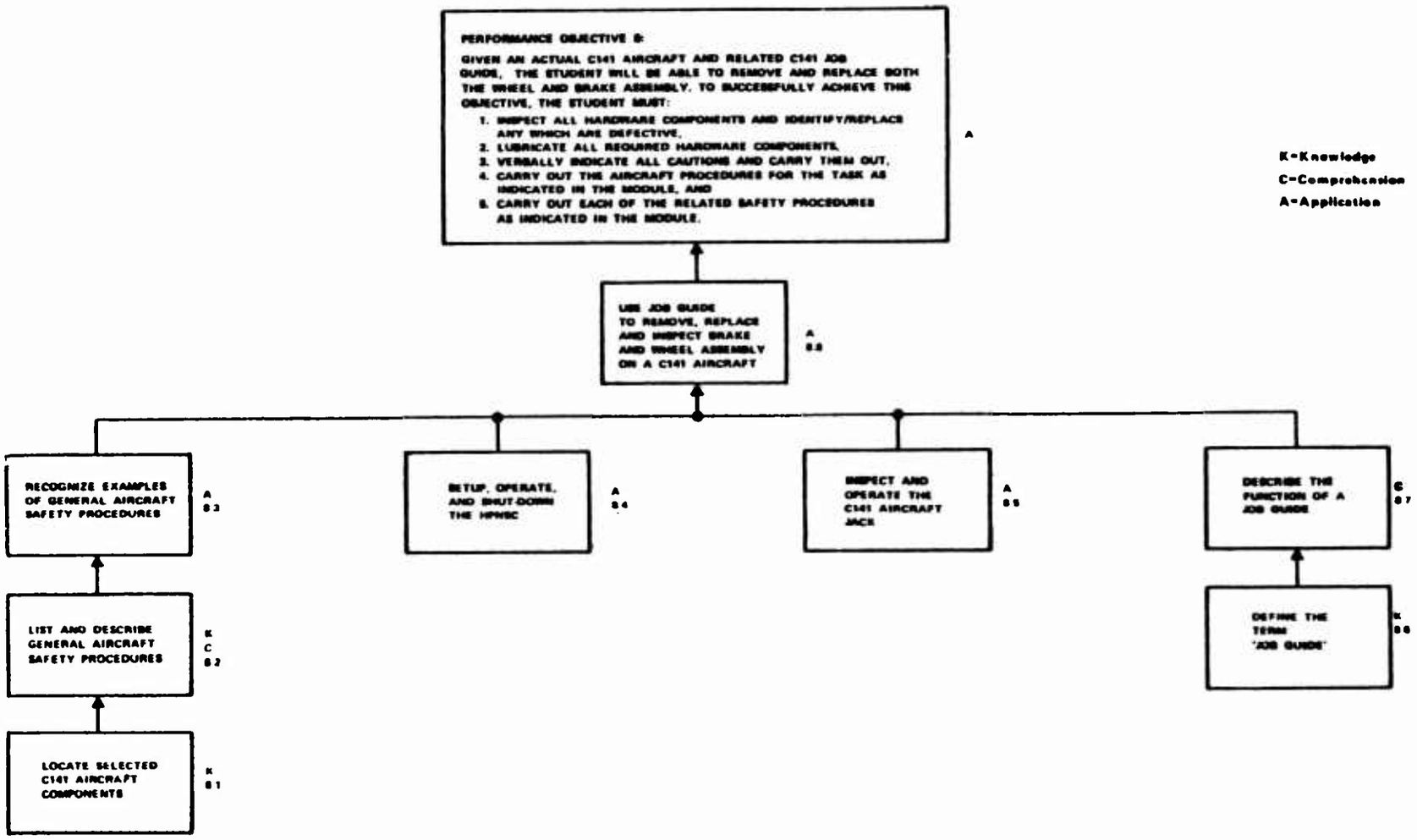


K-Knowledge
C-Comprehension
A-Application


PERFORMANCE OBJECTIVE 5
GIVEN MOCKUPS OF A C141 AXEL, WHEEL AND RELATED INNER AND OUTER HARDWARE INCORPORATING ONE OR MORE DEFECTIVE PARTS, AND A C141 WHEEL REMOVAL/REPLACEMENT CHECKLIST, THE STUDENT WILL BE ABLE TO REMOVE AND REPLACE THE WHEEL/RELATED HARDWARE. TO SUCCESSFULLY ACHIEVE THIS OBJECTIVE, THE STUDENT MUST:
1 INSPECT ALL REQUIRED HARDWARE COMPONENTS AND IDENTIFY/REPLACE ANY WHICH ARE DEFECTIVE.
2 CORRECTLY LUBRICATE ALL REQUIRED HARDWARE COMPONENTS.
3 USE ALL TOOLS CORRECTLY.
4 TORQUE WHEEL TO PROPER TOLERANCES.
5 VERBALLY INDICATE CAUTIONS AND CARRY THEM OUT.
6 CARRY OUT EACH OF THE WHEEL REMOVAL/REPLACEMENT PROCEDURES INDICATED IN THE MODULE, AND
7 CARRY OUT EACH OF THE RELATED SAFETY PROCEDURES INDICATED IN THE MODULE.
A
REMOVE, REPLACE AND INSPECT MOCKUP OF A C141 WHEEL, INNER WHEEL HARDWARE, AND OUTER WHEEL HARDWARE
A 5.16
RECOGNIZE EXAMPLES OF WORN LOOSE DAMAGED BEARINGS
A 5.2
DESCRIBE WORN LOOSE DAMAGED BEARINGS
C 5.1
RECOGNIZE WORN, LOOSE, DISCOLORED, CHIPPED CRACKED METAL PARTS
A 5.4
DESCRIBE WORN, DISCOLORED LOOSE CHIPPED CRACKED METAL PARTS
C 5.3
RECOGNIZE DETERIORATED, CRACKED, BROKEN, LEAKING SEALS
A 5.6
DESCRIBE DETERIORATED, CRACKED, BROKEN, LEAKING SEAL
C 5.5
R&R MOCKUP C141 WHEEL
A 5.9
RECOGNIZE EXAMPLES OF C141 GENERAL AND SAFETY WHEEL R&R PROCEDURES
A 5.8
LIST AND DESCRIBE C141 GENERAL AND SAFETY WHEEL R&R PROCEDURES
K C 5.7
R&R MOCKUP C141 OUTER WHEEL HARDWARE
A 5.12
RECOGNIZE EXAMPLES OF C141 GENERAL AND SAFETY OUTER WHEEL HARDWARE R&R PROCEDURES
A 5.11
LIST AND DESCRIBE C141 GENERAL AND SAFETY OUTER WHEEL HARDWARE R&R PROCEDURES
K C 5.10
R&R MOCKUP C141 INNER WHEEL HARDWARE
A 5.15
RECOGNIZE EXAMPLES OF C141 GENERAL AND SAFETY INNER WHEEL HARDWARE R&R PROCEDURES
A 5.14
LIST AND DESCRIBE C141 GENERAL AND SAFETY INNER WHEEL HARDWARE R&R PROCEDURES
K C 5.13
K=Knowledge
C=Comprehension
A=Application



K=Knowledge
C=Comprehension
A=Application


PERFORMANCE OBJECTIVE 8:
GIVEN AN ACTUAL C141 AIRCRAFT AND RELATED C141 JOB GUIDE, THE STUDENT WILL BE ABLE TO REMOVE AND REPLACE BOTH THE WHEEL AND BRAKE ASSEMBLY. TO SUCCESSFULLY ACHIEVE THIS OBJECTIVE, THE STUDENT MUST:
1. INSPECT ALL HARDWARE COMPONENTS AND IDENTIFY/REPLACE ANY WHICH ARE DEFECTIVE,
2. LUBRICATE ALL REQUIRED HARDWARE COMPONENTS,
3. VERBALLY INDICATE ALL CAUTIONS AND CARRY THEM OUT,
4. CARRY OUT THE AIRCRAFT PROCEDURES FOR THE TASK AS INDICATED IN THE MODULE, AND
5. CARRY OUT EACH OF THE RELATED SAFETY PROCEDURES AS INDICATED IN THE MODULE.
A
USE JOB GUIDE TO REMOVE, REPLACE AND INSPECT BRAKE AND WHEEL ASSEMBLY ON A C141 AIRCRAFT
A 8.8
RECOGNIZE EXAMPLES OF GENERAL AIRCRAFT SAFETY PROCEDURES
A 8.3
SETUP, OPERATE, AND SHUT-DOWN THE HPNSC
A 8.4
INSPECT AND OPERATE THE C141 AIRCRAFT JACK
A 8.5
DESCRIBE THE FUNCTION OF A JOB GUIDE
C 8.7
LIST AND DESCRIBE GENERAL AIRCRAFT SAFETY PROCEDURES
K C 8.2
DEFINE THE TERM 'JOB GUIDE'
K 8.6
LOCATE SELECTED C141 AIRCRAFT COMPONENTS
K 8.1
K=Knowledge
C=Comprehension
A=Application

APPENDIX P
DESCRIPTION OF MODULARIZED INSTRUCTION

OVERVIEW OF MODULES

A module is an instructional package dealing with a single performance objective. It is an attempt to individualize learning by enabling a trainee to master one unit of instruction before moving to another. The learning experiences within a module are presented in a self-instructional format which permits the trainee to control the rate and intensity of study. Since the module package may involve materials which are portable, the trainee can take it to the library, a study carrel or living quarters. The length of a module may vary from only a few minutes of trainee time to several hours. Modules may be used individually or combined to form sequences of learning devoted to a specific overall outcome (e.g., a particular job skill).

CONTENT OF A MODULE

Modules may vary dramatically in terms of content. Some modules provide only a prescription in the sense that a trainee is told where to obtain and how to use such items as instructional materials and assessments. Conversely, other modules may be totally self-contained in that they would contain everything a trainee required in order to achieve a given performance objective. For the modules related to C-141 brake and wheel removal/ replacement, the following general content is proposed:

1. An introduction including the statement of the performance objective.

2. A diagnostic test related to each of the enabling objectives.

3. An answer key to the diagnostic test, including a relationship chart matching incorrectly answered diagnostic test items with appropriate instruction.

4. All instruction required for each enabling objective (other than that limited amount of instruction requiring either instructor delivery or supervision).

5. Self-tests valid for the instruction within the module.

6. Directions on how and where the module post-test will be administered.

STUDENT USE OF AN INSTRUCTIONAL MODULE

Based upon the above proposed content, the modules would be used in the following general manner:

1. Trainees would begin use of a module by reading the introduction including the performance objective.

2. Trainees would complete the diagnostic test.

3. Depending upon the results of the diagnostic test, the relationship chart would guide each trainee to the appropriate instruction.

4. Upon completion of each segment of instruction, trainees would complete the related self-test.

5. Following completion of all instruction, the trainee would take the post-test related to the module. (The post-test could be given on demand or based upon a schedule provided by the instructor.)

Most of the study related to the module could be undertaken independently at a location of the trainee's choosing. However, that instruction requiring the use of mockups or special tools would be completed within the confines of a training environment under instructor control.

ROLE OF THE INSTRUCTOR

The role of the instructor in modular instruction is that of facilitator and evaluator. Essentially, instructors have limited responsibility for delivering "stand-up" instruction. Instead, they are available to assist trainees in overcoming learning problems on a one-to-one basis. Further, instructors will supervise trainee practice of skills involving mockups or special tools as well as evaluating student completion of each post-test. Thus, in a modular situation, the responsibility for instructional delivery moves from the instructor to the modules while the instructor tends to take on a heavily diagnostic role.

APPENDIX Q
PRELIMINARY MEDIA AND ASSESSMENT CHOICES

C141 BRAKE AND WHEEL REMOVAL/REPLACEMENT

Enabling Objective	Preliminary Medial Choice	Preliminary Assessment Choice
1.1	written instruction	short answer item
1.2	written instruction	short answer item
1.3	written instruction	alternative response item
1.4	written instruction	short answer
1.5	written instruction	short answer
1.6	written instruction	alternative response
1.7	written instruction with still pictures	alternative response with still pictures
1.8	written instruction	short answer
1.9	written instruction with still pictures	alternative response with still pictures
1.10	alternative response	alternative response
2.1	written instruction	short answer
2.2	written instruction	short answer
2.3	written instruction	short answer
2.4	written instruction	alternative response
2.5	written instruction	short answer
2.6	written instruction	short answer
2.7	written instruction with sequenced still pictures	alternative response with sequenced still pictures

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2.8	practice	instructor observation
2.9	written instruction	short answer
2.10	written instruction	short answer
2.11	written instruction	alternative response
2.12	written instruction	short answer
2.13	written instruction	short answer
2.14	written instruction with sequenced still pictures.	alternative response with sequenced still pictures
2.15	practice	instructor observation
2.16	written instruction	short answer
2.17	written instruction	alternative response
2.18	written instruction	short answer
2.19	written instruction with sequenced still pictures	alternative response with sequenced still pictures
2.20	practice	instructor observation
2.21	practice	instructor observation
3.1	written instruction	short answer
3.2	written instruction	short answer
3.3	written instruction	short answer
3.4	written instruction	short answer
3.5	written instruction with still pictures	alternative response with still pictures
3.6	written instruction	short answer
3.7	written instruction	alternative response

	with still pictures	with still pictures
3.8	written instruction	short answer
3.9	written instruction with still pictures	alternative response with still pictures
3.10	written instruction with still pictures	alternative response with still pictures
3.11	practice	instructor observation
3.12	written instruction	short answer
3.13	written instruction with still pictures	alternative response with still pictures
3.14	practice	instructor observation
3.15	written instruction	short answer
3.16	written instruction with still pictures	alternative response with still pictures
3.17	practice	instruction observation
4.1	written instruction	short answer
4.2	written instruction	short answer
4.3	written instruction	short answer
4.4	written instruction	short answer
4.5	written instruction with still pictures	alternative response with still pictures
4.6	practice	instructor observation
4.7	written instruction	short answer
4.8	written instruction with still pictures	alternative response with still pictures
4.9	practice	instructor observation

5.1	written instruction	completion
5.3	written instruction with still pictures	alternative response with still pictures
5.4	practice	instructor observation
6.1	written instruction	short answer
6.2	written instruction with still pictures	alternative response with still pictures
6.3	written instruction	short answer
6.4	written instruction with still pictures	alternative response with still pictures
6.5	written instruction	still pictures
6.6	written instruction with still pictures	alternative response with still pictures
6.7	written instruction	short answer
6.8	written instruction with still pictures	alternative response with still pictures
6.9	practice	instructor observation
6.10	written instruction	short answer
6.11	written instruction with still pictures	alternative response with still pictures
6.12	practice	instructor observation
6.13	written instruction	short answer
6.14	written instruction with still pictures	alternative response with still pictures
6.15	practice	instructor observation
7.1	written instruction with still pictures	alternative response with still pictures
7.2	written instruction	alternative response

	with still pictures	with still pictures
7.3	written instruction	short answer
7.4	written instruction with still pictures	alternative response with still pictures
7.5	practice	instructor observation
7.6	practice	instructor observation
8.1	written instruction with still pictures	alternative response with still pictures
8.2	written instruction	short answer
8.3	written instruction with still pictures	alternative response with still pictures
8.4	practice	instructor observation
8.5	practice	instructor observation
8.6	written instruction	completion
8.7	written instruction	short answer
8.8	practice	instructor observation

APPENDIX R
SAMPLE JOB GUIDE MANUAL

VE AND INSTALL MAIN LANDING GEAR
LS AND BRAKES

INPUT CONDITIONS

Applicable Serial Nos: All
Supplies:

Clean rags (as required)
Grease, MIL-G-25760
Oil, MIL-C-6529
Cleaning solvent, P-D-680
Cap and plug kit

Personnel Required: Two

Assistant required to aid in jacking and handling wheel and brake during remove and install.

Specialist required to connect and disconnect hydraulic swivel fittings during remove and install brakes.

Technician required to perform In-Process inspection during installation.

Equipment Condition:

Aircraft parked, chocked and statically grounded per T.O. 1C-141A-2-2JG-4.

Aircraft positioned on hard, level service. Slope tolerance of 1.5 percent, zero degrees, 51-1/2 minutes.

Landing gear ground safety pins installed per T.O. 1C-141A-2-1MS-1.

Main landing gear shock strut serviced per T.O. 1C-141A-2-2JG-5.

No. 3 hydraulic system accumulators pressurized per T.O. 1C-141A-2-3JG-2.

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WARNING

Observe all safety precautions in AFM127-101; T.O. 00-25A-1; T.O. 1C-141A-2-1MS-1.

CAUTION

Always jack aft axle first, or both axles simultaneously when there is a requirement to change tires on both axles on one gear.

Special Tools & Test Equipment:

Axle j Type F-2; used to jack bogie (two required if forwar ft wheels are to be removed). (Alternate: Axle jacks, 05; used to jack front or rear axles if both tires a at.)

Torque wrench, calibrated to 960 inch-pounds; used to torque axle nut.

Torque wrench, calibrated to 480 inch-pounds; used to torque axle nut.

Spanner Wrench, PN 3S50034; used to remove and install axle nut.

Torque adapter Wrench, PN 7227089-10; used to check position of lockring.

Valve core Tool, PN 968RB; used to remove or install valve core. (Alternate: Equivalent)

NOTE: Under an emergency situation, or when a MLG brake leak occurs at a station where brake change capability does not exist, it is permissible to cap off a maximum of one brake per main gear for a one time flight to a station having brake change capability. Cap off brake by obtaining cap/plug adapters from crew compartment. Disconnect flex hose (4) from swivel at brake (20). Install female part of adapter to the brake swivel and flex hose (4) to male part of adapter. Using number 3 hydraulic system pressurize affected brake and check for leaks.

REMOVE WHEEL AND TIRE

NOTE: If there is not enough room between the aircraft and axle to remove the wheel, inflate both landing gear struts. (Refer to T.O. 1C-141A-2-2JG-4)

1. Make sure that the parking brakes are off.

2. Remove forward and aft chocks.

3. Disconnect leveler rod (37).

   a. Remove cotter pin (36).

   b. Remove nut (35).

   c. Remove outer washer (34).

   d. Free leveler rod by pulling it off of bolt.

   e. Leave inner washer (38) in bolt and put outer washer (34) and nut (35) onto bolt for safekeeping.

   f. Tie leveler rod to forward torque arm so it will not dangle or be damaged.

4. Jack axle until tire clears ground. (Refer to T.O. 1C-141A-2-2JG-4)

5. Set parking brake.

   a. Depress top part of rudder pedals (40).

   b. Pull out parking brake handle (39).

   c. Release rudder pedals (40).

   NOTE: If parking brake handle will not set in the out position, check to make sure that there is enough hydraulic pressure (Refer to T.O.

6. Deflate tire.

   a. Remove air valve cover.

   b. Use valve core tool to deflate tire until all air is out.

c. Use valve core tool to remove valve core.

7. Remove outer wheel hardware.

a. Remove snapring (23).

b. Remove hubcap (5).

c. Remove grease retainer ring (9).

d. Remove felt grease seal (10).

8. Disconnect anti-skid detector (6).

a. Use wire snippers to cut and remove safety writing from screws.

b. Remove the three screws and place them in hubcap for safekeeping.

c. Place skid detector (6) inside axle (22) for safe storage.

9. Remove axle nut (7) and lock ring (8).

a. Remove cotter pin (25) from lock ring (8) and axle nut (7).

b. Use circular spanner wrench to remove axle nut (7).

c. Remove lock ring (8).

10. Clean axle nut (7) and lock ring (8) with clean rag.

11. Remove rest of outer wheel hardware.

a. Remove grease retainer ring (11).

b. Remove outer bearing (12), catching it in rag and keeping it wrapped in rag for protection.

13. With assistance, remove wheel and tire from axle.

CAUTION

In removing wheel, try to support wheel as it comes off so as to avoid damaging end of axle.

END OF TASK

REMOVE BRAKE

NOTE: Remove wheel and tire as per this T.O.

1. Remove outer spacer (19) from axle.

2. Request hydraulic specialist to:

   1) Depressurize #3 hydraulic system per T.O. 1C-141A-2-3JG-1.

   2) Disconnect hydraulic line (4) and swivel fitting (3).

   3) Cap fitting and plug line.

3. Separate torque link (31) from brake (20).

   a. Use screwdriver to pry lock tab on star washer (32) out of the indent on nut (33).

   b. Use spanner wrench to loosen nut (33) 3 or 4 turns.

   c. Tap nut (33) with hammer to free bolt (30).

   d. Remove nut (33), star washer (32), and bolt (30).

   e. Set torque link (31) out of the way by lifting it up and back.

CAUTION

In taking the brake off the axle care must be taken to protect the bearing surfaces on the axle.

4. With assistant, remove brake (20) from axle.

5. Use brake dolly to transport brake to service chariot.

NOTE: Sometimes the inner spacer sticks to the brake. Be sure the spacer is removed before brake leaves the area.

END OF TASK

INSTALL BRAKE

1. Using solvent, clean axle (22) and spacers (19,20).

2. Apply a thin film of grease to axle (22).

3. Install inner spacer (21) on axle (22). (Make sure it goes all the way on).

4. Get the new brake (20) and remove any service tags and/or wire attachments.

5. Align the rotor and stator discs of the brake.

6. With assistant, install brake onto axle. (Make sure it is snug against shoulder of inner spacer (21.)

7. Install torque link (31).

   a. Align torque link (31) with brake (20) so that bolt holes line up exactly.

   b. Install bolt (30) so that flat edge of bolt head lines up with alignment bar on brake housing.

      NOTE: When bolt is properly installed, the bolt will stick out the other side of the hole by about 1/32 of an inch.

   c. Place star washer (32) on the end of bolt (30).

      NOTE: If the star washer will not stay on end of bolt, make sure that the bolt is seated correctly and that it sticks out the right amount. If the bolt does stick out the right amount, then you can hold it in place by applying a little grease to the brake housing for the washer to stick to.

   d. Install nut (33), tightening it with the spanner wrench until all end play in the bolt is removed.

   e. Continue to tighten nut (33) with the spanner wrench (or with a punch and hammer) until a tab on the star washer (32) lines up with an indent on the nut (33).

   f. Use a screwdriver to bend a tab on the star washer (32) part way into an indent or nut (33).

g. Use a hammer and punch to seat tab securely into the indent.

8. Request hydraulic specialist to:

   1) Remove cap from fitting (3) and plug from line (4).

   2) Connect line (4) to swivel fitting (3).

   3) Bleed brake per T.O. 1C-141A-2-3JG-2.

   4) Service hydraulic system per T.O. 1C-141A-2-2JG-5.

   5) Check adjustment of brake and leak check brake per T.O. 1C-141A-2-12JG-6.

9. Set parking brake.

   a. Depress top part of rudder pedals (40).

   b. Pull out parking brake handle (39).

   c. Release rudder pedals (40).

10. Install outer spacer (19) with the flared end toward the brake.

END OF TASK

IN-SHOP PREPARATION OF WHEEL FOR INSTALLATION

NOTE: For wheels which have been removed and are to be reinstalled, follow steps 1-6 only. For installation of a new wheel follow steps 7-12 only.

1. Remove inner wheel hardware.

   a. Remove snapring (18).

   b. Remove grease retainer ring (17).

   c. Remove felt seal (16).

   d. Remove grease retainer ring (15).

   e. Remove inner bearing (14), placing it in a rag for protection.

   NOTE: Check for proper bearing part number - #PN522549.

2. Using cleaning solvent, clean inner and outer wheel hardware.

   a. Clean felt seals (10, 16).

   b. Clean retaining rings (9, 11, 15, 17).

   c. Clean bearings (12, 14).

3. Inspect felt seals, retaining rings, and bearings for wear and defects.

4. Lubricate felt seals (10, 16) with oil.

5. Repack bearings (12, 14) with grease.

6. Install inner wheel hardware.

   a. Install inner bearing (14).
   b. Install grease retainer ring (15).

   c. Install felt seal (16).

   d. Install grease retainer ring (17).

   e. Install snapring (18).

NOTE: For wheels that are being reinstalled, step 6 ends the wheel preparation task. For the installation of a new wheel follow steps 7-12.

7. Using cleaning solvent, clean outer wheel hardware.

   a. Clean felt seal (10).

   b. Clean retaining rings (9, 11).

   c. Clean bearing (12).

8. Inspect felt seal, retaining rings, and bearing (9, 10, 11, 12) for wear and defects.

9. Lubricate felt seal (10) with oil.

10. Repack outer bearing (12) with grease.

11. Remove inner wheel hardware to check for proper bearing part number - #PN-522549.

    a. Remove snapring (18).

    b. Remove grease retainer ring (17).

    c. Remove and discard paper protective seal.

    d. Remove felt seal (16).

    e. Remove grease retainer ring (15).

    f. Remove bearing (14) and check for proper part number - #PN-522549.

12. Reinstall inner wheel hardware.

    a. Install bearing (14).

    b. Install grease retainer ring (15).

    c. Install felt seal (16).

    d. Install grease retainer ring (17).

    e. Install snapring (18).

END OF TASK

INSTALL WHEEL AND TIRE

NOTE: Prepare wheel for installation as per this T.O.

NOTE: Before starting installation, check to be sure parking brakes are set.

1. Visually inspect wheel and tire assembly as per T.O. 1C-141A-2-1MS-1.

2. Check tire pressure for proper inflation (190 +10, -5 psi).

3. Check to make sure that the outer spacer (19) has been installed with flared end towards the brake.

4. Remove inner wheel hardware to check for proper bearing part number - #PN-522549.

   a. Remove snapring (18).

   b. Remove grease retainer ring (17).

   c. Remove felt seal (16).

   d. Remove grease retainer ring (15).

   e. Remove bearing (14) and check for proper part number - #PN-522549.

5. Reinstall inner wheel hardware.

   a. Install bearing (14).

   b. Install grease retainer ring (15).

   c. Install felt seal (16).

   d. Install grease retainer ring (17).

   e. Install snapring (18).

6. With assistance, put wheel onto axle and engage it with brake.

   a. Check alignment of rotors on brake.

   b. Guide wheel onto axle.

NOTE: Lift wheel carefully so as not to damage end of axle.

c. Keep aligning rotors as necessary while jiggling wheel all the way on.

7. Install outer bearing (12).

8. Install lock ring (8) and axle nut(7).

   a. Install lock ring (8) with lock keys in axle lock slots.

   b. While holding lock ring (8) in place with one hand, install axle nut (7) and hand tighten it with other hand.

9. Release brakes.

10. Using spanner wrench (round head), torque axle nut (7) to 960 inch pounds.

    NOTE: While tightening axle nut, rotate wheel clockwise.

11. Let up on axle nut tightness by backing off to zero inch pounds.

12. Using spanner wrench (rectangular head), torque lock ring (8) to 600 inch pounds (in either direction) to insure that the lock keys are firmly seated in axle lock slots.

WARNING

If ring nut (8) is not properly seated, the whole wheel assembly can come off.

13. Using spanner wrench (round head), torque axle nut (7) to 480 inch pounds.

14. Continue tightening axle nut (7) until the first (of the three) locking holes you come to lines up with an indent on the lock ring (8).

15. Install cotter pin (25).

    a. Insert cotter pin (25) through indent in lock ring (8) and into locking hole in axle nut (7).

b. Secure cotter pin and flatten rounded head into lock ring indent.

16. Install anti-skid detector (6).

a. Remove anti-skid detector (6) from inside the axle (22) and place in position on axle nut (7).

b. Secure anti-skid detector with three screws (24). NOTE: Be sure screws are securely seated but do not overtighten them.

c. Safety wire the three screws (24) using single strand method.

17. Install rest of outer wheel hardware.

a. Install grease retainer ring (11).

b. Install felt seal (10).

c. Install grease retainer ring (9).

d. Install hubcap (5) with key inserted into alignment hole in wheel.

e. Install snapring (23).

18. Release parking brake.

CAUTION

Be sure to get all equipment out from under the aircraft before lowering the jacks.

NOTE: If both axles are jacked, do step 17a to both jacks at the same time.

19. Lower aircraft.

a. Slowly release pressure on jack.

b. When jack is clear of jack pad (38.2), remove jack.

20. Put forward and aft wheel chocks into place.

21. Install leveler rod (37).

a. Untie leveler rod.

b. Remove nut (35) and outer washer (34), leaving inner washer (38) on bolt.

c. Place end of leveler rod (37) onto bolt.

d. Put on washer (34) and nut (35).

e. Tighten nut (35) finger tight and then back off so that one of the indents on the nut aligns with the cotter pin hole in the bolt.

f. Insert and secure cotter pin (36).

22. Deflate the struts (Refer to T.O. 1C-141A-2-2JG-4).

END OF TASK

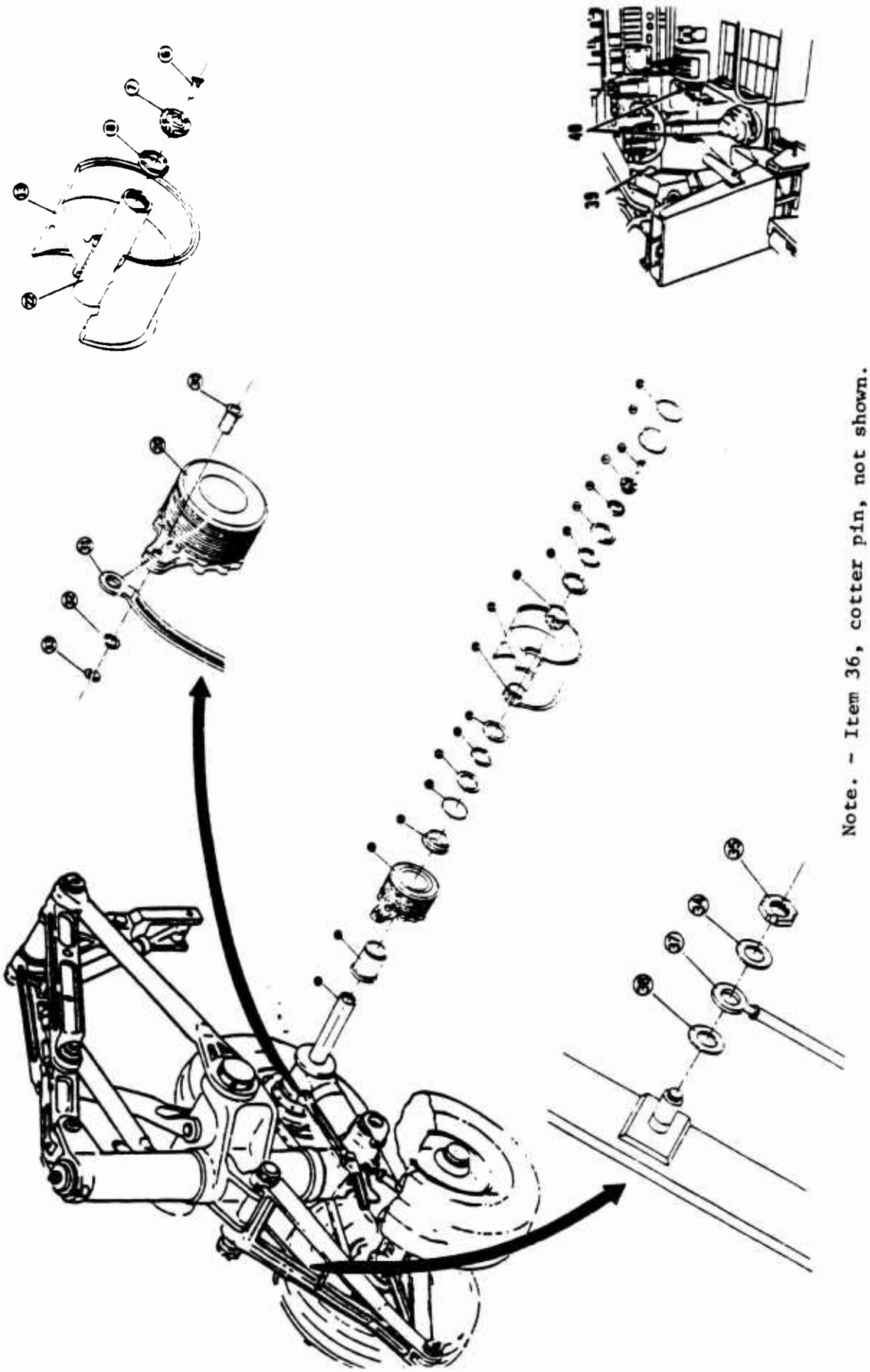

Figure 12 C-141 WHEEL AND BRAKE ASSEMBLY