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Mod-5A Wind Turbine Generator Program Design Report

Volume IV—Drawings and Specifications
Book 2

General Electric Company
(Advanced Energy Programs Department)

August 1984

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Volume I, Executive Summary

Volume I contains an overview of the MOD-5A Program. These topics are covered:

- Objectives of the MOD-5A Program
- Description of the Final Design (Model 304.2)
- Cost of Energy
- Power Output
- Trade-Off Studies
- Development Tests
- Analyses of Loads and Dynamics
- Manufacturing and Quality Assurance and Safety Plans

Volume II, Conceptual and Preliminary Design

These sections comprise Volume II, which is divided into two books, as follows:

Book 1
- 1.0 Summary
- 2.0 Introduction
- 3.0 Design Requirements
- 4.0 Conceptual Design Studies
- 5.0 Design, Development, and Optimization
- 6.0 System Dynamics Analysis
- 7.0 System Loads Analysis

Book 2
- 8.0 Development Tests
- 9.0 Design Criteria
- Appendix A System Specification
- Appendix B Design Load Tables

Volume III, Final Design and System Description

These sections comprise Volume III, which is divided into two books, as follows:

Book 1
- 1.0 Summary
- 2.0 Introduction
- 3.0 System Description - Model 304.2
- 4.0 Rotor Subsystem
- 5.0 Drivetrain Subsystem
- 6.0 Nacelle Subsystem
- 7.0 Tower and Foundation Subsystems

Book 2	8.0	Power Generation Subsystem
	9.0	Control and Instrumentation Subsystems
	10.0	Manufacturing
	11.0	Site and Erection
	12.0	Quality Assurance and Safety
	13.0	FMEA, RAM and Maintenance
	Appendix A	C.F. Braun & Company - Foundation Design Criteria
	Appendix B	GE - Product Assurance Program Plan for the MOD-5A WTG Program
	Appendix C	GE - System Safety Plan for the MOD-5A Program
	Appendix D	GE - MOD-5A Configuration Management Plan
	Appendix E	GE - MOD-5A Defect Reports for Development Hardware
	Appendix F	GE - MOD-5A Program Quality Assurance Requirements for the Control of Raw Materials and the Blade Fabrication Process
	Appendix G	GE - Statement of Work for the Erection of the MOD-5A WTG Yaw, Nacelle and Blade Subsystems

Volume IV, Drawings and Specifications

This volume contains the numbered drawings and specifications for the final design of the MOD-5A wind turbine. The volume is divided into five books, as follows:

Book 1	47A380002 through 47A380030
Book 2	47A380031 through 47A380068
Book 3	47A380074 through 47A380126
Book 4	47A380128 through 47A387125
Book 5	47D381002 through 47D387130

Volume IV of the MOD-5A Wind Turbine Generator Program Design Report contains the drawings and specifications for the baseline configuration in ascending drawing number order. Due to binding limitations, this volume is presented in multiple books.

Each book contains a full breakdown parts listing, as well as "where-used" list. The first and last drawing number in each part is noted below to indicate in which part of Volume IV to locate a particular drawing.

Volume IV	First Drawing
Part 1	47A380002 through 47A380030
Part 2	47A380031 through 47A380068
Part 3	47A380074 through 47A380126
Part 4	47A380128 through 47A387125
Part 5	47D381002 through 47D387130

NOTES: Part numbers preceded by "**" or not starting with "47-" are either standard hardware, vendor numbers, or unissued drawings. These numbers appear on the parts lists, but are not included in the volume.

DRAWINGS AND SPECIFICATIONS

WTG - MOD 5A

DRAWING LIST

(NUMERICAL SEQUENCE)

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	ECN ---- OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47A380024	INSTL CABLING REQT				X		0000		EA	47E382304G1	X		001867
47A380030	SPEC,SYST DISP PNL				X		0000		EA	47E387112G1	X		001849
47A380046	CONT ELEK CAB SPEC				X		0000		EA	47E387062G1	X		000564
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47D387083G1	X		000663
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47D387089G1	X		001561
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47D387113G1	X		001774
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47D387121G1	X		000877
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47D387130G1	X		000914
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47E387027G1	X		001370
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47E387037G1	X		000701
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47E387062G1	X		000561
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47E387072G1	X		000777
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47E387084G1	X		001811
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47E387085G1	X		001636
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47E387091G1	X		001513
47A380052	ELECTRICAL FAB. STD				X	5	0000		EA	47E387095G1	X		000638
												00.000	
47A380067	CONT SYST U.P.S.SPEC				M		0000		EA	47E387081G1	01.000	01.000	001318
47A380068	30-KVA XFMR SPEC				M		0000		EA	47E387081G1	01.000	01.000	001316
47A380069P31	NAMEPLATE,IDENT (J1)				*		0000		EA	47E387027G1	01.000	01.000	001345
47A380069P31	NAMEPLATE,IDENT (J1)				*		0000		EA	47E387084G1	01.000	01.000	001822
47A380069P31	NAMEPLATE,IDENT (J1)				*		0000		EA	47E387085G1	01.000	01.000	001646
47A380069P31	NAMEPLATE,IDENT (J1)				*		0000		EA	47E387091G1	01.000	01.000	001524
												04.000	
47A380069P32	NAMEPLATE,IDENT (J2)				*		0000		EA	47E387084G1	01.000	01.000	001823
47A380069P32	NAMEPLATE,IDENT (J2)				*		0000		EA	47E387085G1	01.000	01.000	001647
47A380069P32	NAMEPLATE,IDENT (J2)				*		0000		EA	47E387091G1	01.000	01.000	001525
												03.000	
47A380069P33	NAMEPLATE,IDENT (J3)				B		0000		EA	47E387084G1	01.000	01.000	001824
47A380069P33	NAMEPLATE,IDENT (J3)				B		0000		EA	47E387091G1	01.000	01.000	001526
												02.000	
47A380069P52	NAMEPLATE, IDENT (TB*				*		0000		EA	47E387072G1	01.000	01.000	000782
47A380069P71	NAMEPLATE,IDENT(GND)				*		0000		EA	47E387027G1	01.000	01.000	001346
47A380070P3	NPL, AN/REV STATUS				*		0000		EA	47E387027G1	01.000	01.000	001348
47A380070P3	NPL, AN/REV STATUS				*		0000		EA	47E387062G1	01.000	01.000	000560
47A380070P3	NPL, AN/REV STATUS				*		0000		EA	47E387072G1	01.000	01.000	000677
47A380070P3	NPL, AN/REV STATUS				*		0000		EA	47E387084G1	01.000	01.000	001825
47A380070P3	NPL, AN/REV STATUS				*		0000		EA	47E387085G1	01.000	01.000	001648

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47A380070P3	NPL, AN/REV STATUS				*		0000		EA	47E387091G1	01.000	01.000	001527
47A380070P3	NPL, AN/REV STATUS				*		0000		EA	47E387095G1	01.000	01.000	000640
												07.000	
47A380071PAR	SLEEVING, SHRINK				*		0000		FT	47D387121G1		AR	000881
47A380071PAR	SLEEVING, SHRINK				*		0000		FT	47D387130G1		AR	000920
47A380071PAR	SLEEVING, SHRINK				*		0000		FT	47E387027G1		AR	001366
47A380071PAR	SLEEVING, SHRINK				*		0000		FT	47E387062G1		AR	000954
47A380071PAR	SLEEVING, SHRINK				*		0000		FT	47E387072G1		AR	000784
47A380071PAR	SLEEVING, SHRINK				*		0000		FT	47E387084G1		AR	001818
47A380071PAR	SLEEVING, SHRINK				*		0000		FT	47E387085G1		AR	001642
47A380071PAR	SLEEVING, SHRINK				*		0000		FT	47E387091G1		AR	001520
47A380071PAR	SLEEVING, SHRINK				*		0000		FT	47E387095G1		AR	000643
												00.000	
47A380094	7500KVA VAR SP GEN				X		0000		EA	47E387081G1		X	001864
47A380102	FINISH				X		0000		PT	47C387096G1		X	000827
47A380102	FINISH				X		0000		PT	47E387084G1		X	001847
												00.000	
47A380102P1	FINISH				M		0000		QT	47D387121G1		AR	000878
47A380102P1	FINISH				M		0000		QT	47D387130G1		AR	000917
												00.000	
47D381002P1	BEARING, YAW				M		0000		EA	47E382133G1	01.000	01.000	000025
47D381003P1	ACTUATOR,HYDRAULIC				M		0000		EA	47E382165G1	04.000	04.000	000032
47D381010P1	BRAKE ASSY				M		0000		EA	47E382165G1	08.000	08.000	000031
47D381010P2	BRAKE ASSY				M		0000		EA	47E382603G1	02.000	04.000	000218
47D381010P2	BRAKE ASSY				M		0000		EA	47E382603G2	02.000	04.000	000246
												08.000	
47E381017	YAW SR ELECT INTFC				X		0000		EA	47E382594G1		X	000109
47D381018	ELEC INTERFACE				X		0000		EA	47E382599G1		X	001236
47D381019P1	SLIP RNG UN YAW AXIS				M		0000		EA	47E382594G1	01.000	01.000	000108
47D381020P1	ROTOR SLIPRING UNIT				M		0000		EA	47E382599G1	01.000	01.000	001237
47D381024P1	ROTARY POSITION SR				M		0000		EA	47E382599G1	01.000	01.000	001252
47C381030P1	HINGE, TRAP DOOR				*		0000		EA	47D382430G1	01.000	02.000	000397
47C381030P1	HINGE, TRAP DOOR				*		0000		EA	47D382430G2	01.000	02.000	000405
47C381030P1	HINGE, TRAP DOOR				*		0000		EA	47D382474G1	01.000	01.000	000414
47C381030P1	HINGE, TRAP DOOR				*		0000		EA	47D382474G2	01.000	01.000	000422
												06.000	

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47C381036P1	BOLT,FATIGUE RATED				B		0000		EA	47E382363G1	14.000	14.000	000350
47C381036P10	BOLT,FATIGUE RATED				B		0000		EA	47E382363G1	12.000	12.000	000327
47C381036P10	BOLT,FATIGUE RATED				B		0000		EA	47E382496G1	08.000	08.000	001270
47C381036P10	BOLT,FATIGUE RATED				B		0000		EA	47E382608G1	60.000	60.000	001291
												80.000	
47C381036P14	BOLT,FATIGUE RATED				B		0000		EA	47E382602G1	16.000	16.000	000167
47C381036P14	BOLT,FATIGUE RATED				B		0000		EA	47E382603G1	12.000	24.000	000238
47C381036P14	BOLT,FATIGUE RATED				B		0000		EA	47E382603G2	12.000	24.000	000265
												64.000	
47C381036P15	BOLT,FATIGUE RATED				B		0000		EA	47E382165G1	36.000	36.000	000045
47C381036P16	BOLT,FATIGUE RATED				B		0000		EA	47E382165G1	12.000	12.000	000046
47C381036P2	BOLT,FATIGUE RATED				B		0000		EA	47E382363G1	32.000	32.000	000324
47C381036P2	BOLT,FATIGUE RATED				B		0000		EA	47E382602G1	20.000	20.000	000174
												52.000	
47C381036P20	BOLT, FATIGUE RATED				B		0000		EA	47D382598G1	08.000	08.000	000548
47C381036P20	BOLT, FATIGUE RATED				B		0000		EA	47E382363G1	88.000	88.000	000326
47C381036P20	BOLT, FATIGUE RATED				B		0000		EA	47E382597G1	120.000	120.000	000537
												216.000	
47C381036P21	BOLT				B		0000		EA	47E382608G1	08.000	08.000	001295
47C381036P22	BOLT,FATIGUE RATED				B		0000		EA	47D382598G1	08.000	08.000	000549
47C381036P24	BOLT,FATIGUE RATED				B		0000		EA	47D382598G1	08.000	08.000	000547
47C381036P24	BOLT,FATIGUE RATED				B		0000		EA	47E382441G1	36.000	36.000	000196
												44.000	
47C381036P25	BOLT,FATIGUE RATED				B		0000		EA	47E382363G1	36.000	36.000	000328
47C381036P26	BOLT,FATIGUE RATED				B		0000		EA	47E382363G1	12.000	12.000	000348
47C381036P26	BOLT,FATIGUE RATED				B		0000		EA	47E382607G1	96.000	96.000	001279
												108.000	
47C381036P3	BOLT,FATIGUE RATED				B		0000		EA	47E382496G1	84.000	84.000	001268
47C381036P32	BOLT				M		0000		EA	47E382133G1	144.000	144.000	000026
47C381036P4	BOLT,FATIGUE RATED				M		0000		EA	47E382306G1	20.000	20.000	000310
47C381036P40	BOLT, STRUCT. 2-12				M		0000		EA	47E382306G1	24.000	24.000	000307
47C381036P5	BOLT,FATIGUE RATED				B		0000		EA	47E382495G1	24.000	48.000	001267

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47C381036P50	BOLT				B		0000		EA	47E382553G1	36.000	36.000	000366
47C381036P6	BOLT,FATIGUE RATED				B		0000		EA	47E382363G1	60.000	60.000	000325
47C381036P6	BOLT,FATIGUE RATED				B		0000		EA	47E382602G1	20.000	20.000	000170
												80.000	
47A381037P1	LACING TAPE				*		0000		FT	47D387121G1	AR		000880
47A381037P1	LACING TAPE				*		0000		FT	47D387130G1	AR		000919
47A381037P1	LACING TAPE				*		0000		FT	47E387062G1	AR		000853
47A381037P1	LACING TAPE				*		0000		FT	47E387072G1	AR		000773
47A381037P1	LACING TAPE				*		0000		FT	47E387084G1	AR		001820
47A381037P1	LACING TAPE				*		0000		FT	47E387085G1	AR		001644
47A381037P1	LACING TAPE				*		0000		FT	47E387091G1	AR		001522
47A381037P1	LACING TAPE				*		0000		FT	47E387095G1	AR		000642
												00.000	
47A381038P3	TAPE,LACING				*		0000		FT	47E387027G1	AR		001367
47C381039P1	EXPANSION JOINT				M		0000		EA	47E382570G1	02.000	02.000	000519
47C381039P2	EXPANSION JOINT				M		0000		EA	47E382570G1	01.000	01.000	000520
47D381040P1	HEAT EXCHANGER				M		0000		EA	47E387062G1	02.000	02.000	000555
47A381043PAR	SLEEVING, VINYL				*		0000		FT	47E387062G1	AR		000955
47A381043PAR	SLEEVING, VINYL				*		0000		FT	47E387072G1	AR		000774
47A381043PAR	SLEEVING, VINYL				*		0000		FT	47E387095G1	AR		000629
												00.000	
47A381044PAR	SLEEVING,TEFLON				*		0000		FT	47D387089G1	AR		001383
47A381044PAR	SLEEVING,TEFLON				*		0000		FT	47D387121G1	AR		000868
47A381044PAR	SLEEVING,TEFLON				*		0000		FT	47D387130G1	AR		000921
47A381044PAR	SLEEVING,TEFLON				*		0000		FT	47E387084G1	AR		001819
47A381044PAR	SLEEVING,TEFLON				*		0000		FT	47E387085G1	AR		001643
47A381044PAR	SLEEVING,TEFLON				*		0000		FT	47E387091G1	AR		001521
												00.000	
47A381044P5	SLEEVING				B		0000		FT	47D387113G1	AR		001469
47A381045PAR	CLAMP,LOOP-CUSHIONED				M		0000		EA	47E387062G1	AR		000579
47A381045P3	CLAMP,CABLE (.187 DI*				*		0000		EA	47E387072G1	02.000	02.000	000743
47A381045P5	CABLE CLAMP				B		0000		EA	47E387084G1	03.000	03.000	001817
47A381045P5	CABLE CLAMP				B		0000		EA	47E387085G1	03.000	03.000	001641
47A381045P5	CABLE CLAMP				B		0000		EA	47E387091G1	03.000	03.000	001519
												09.000	
47A381045P6	CLAMP,CABLE (.375 DI*				*		0000		EA	47E387072G1	04.000	04.000	000744

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47E381046P1	GEARBOX ENVELOPE				B		0000		EA	47E382553G1	01.000	01.000	000364
47B381059P4	CONNECTOR CUTOUT COV*				*		0000		EA	47E387072G1	03.000	03.000	000680
47D381060P1	VIDEO MONITOR				M		0000		EA	47E387112G1	01.000	01.000	001327
47C381066P1	HOSE ASSY				M		0000		EA	47J382330G1	04.000	04.000	001126
47C381066P2	HOSE ASSY				M		0000		EA	47J382330G1	06.000	06.000	001125
47A381067P1	CTL PROCESSING UNIT				M		0000		EA	47E387095G1	01.000	01.000	000594
47A381067P10	120 VAC TRK OUT MDL				M		0000		EA	47E387062G1	47.000	47.000	000570
47A381067P11	12-BIT A/D CONVERTER				M		0000		EA	47E387095G1	02.000	02.000	000603
47A381067P12	12-BIT SS ANLG INPUT				M		0000		EA	47E387095G1	03.000	03.000	000604
47A381067P13	12-BIT ANALOG OUTPUT				M		0000		EA	47E387095G1	02.000	02.000	000605
47A381067P14	WATCHDOG TIMER				M		0000		EA	47E387095G1	01.000	01.000	000601
47A381067P15	ERROR DETECTOR				M		0000		EA	47E387095G1	01.000	01.000	000600
47A381067P16	POWER SUPPLY				M		0000		EA	47E387095G1	01.000	01.000	000591
47A381067P17	CHASSIS INTERFACE				M		0000		EA	47E387095G1	01.000	01.000	000595
47A381067P18	CHASSIS				M		0000		EA	47E387095G1	02.000	02.000	000592
47A381067P2	ARITH. PROCESSING				M		0000		EA	47E387095G1	01.000	01.000	000599
47A381067P20	FILLER BLANK				M		0000		EA	47E387095G1	15.000	15.000	000602
47A381067P23	CABLE, I/O TRACK				M		0000		EA	47E387062G1	01.000	01.000	000575
47A381067P3	16K EXECUTIVE MEMORY				M		0000		EA	47E387095G1	01.000	01.000	000596
47A381067P31	TERMINATOR PLUG				M		0000		EA	47E387062G1	01.000	01.000	000571
47A381067P4	12K PROM, 4K RAM MEM				M		0000		EA	47E387095G1	01.000	01.000	000598
47A381067P5	16K RAM MEMORY				M		0000		EA	47E387095G1	01.000	01.000	000597
47A381067P6	TTY & EIA INTFC MDL				M		0000		EA	47E387095G1	03.000	03.000	000606
47A381067P7	I/O SYS DRIVER MDL				M		0000		EA	47E387095G1	01.000	01.000	000607
47A381067P8	I/O TRACK				M		0000		EA	47E387062G1	08.000	08.000	000568

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47A381067P9	120 VAC TRK INP MDL				M		.0000		EA	47E387062G1	81.000	81.000	000569
47C381072P1	CLAMP UNIT				M		0000		EA	47J382330G1	04.000	04.000	001138
47C381072P2	CLAMP UNIT				M		0000		EA	47J382330G1	52.000	52.000	001137
47C381072P3	CLAMP UNIT				M		0000		EA	47C382336G1	01.000	38.000	001133
47C381072P3	CLAMP UNIT				M		0000		EA	47C382336G2	01.000	08.000	001136
47C381072P3	CLAMP UNIT				M		0000		EA	47C382336G3	01.000	06.000	001186
												52.000	
47B381074P1	HOSE ASSY				M		0000		EA	47J382313G1	02.000	02.000	000086
47C381075P1	HOSE ASSY				M		0000		EA	47J382313G1	04.000	04.000	000084
47C381075P2	HOSE ASSY				M		0000		EA	47J382313G1	04.000	04.000	000085
47D381078P1	HIGH SPEED SFT ASSY				B		0000		EA	47D382589G1	01.000	01.000	000372
47D381080P1	TPR RLR BRG,SPDL/AFT				M		0000	80657	EA	47E382441G1	01.000	01.000	000178
47D381081P1	TPR RLR BRG,SPDL/FWD				M		0000	80657	EA	47E382441G1	01.000	01.000	000179
47D381082P1	COUPLING HUB, FWD				*		0000		EA	47D382435G1	01.000	01.000	000210
47D381082P2	TORQUE PLATE				M		0000		EA	47E382441G1	01.000	01.000	000195
47C381083P1	COUPLING HUB, AFT				*		0000		EA	47D382435G1	01.000	01.000	000211
47C381084P1	VALVE,THERMO,AMOT				M		0000		EA	47E382579G1	01.000	01.000	000477
47C381086P1	VALVE,RELIEF,4-IN				M		.0000		EA	47E382579G1	01.000	01.000	000478
47C381087P1	NUT				M		0000		EA	47E382306G1	20.000	20.000	000311
47C381087P1	NUT				M		0000		EA	47E382610G1	28.000	56.000	001028
												76.000	
47C381087P10	LOCKNUT				B		0000		EA	47E382363G1	124.000	124.000	000331
47C381087P10	LOCKNUT				B		0000		EA	47E382608G1	08.000	08.000	001296
												132.000	
47C381087P13	NUT, FATIGUE RATED				B		0000		EA	47E382133G1	144.000	144.000	000027
47C381087P13	NUT, FATIGUE RATED				B		0000		EA	47E382597G1	120.000	120.000	000538
												264.000	
47C381087P18	NUT 2-12				M		0000		EA	47E382306G1	24.000	24.000	000308
47C381087P2	LOCKNUT				B		0000		EA	47E382363G1	92.000	92.000	000329
47C381087P2	LOCKNUT				B		0000		EA	47E382602G1	40.000	40.000	000173
												132.000	

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47C381087P22	LOCKNUT				B		0000		EA	47E382553G1	36.000	36.000	000368
47C381087P5	NUT				B		0000		EA	47E382441G1	360.000	360.000	000200
47C381087P5	NUT				B		0000		EA	47E382603G1	12.000	24.000	000239
47C381087P5	NUT				B		0000		EA	47E382603G2	12.000	24.000	000266
												408.000	
47C381087P6	LOCKNUT				B		0000		EA	47E382363G1	12.000	12.000	000330
47C381087P6	LOCKNUT				B		0000		EA	47E382608G1	60.000	60.000	001292
												72.000	
47C381087P9	NUT				B		0000		EA	47D382598G1	24.000	24.000	000546
47C381087P9	NUT				B		0000		EA	47E382363G1	12.000	12.000	000349
47C381087P9	NUT				B		0000		EA	47E382441G1	36.000	36.000	000198
47C381087P9	NUT				B		0000		EA	47E382607G1	96.000	96.000	001280
												168.000	
47C381088P1	WASHER, 1.00 DIA				M		0000		EA	47E382306G1	20.000	20.000	000319
47C381088P1	WASHER, 1.00 DIA				M		0000		EA	47E382363G1	92.000	92.000	000332
47C381088P1	WASHER, 1.00 DIA				M		0000		EA	47E382496G1	84.000	84.000	001269
47C381088P1	WASHER, 1.00 DIA				M		0000		EA	47E382602G1	40.000	40.000	000171
47C381088P1	WASHER, 1.00 DIA				M		0000		EA	47E382610G1	28.000	56.000	001029
												292.000	
47C381088P10	WASHER, 1.50 DIA				B		0000		EA	47D382598G1	24.000	24.000	000552
47C381088P10	WASHER, 1.50 DIA				B		0000		EA	47E382363G1	136.000	136.000	000346
47C381088P10	WASHER, 1.50 DIA				B		0000		EA	47E382607G1	96.000	96.000	001282
47C381088P10	WASHER, 1.50 DIA				B		0000		EA	47E382608G1	68.000	68.000	001298
												324.000	
47C381088P13	WASHER, HARDENED STL				B		0000		EA	47E382133G1	144.000	144.000	000028
47C381088P13	WASHER, HARDENED STL				B		0000		EA	47E382597G1	120.000	120.000	000540
												264.000	
47C381088P14	WASHER, HARDENED STL				B		0000		EA	47E382133G1	144.000	144.000	000029
47C381088P14	WASHER, HARDENED STL				B		0000		EA	47E382597G1	120.000	120.000	000539
												264.000	
47C381088P17	WASHER 2.00				M		0000		EA	47E382306G1	24.000	24.000	000318
47C381088P18	WASHER 2.00				B		0000		EA	47E382306G1	24.000	24.000	000309
47C381088P2	WASHER, 1.00 DIA				M		0000		EA	47E382306G1	20.000	20.000	000312
47C381088P2	WASHER, 1.00 DIA				M		0000		EA	47E382363G1	105.000	105.000	000345
47C381088P2	WASHER, 1.00 DIA				M		0000		EA	47E382602G1	40.000	40.000	000172
												165.000	
47C381088P21	WASHER				B		0000		EA	47E382553G1	36.000	36.000	000367

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47C381088P22	WASHER				B		0000		EA	47E382553G1	36.000	36.000	000369
47C381088P5	WASHER,1.25 DIA				B		0000		EA	47E382363G1	12.000	12.000	000333
47C381088P5	WASHER,1.25 DIA				B		0000		EA	47E382441G1	240.000	240.000	000201
47C381088P5	WASHER,1.25 DIA				B		0000		EA	47E382496G1	08.000	08.000	001271
47C381088P5	WASHER,1.25 DIA				B		0000		EA	47E382602G1	16.000	16.000	000168
												276.000	
47C381088P6	WASHER,1.25 DIA				B		0000		EA	47E382363G1	12.000	12.000	000347
47C381088P6	WASHER,1.25 DIA				B		0000		EA	47E382603G1	24.000	48.000	000242
47C381088P6	WASHER,1.25 DIA				B		0000		EA	47E382603G2	24.000	48.000	000270
												108.000	
47C381088P9	WASHER,1.50 DIA				M		0000		EA	47D382598G1	24.000	24.000	000545
47C381088P9	WASHER,1.50 DIA				M		0000		EA	47E382363G1	136.000	136.000	000334
47C381088P9	WASHER,1.50 DIA				M		0000		EA	47E382441G1	72.000	72.000	000197
47C381088P9	WASHER,1.50 DIA				M		0000		EA	47E382607G1	96.000	96.000	001281
47C381088P9	WASHER,1.50 DIA				M		0000		EA	47E382608G1	68.000	68.000	001293
												396.000	
47E381089P1	TRAILING EDGE INSTL				M		0000		EA	47E382590G1	02.000	02.000	001008
47E381089P2	TRAILING EDGE INSTL				M		0000		EA	47E382590G1	02.000	02.000	001009
47E381089P3	TRAILING EDGE INSTL				M		0000		EA	47E382590G1	02.000	02.000	001010
47D381090P1	INNER BLADE SECTION				M		0000		EA	47E382590G1	02.000	02.000	001006
47D381091P1	ICE DETECTOR				M		0000		EA	47E382469G1	02.000	04.000	001071
47E381093P1	BGR THRUST TEETER				M		0000		EA	47E382605G1	02.000	02.000	001198
47D381097P1	OUTER BLADE SECTION				M		0000		EA	47E382590G1	02.000	02.000	001007
47B381099PAR	WIRE,AWG 30,SLDRLESS				B		0000		FT	47D387113G1	AR		001776
47B381099PAR	WIRE,AWG 30,SLDRLESS				B		0000		FT	47E387037G1	AR		000698
												00.000	
47E381100P1	CABINET				M		0000		EA	47E387062G1	01.000	01.000	000554
47D381101P1	SHRINK DISC				M		0000		EA	47E382605G1	02.000	02.000	001200
47C381102P1	ROTOR SEAL FWD				M		0000	03668	EA	47E382441G1	02.000	02.000	000189
47C381103P1	ROTOR SEAL AFT				M		0000	03668	EA	47E382441G1	02.000	02.000	000190
47C381104P1	STUD				M		0000		EA	47E382441G1	120.000	120.000	000192
47C381104P2	STUD				M		0000		EA	47E382441G1	120.000	120.000	000193

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47E381105G1	BOLSTER ASSY				M		0000		EA	47E382590G1	01.000	01.000	000985
47B381106P1	"O" RING SEAL, AFT				M		0000		EA	47E382441G1	01.000	01.000	000181
47E381107P1	TROLLEY ASSY				M		0000		EA	47E382165G1	02.000	02.000	000034
47B381108P1	SENSOR, ROTOR SPEED				M		0000	81692	EA	47E382498G1	02.000	02.000	001276
47B381109P1	WSHR, BELLEVILLE SPR				B		0000	92830	EA	47E382441G1	120.000	120.000	000199
47C381110P1	SEAL, FWD, COUPLING				M		0000		EA	47E382601G1	04.000	04.000	000214
47C381111P1	BELLOWS JOINT				M		0000		EA	47E382599G1	01.000	01.000	001238
47E381112G1	FOUNDATION REQT				M		0000		EA	47E382297G1	01.000	01.000	000006
47E381112P1	FOUNDATION ASSEMBLY				M		0000		EA	47E381112G1	01.000	01.000	000007
47E381112P10	#11 REINFORCING ROD				M		0000		FT	47E381112G1	AR		000016
47E381112P3	NUT				B		0000		EA	47E381112G1	192.000	192.000	000009
47E381112P5	RECT. WIREWAY				M		0000		EA	47E381112G1	03.000	03.000	000011
47E381112P6	CONDUIT SECTION				M		0000		EA	47E381112G1	01.000	01.000	000012
47E381112P7	CONDUIT SECTION				M		0000		EA	47E381112G1	02.000	02.000	000013
47E381112P8	CONDUIT SECTION				M		0000		EA	47E381112G1	01.000	01.000	000014
47E381112P9	#09 REINFORCING ROD				M		0000		FT	47E381112G1	AR		000015
47E381113P1	FAIRING ENVELOPE				B		0000		EA	47D382606G1	01.000	01.000	000378
47D381114P1	BRG,RADIAL-TEETER				M		0000		EA	47E382583G1	01.000	02.000	001195
47C381115P1	ACTUATOR				B		0000		EA	47E382610G1	06.000	12.000	001025
47D382000	TOWER GEOMETRY/DIAG				X		0000		EA	47E382304G1	X		001873
47C382020	LUBRICATION SCHEM				X		0000		EA	47E382570G1	X		000535
47E382045	GEOMETRY ENVELOPE				X		0000		EA	47E382304G1	X		001307
47E382050P1	YAW HSG STRUCT,UPPER				M		0000		EA	47E382133G1	01.000	01.000	000023
47B382131P1	ENCLOSURE, DOOR				*		0000		EA	47D382430G1	01.000	02.000	000396
47B382131P1	ENCLOSURE, DOOR				*		0000		EA	47D382430G2	01.000	02.000	000404
47B382131P1	ENCLOSURE, DOOR				*		0000		EA	47D382474G1	01.000	01.000	000413

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47B382131P1	ENCLOSURE, DOOR				*		0000		EA	47D382474G2	01.000	01.000 06.000	000421
47E382133G1	YAW STRUCTURE ASSY				M		0000		EA	47D382593G1	01.000	01.000	000022
47E382165G1	YAW DRIVE INSTL				M		0000		EA	47D382593G1	01.000	01.000	000030
47C382181P1	TRACK MTG BRACKET				M		0000		EA	47E382165G1	04.000	04.000	000033
47C382181P2	TRACK, MTG BRACKET				M		0000		EA	47E382165G1	02.000	02.000	000063
47D382192P1	BRAKE MTG PLATE				M		0000		EA	47E382165G1	02.000	02.000	000041
47B382193P1	PIN, CLEVIS - BRAKE				M		0000		EA	47E382165G1	04.000	04.000	000044
47B382196P1	SPACER, CLEVIS BLOCK				M		0000		EA	47E382165G1	04.000	04.000	000061
47B382196P2	SPCR,ACTUATOR CLEVIS				M		0000		EA	47E382165G1	08.000	08.000	000062
47D382198P1	CLEVIS BLOCK				M		0000		EA	47E382165G1	02.000	02.000	000042
47D382198P2	CLEVIS BLOCK				M		0000		EA	47E382165G1	02.000	02.000	000064
47B382200P1	RETAINER, PIN				M		0000		EA	47E382165G1	04.000	04.000	000043
47E382219P1	YAW HSG STRUCT,LOWER				M		0000		EA	47E382133G1	01.000	01.000	000024
47C382234P1	GASKET				M		0000		EA	47E387062G1	02.000	02.000	000565
47B382248P1	AIR BAF, RIGHT SIDE				M		0000		EA	47E387062G1	01.000	01.000	000573
47B382248P2	AIR BAF, LEFT SIDE				M		0000		EA	47E387062G1	01.000	01.000	000574
47E382264P1	SIDE SUPPORT,WLDMT				M		0000		EA	47E382363G1	01.000	01.000	000361
47E382265P1	SIDE SUPPORT				M		0000		EA	47E382363G1	01.000	01.000	000320
47E382265P2	SIDE SUPPORT				M		0000		EA	47E382363G1	01.000	01.000	000321
47E382271P1	ROTOR ADAPTER,WLDMT				M		0000		EA	47E382363G1	01.000	01.000	000362
47E382272P1	ROTOR ADAPTER STRL				M		0000		EA	47E382363G1	01.000	01.000	000323
47D382274	NACELLE GEOMETRY				X		0000		EA	47E382304G1	X		001874
47B382277P1	DRIP TROUGH				M		0000		EA	47E382165G1	02.000	02.000	000069
47B382277P2	DRIP TROUGH				M		0000		EA	47E382165G1	02.000	02.000	000070

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47C382278P1	MANIFOLD FITTING				M		0000		EA	47E382165G1	02.000	02.000	000065
47A382285	PROFILE COORDINATES				X		0000		EA	47E382590G1	X		001228
47J382287P1	CENTER BLADE SECT				M		0000		EA	47E382590G1	01.000	01.000	000984
47D382288	GENERAL SITE LCTN				X		0000		EA	47E382304G1	X		001870
47D382296P1	LOW SPEED SHAFT				*		0000		EA	47D382435G1	01.000	01.000	000209
47E382297G1	TWR/FOUNDATION INSTL				M		0000		EA	47D382356G1	01.000	01.000	000003
47E382297P7	GROUT				M		0000		LB	47E382297G1	AR		000020
47D382298	SITE PLAN-1ST UNIT				X		0000		EA	47E382304G1	X		001871
47E382301P1	BOLSTER				M		0000		EA	47E381105G1	02.000	02.000	000986
47E382303P1	TWR/ FDN PLATF REQT				M		0000		EA	47E382297G1	01.000	01.000	000017
47E382304G1	WTG ASSY, MOD-5A	1			M		0000		EA			01.000	000001
47E382306G1	BED PL.,MACH.&DRILL.	01			M		0000		EA	47E382363G1	01.000	01.000	000304
47J382313G1	HYDR PIPING, YAW DR				M		0000		EA	47D382593G1	01.000	01.000	000075
47E382314	HYDRAULIC SYS SCHEM				X		0000		EA	47J382313G1	X		000105
47J382330G1	BLADE HYDRAULIC INST				M		0000		EA	47E382590G1	01.000	01.000	001122
47J382330P1	TUBING HYDRAULIC				M		0000		FT	47J382330G1	720.000	720.000	001123
47J382330P2	TUBING HYDRAULIC				M		0000		FT	47J382330G1	480.000	480.000	001124
47E382333P1	SPINDLE SHAFT				M		0000		EA	47E382441G1	01.000	01.000	000177
47E382334P1	TIP,BLADE				M		0000		EA	47E382582G1	02.000	04.000	001053
47C382335P1	TUBE ADAPTER				M		0000		EA	47J382330G1	04.000	04.000	001140
47C382335P2	TUBE ADAPTER				M		0000		EA	47J382330G1	06.000	06.000	001139
47C382336G1	BRKT,CLAMP MODIFIED				M		0000		EA	47J382330G1	38.000	38.000	001131
47C382336G2	BRKT,CLAMP MODIFIED				M		0000		EA	47J382330G1	08.000	08.000	001134
47C382336G3	BRKT,CLAMP				M		0000		EA	47J382330G1	06.000	06.000	001184
47C382336P1	BRACKET,ANGLE				M		0000		EA	47C382336G1	02.000	76.000	001132

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47C382336P1	BRACKET,ANGLE				M		0000		EA	47C382336G2	02.000	16.000	001135
47C382336P1	BRACKET,ANGLE				M		0000		EA	47C382336G3	02.000	12.000	001185
												104.000	
47C382337P1	ADAPTER,TUBE				M		0000		EA	47J382330G1	12.000	12.000	001145
47B382338P1	STUD,MOUNTING				M		0000		EA	47J382330G1	10.000	10.000	001142
47C382349P1	SLEEVE,SPLIT				M		0000		EA	47J382330G1	150.000	150.000	001149
47C382349P2	SLEEVE,SPLIT				M		0000		EA	47J382330G1	100.000	100.000	001150
47C382350P1	TEETER SPRT OUTER				M		0000		EA	47C382551G2	01.000	04.000	001000
47C382351P1	TEETER SPRT INNER				M		0000		EA	47C382551G1	01.000	04.000	000996
47D382352G1	TEETER ARM ASSY				M		0000		EA	47E382605G1	04.000	04.000	001204
47D382352P1	TEETER ARM				M		0000		EA	47D382352G1	01.000	04.000	001205
47D382352P2	RETAINING RING				M		0000		EA	47D382352G1	01.000	04.000	001206
47C382353P1	TEETER SUPPORT PIN				M		0000		EA	47E382605G1	04.000	04.000	001210
47E382355P1	TWR STRUCTURE ASSY				M		0000		EA	47E382297G1	01.000	01.000	000004
47D382356G1	TOWER ASSY, WTG				M		0000		EA	47E382304G1	01.000	01.000	000002
47E382357G1	BRACKET,INBOARD				M		0000		EA	47J382330G1	02.000	02.000	001127
47E382357P1	BRACKET				M		0000		EA	47E382357G1	01.000	02.000	001128
47D382358P1	BRKT,OUTBOARD				M		0000		EA	47J382330G1	02.000	02.000	001130
47C382359P1	PLATE				M	M	0000		EA	47J382330G1	04.000	04.000	001165
47C382360G1	SUPPORT,HOSE				M		0000		EA	47J382330G1	02.000	02.000	001160
47C382360P1	PLATE				M		0000		EA	47C382360G1	01.000	02.000	001161
47C382360P2	PAD				M		0000		EA	47C382360G1	01.000	02.000	001162
47D382361G1	BASE,HOSE SUPPORT				M		0000		EA	47J382330G1	02.000	02.000	001155
47D382361P1	PLATE				M		0000		EA	47D382361G1	01.000	02.000	001156
47D382361P2	PAD				M		0000		EA	47D382361G1	01.000	02.000	001157
47E382363G1	NACELLE STRUCT ASSY	1			M		0000		EA	47E382597G1	01.000	01.000	000303

IDENTIFICATION NO.	NOMENCLATURE	--- ECN --- DWG INC	DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47D382372P1	RTR BRG RETAINER,FWD				M		0000		EA	47E382441G1	01.000	01.000	000184
47B382373P1	SPACER				M		0000		EA	47J382330G1	08.000	08.000	001166
47B382373P2	SPACER				M		0000		EA	47J382330G1	08.000	08.000	001167
47B382373P3	SPACER				M		0000		EA	47J382330G1	08.000	08.000	001168
47C382390P1	PLUG, SHAFT TEETER				M		0000		EA	47D382397G1	02.000	02.000	000992
47B382396P1	SHIM,BRG				M		0000		EA	47E382605G1	02.000	02.000	001199
47B382396P1	SHIM,BRG				X		0000		EA	47E382608G1	X	02.000	001290
47D382397G1	TEETER PVT SFT ASSY				M		0000		EA	47D382550G1	01.000	01.000	000990
47D382397P1	TEETER PIVOT SHAFT				M		0000		EA	47D382397G1	01.000	01.000	000991
47B382398P1	SPACER				M		0000		EA	47E382413G1	AR		001082
47C382399P1	BLOCK,BALLAST				M		0000		EA	47E382413G1	96.000	96.000	001080
47E382400G1	LIGHTING PROT INSTL				M		0000		EA	47E382590G1	02.000	02.000	001106
47E382400P3	LIGHTING STRIP				M		0000		FT	47E382400G1	AR		001109
47E382400P4	SPLICE PLATE				M		0000		EA	47E382400G1	16.000	32.000	001110
47E382400P6	SHIM				M		0000		EA	47E382400G1	02.000	04.000	001112
47B382401P1	STUD				M		0000		EA	47E382413G1	32.000	32.000	001081
47E382403P1	INSERT,BOLSTER				M		0000		EA	47C382552G1	01.000	02.000	001004
47D382406	GEOMETRY DWG				X		0000		EA	47E382590G1	X		001225
47E382407P1	LOW SP BK SPRT BRKT				M		0000		EA	47E382495G1	01.000	02.000	001255
47E382413G1	BALLAST INSTL				M		0000		EA	47E382590G1	01.000	01.000	001079
47B382419P1	WASHER				B		0000		EA	47E382165G1	96.000	96.000	000050
47B382420P1	JAM NUT				B		0000		EA	47E382165G1	04.000	04.000	000056
47E382429P1	BED PL. STRUCT. WELD				M		0000		EA	47E382306G1	01.000	01.000	000305
47D382430G1	TRAP DR, BEDPL / TWR				M		0000		EA	47E382472G1	02.000	02.000	000389
47D382430G2	TRAP DR, BEDPL / TWR				M		0000		EA	47E382472G1	02.000	02.000	000398

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47D382430P1	COVER				M		0000		EA	47D382430G1	01.000	02.000	000390
47D382430P1	COVER				M		0000		EA	47D382430G2	01.000	02.000	000399
												04.000	
47D382430P2	ANGLE				M		0000		EA	47D382430G1	02.000	04.000	000391
47D382430P2	ANGLE				M		0000		EA	47D382430G2	02.000	04.000	000400
												08.000	
47D382430P3	ANGLE				M		0000		EA	47D382430G1	02.000	04.000	000392
47D382430P3	ANGLE				M		0000		EA	47D382430G2	02.000	04.000	000401
												08.000	
47D382430P4	RIB				M		0000		EA	47D382430G1	02.000	04.000	000393
47D382430P4	RIB				M		0000		EA	47D382430G2	02.000	04.000	000402
												08.000	
47D382430P5	PLATE				M		0000		EA	47D382430G1	01.000	02.000	000394
47D382430P6	BAR				M		0000		EA	47D382430G1	01.000	02.000	000395
47D382430P6	BAR				M		0000		EA	47D382430G2	01.000	02.000	000403
												04.000	
47D382435G1	LOW SPEED SHAFT ASSY				*		0000		EA	47E382601G1	01.000	01.000	000208
47C382436P1	SEAL RTNR, COUPLING				M		0000		EA	47E382601G1	02.000	02.000	000212
47C382437P1	SEAL PL, FWD CPLG				M		0000		EA	47E382601G1	06.000	06.000	000213
47E382440	SCHEM ROTOR HYDR SYS				X		0000		EA	47E382590G1	X		001227
47E382441G1	YOKE / SPINDLE ASSY				M		0000		EA	47E382601G1	01.000	01.000	000159
47E382450P1	GEARBOX MTG. STRUCT.				M		0000		EA	47E382306G1	01.000	01.000	000306
47B382454P1	ANTI-ROTATION PIN				M		0000		EA	47E382441G1	02.000	02.000	000183
47D382455P1	DISC, RTR SPEED SNSR				M		0000		EA	47E382441G1	01.000	01.000	000191
47D382456P1	RTR SEAL RTNR, AFT				M		0000		EA	47E382441G1	01.000	01.000	000182
47D382457P1	LOW SPEED BRAKE DISC				M		0000		EA	47E382441G1	01.000	01.000	000185
47C382458P1	RETAINER, AFT				M		0000		EA	47E382441G1	06.000	06.000	000180
47E382460	BLADE TOLERANCE DWG				X		0000		EA	47E382590G1	X		001226
47D382461P1	LOW SPEED BRAKE				M		0000		EA	47E382495G1	04.000	08.000	001256
47C382463G1	RING, MOUNTING				M		0000		EA	47C382464G1	02.000	08.000	001067

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47C382463P1	RING, MOUNTING				M		0000		EA	47C382463G1	02.000	08.000	001068
47C382464G1	RING & HOUSING ASSY				M		0000		EA	47E382469G1	02.000	04.000	001066
47C382464G1	RING & HOUSING ASSY				M		0000		EA	47E382469G2	02.000	04.000	001097
												08.000	
47D382465P1	FRAME,TRAP DOOR				M		0000		EA	47E382472G1	02.000	02.000	000423
47B382467P1	RETAINER				M		0000		EA	47E382469G1	02.000	04.000	001072
47B382467P2	RETAINER / COVER				M		0000		EA	47E382469G1	02.000	04.000	001075
47B382467P2	RETAINER / COVER				M		0000		EA	47E382469G2	02.000	04.000	001103
												08.000	
47B382468P1	GASKET				M		0000		EA	47E382469G1	02.000	04.000	001073
47E382469G1	ICE DETECTOR INSTL				M		0000		EA	47E382590G1	02.000	02.000	001065
47E382469G2	ICE DETECTOR INSTL				M		0000		EA	47E382590G1	02.000	02.000	001096
47B382470P1	GASKET, COVER				M		0000		EA	47E382469G1	02.000	04.000	001078
47B382470P1	GASKET, COVER				M		0000		EA	47E382469G2	02.000	04.000	001105
												08.000	
47E382472G1	LAD & FALSE FL INSTL				M		0000		EA	47E382597G1	01.000	01.000	000388
47E382472P11	SEALING STRIP				M		0000		EA	47E382472G1	AR		000429
47E382472P8	ROOF SCUTTLE				B		0000		EA	47E382472G1	01.000	01.000	000426
47D382474G1	TRAP DR,BEDPL / LUBE				M		0000		EA	47E382472G1	01.000	01.000	000406
47D382474G2	TRAP DR,BEDPL / LUBE				M		0000		EA	47E382472G1	01.000	01.000	000415
47D382474P1	COVER				M		0000		EA	47D382474G1	01.000	01.000	000407
47D382474P1	COVER				M		0000		EA	47D382474G2	01.000	01.000	000416
												02.000	
47D382474P2	ANGLE				M		0000		EA	47D382474G1	02.000	02.000	000408
47D382474P2	ANGLE				M		0000		EA	47D382474G2	02.000	02.000	000417
												04.000	
47D382474P3	ANGLE				M		0000		EA	47D382474G1	02.000	02.000	000409
47D382474P3	ANGLE				M		0000		EA	47D382474G2	02.000	02.000	000418
												04.000	
47D382474P4	RIB				M		0000		EA	47D382474G1	02.000	02.000	000410
47D382474P4	RIB				M		0000		EA	47D382474G2	02.000	02.000	000419
												04.000	

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47D382474P5	PLATE				M		0000		EA	47D382474G1	01.000	01.000	000411
47D382474P6	BAR				M		0000		EA	47D382474G1	01.000	01.000	000412
47D382474P6	BAR				M		0000		EA	47D382474G2	01.000	01.000 02.000	000420
47C382475P1	MOUNTING BLOCK				M		0000		EA	47E382472G1	02.000	02.000	000424
47B382480P1	BRACKET, SENSOR				M		0000		EA	47E382498G1	02.000	02.000	001275
47C382485P1	LIFTING,BRKT				M		0000		EA	47D382598G1	02.000	02.000	000543
47E382486P1	SIDE SUPPORT				M		0000		EA	47E382599G1	01.000	01.000	001235
47E382488P1	PRE-LOAD FIXTURE				M		0000		EA	47E382605G1	02.000	02.000	001213
47E382491G1	AIR DUCT UNIT				M		0000		EA	47E387062G1	02.000	02.000	000556
47D382492P1	NUT PLATE				M		0000		EA	47E382495G1	01.000	02.000	001259
47D382492P2	NUT PLATE				M		0000		EA	47E382495G1	02.000	04.000	001258
47D382492P3	NUT PLATE				M		0000		EA	47E382495G1	01.000	02.000	001260
47D382492P4	NUT PLATE				M		0000		EA	47E382495G1	02.000	04.000	001257
47D382493P1	NUT PLATE				M		0000		EA	47E382495G1	02.000	04.000	001262
47D382493P2	NUT PLATE				M		0000		EA	47E382495G1	01.000	02.000	001263
47D382493P3	NUT PLATE				M		0000		EA	47E382495G1	02.000	04.000	001261
47B382494P1	NUT PLATE				M		0000		EA	47E382495G1	08.000	16.000	001264
47E382495G1	LOW SP BK SPRT ASSY				M		0000		EA	47E382496G1	02.000	02.000	001254
47E382496G1	LOW SPEED BRAKE INST				M		0000		EA	47E382607G1	01.000	01.000	001253
47E382498G1	RTR SPEED SNSR INSTL				M		0000		EA	47E382607G1	01.000	01.000	001274
47C382499P1	TOWER ACCESS DOOR				M		0000		EA	47E382297G1	01.000	01.000	000005
47D382550G1	SFT,TEETER BRG ASSY				M		0000		EA	47E381105G1	01.000	01.000	000987
47D382550P1	CLOTH,FIBERGLASS				M		0000		FT	47D382550G1	AR		000988
47D382550P2	ADHESIVE				M		0000		OZ	47D382550G1	AR		000989
47C382551G1	TEETER RESTR ASSY				M		0000		EA	47E381105G1	04.000	04.000	000993

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47C382551G2	TEETEER RESTR ASSY				M		0000		EA	47E381105G1	04.000	04.000	000997
47C382551P1	CLOTH, FIBERGLASS				M		0000		FT	47C382551G1	AR		000994
47C382551P1	CLOTH, FIBERGLASS				M		0000		FT	47C382551G2	AR		000998
												00.000	
47C382551P2	ADHESIVE, EPOXY				M		0000		OZ	47C382551G1	AR		000995
47C382551P2	ADHESIVE, EPOXY				M		0000		OZ	47C382551G2	AR		000999
												00.000	
47C382552G1	BOLSTER INSR ASSY				M		0000		EA	47E381105G1	02.000	02.000	001001
47C382552P1	CLOTH,FIBERGLASS				M		0000		FT	47C382552G1	AR		001002
47C382552P2	ADHESIVE				M		0000		OZ	47C382552G1	AR		001003
47E382553G1	GEARBOX INSTALLATION				M		0000		EA	47E382597G1	01.000	01.000	000363
47D382554P1	FLOORING, BEDPLATE				M		0000		EA	47E382306G1	01.000	01.000	000313
47D382555P1	LIFTING BRKT				M		0000		EA	47D382598G1	02.000	02.000	000544
47E382556G1	GEARBOX/CLG PLATFORM				M		0000		EA	47E382579G1	01.000	01.000	000444
47E382556P1	ANGLE,4 X 4 X 3/8				M		0000		EA	47E382556G1	04.000	04.000	000445
47E382556P10	SIDE PLATE 4.0 HT				M		0000		EA	47E382556G1	02.000	02.000	000454
47E382556P11	ANGLE,3 X 3 X 3/8				M		0000		EA	47E382556G1	04.000	04.000	000455
47E382556P12	ANGLE,3 X 3 X 3/8				M		0000		EA	47E382556G1	04.000	04.000	000456
47E382556P13	ANGLE,3 X 3 X 3/8				M		0000		EA	47E382556G1	02.000	02.000	000457
47E382556P14	ANGLE,3 X 3 X 3/8				M		0000		EA	47E382556G1	02.000	02.000	000458
47E382556P2	CHANNEL,8-20 LB				M		0000		EA	47E382556G1	02.000	02.000	000446
47E382556P3	CHANNEL,6-16.3 LB				M		0000		EA	47E382556G1	04.000	04.000	000447
47E382556P4	ANGLE,3X3-7.2 LB				M		0000		EA	47E382556G1	04.000	04.000	000448
47E382556P5	CHANNEL,8-20 LB				M		0000		EA	47E382556G1	04.000	04.000	000449
47E382556P6	9-IN X 2 1/2 DP DECK				M		0000		EA	47E382556G1	14.000	14.000	000450
47E382556P7	6-IN X 2 1/2 DP DECK				M		0000		EA	47E382556G1	01.000	01.000	000451
47E382556P8	9-IN X 2 1/2 DP DECK				M		0000		EA	47E382556G1	01.000	01.000	000452

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47E382556P9	END PLATE 4.0 HT				M		0000		EA	47E382556G1	02.000	02.000	000453
47C382557P1	ROTOR BRG SHIM				M		0000		EA	47E382441G1	04.000	04.000	000186
47B382558P1	INSERT, BRAKE DISC				M		0000		EA	47E382441G1	120.000	120.000	000187
47C382559P1	RTR SEAL RTNR, FWD				M		0000		EA	47E382441G1	01.000	01.000	000188
47C382560P1	PLUG, TORQUE PLATE				M		0000		EA	47E382441G1	02.000	02.000	000194
47D382563G1	TORQUE PLATE ASSY				M		0000		EA	47E382165G1	04.000	04.000	000035
47D382563P1	TORQUE PLATE				M		0000		EA	47D382563G1	01.000	04.000	000036
47B382564P1	BEARING ANGLE				M		0000		EA	47D382563G1	02.000	08.000	000037
47E382570G1	LUBE PLATFORM INSTL				M		0000		EA	47E382597G1	01.000	01.000	000442
47E382570P10	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000513
47E382570P11	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000514
47E382570P12	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000515
47E382570P13	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000516
47E382570P4	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000507
47E382570P5	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000508
47E382570P6	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000509
47E382570P7	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000510
47E382570P8	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000511
47E382570P9	PIPE ASSY				M		0000		EA	47E382570G1	01.000	01.000	000512
47E382571	LIFT REQT. TWR CMPNT				X		0000		EA	47D382356G1	X		000157
47D382572P1	SPACER,ADAPTER				M		0000		EA	47E382363G1	01.000	01.000	000338
47D382572P2	SPACER,ADAPTER				M		0000		EA	47E382363G1	01.000	01.000	000339
47D382572P3	SPACER,ADAPTER				M		0000		EA	47E382363G1	01.000	01.000	000340
47D382572P4	SPACER,ADAPTER				M		0000		EA	47E382363G1	01.000	01.000	000341
47D382572P5	SPACER,SIDE SUPPORT				M		0000		EA	47E382363G1	04.000	04.000	000342

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47D382572P6	SPACER,SIDE SUPPORT				M		0000		EA	47E382363G1	02.000	02.000	000343
47D382572P7	SPACER,SIDE SUPPORT				M		0000		EA	47E382363G1	02.000	02.000	000344
47D382574P1	TOP,STRL,FWD,WLDMT				M		0000		EA	47E382363G1	01.000	01.000	000360
47D382575P1	TOP STRUCTURE FWD				M		0000		EA	47E382363G1	01.000	01.000	000336
47D382576P1	TOP,STRL,AFT,WLDMT				M		0000		EA	47E382363G1	01.000	01.000	000359
47D382577P1	TOP STRUCTURE,AFT				M		0000		EA	47E382363G1	01.000	01.000	000322
47E382578P1	CRANE,MOUNTING STRL				M		0000		EA	47E382363G1	01.000	01.000	000337
47E382579G1	COOLING PLATFORM ASM				M		0000		EA	47E382570G1	01.000	01.000	000443
47E382579P16	PIPE,SCHED 40,5-IN				M		0000		FT	47E382579G1	07.000	07.000	000483
47E382579P18	PIPE,SCHED 40				M		0000		FT	47E382579G1	90.000	90.000	000485
47E382579P24	PIPE,SCHED 40,3IN				M		0000		FT	47E382579G1	05.000	05.000	000491
47B382580P1	SEAL,TOP STRUCTURE				M		0000		EA	47E382363G1	01.000	01.000	000351
47B382580P2	SEAL,TOP STRUCTURE				M		0000		EA	47E382363G1	01.000	01.000	000353
47B382580P3	SEAL,TOP STRUCTURE				M		0000		EA	47E382363G1	02.000	02.000	000354
47E382581P1	HUB, BRG - TEETER				M		0000		EA	47E382583G1	01.000	02.000	001196
47E382582G1	BLADE TIP ATCH ASSY				M		0000		EA	47E382590G1	02.000	02.000	001051
47E382582P10	ADHESIVE,EPOXY				B		0000		PT	47E382582G1	AR		001061
47E382582P11	GLASSFIBER CLOTH				B		0000		FT	47E382582G1	AR		001062
47E382583G1	TEETER HUB/BRG ASSY				M		0000		EA	47E382605G1	02.000	02.000	001194
47E382583P3	DOWEL PIN				M		0000		EA	47E382583G1	03.000	06.000	001197
47C382584G1	MOT/PUMP/CLR PLATF				M		0000		EA	47E382579G1	01.000	01.000	000464
47C382584P1	PLATE,BASE				M		0000		EA	47C382584G1	01.000	01.000	000465
47C382584P2	BEAM,4 W 13#				M		0000		EA	47C382584G1	02.000	02.000	000466
47C382584P3	BEAM,6 W 9#				M		0000		EA	47C382584G1	02.000	02.000	000467
47B382585P1	ANCHOR STUD				M		0000		EA	47E381112G1	96.000	96.000	000008

IDENTIFICATION NO.	NOMENCLATURE	--- ECN --- DWG INC	OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47B382586P1	ANCHOR PLATE				M		0000		EA	47E381112G1	48.000	48.000	000010
47D382587P1	FLOATING MT BRACKET				M		0000		EA	47E382592G1	04.000	04.000	000152
47D382588P1	CROSS SPRT TOP STRL				M		0000		EA	47E382363G1	01.000	01.000	000352
47D382589G1	GEN & HS SFT INSTL				M		0000		EA	47E382597G1	01.000	01.000	000370
47E382590G1	ROTOR BLADE ASSY				M		0000		EA	47E382304G1	01.000	01.000	000983
47E382590P12	FIBERGLASS,CLOTH				B		0000		EA	47E382590G1	AR		001095
47E382590P23	ADHESIVE,EPOXY				B		0000		PT	47E382590G1	AR		001191
47D382591P1	STRUCTURE FRAME UNIT				M		0000		EA	47E382592G1	04.000	04.000	000149
47E382592G1	PERS ELEV/SUPT INSTL				M		0000		EA	47D382356G1	01.000	01.000	000146
47E382592P5	ANGLE SECTION				M		0000		EA	47E382592G1	20.000	20.000	000151
47D382593G1	YAW S/S ASSY				M		0000		EA	47D382356G1	01.000	01.000	000021
47E382594G1	YAW SLIP RING INSTL				M		0000		EA	47D382593G1	01.000	01.000	000107
47E382595G1	TWR PLATFORM INSTL				M		0000		EA	47D382356G1	01.000	01.000	000127
47D382596G1	AUX CRANE INSTL				M		0000		EA	47E382597G1	01.000	01.000	000373
47E382597G1	NACELLE OVERALL ASSY	1			M		0000		EA	47E382304G1	01.000	01.000	000302
47E382597G1	NACELLE OVERALL ASSY	1			X		0000		EA	47E382607G1	X	01.000	001230
47D382598G1	LFT BRACKETS INSTL				M		0000		EA	47E382597G1	01.000	01.000	000542
47D382598P8	SPACER,STA 227.5				M		0000		EA	47D382598G1	04.000	04.000	000550
47D382598P9	SPACER,STA 227.5				M		0000		EA	47D382598G1	02.000	02.000	000551
47E382599G1	SLIP RING INST				M		0000		EA	47E382607G1	01.000	01.000	001232
47E382599P10	CONDUIT 1.50 DIA				M		0000		EA	47E382599G1	06.000	06.000	001242
47E382599P19	ANGLES				M		0000		EA	47E382599G1	02.000	02.000	001251
47E382599P9	CONDUIT 2.00 DIA				M		0000		EA	47E382599G1	03.000	03.000	001241
47E382600P1	YOKE STRL,WELDMENT				M		0000		EA	47E382602G1	01.000	01.000	000161
47E382601G1	YOKE ASSY				M		0000		EA	47E382304G1	01.000	01.000	000158

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47E382601G1	YOKE ASSY				X		0000		EA	47E382607G1	X	01.000	001231
47E382601P27	GREASE				B		0000		LB	47E382601G1	AR		000300
47E382602G1	MACHINING ASSY, YOKE				M		0000		EA	47E382441G1	01.000	01.000	000160
47E382602P16	YOKE BRG CAP MACH				X		0000		EA	47E382602G1	X		000176
47E382602P2	YOKE BRG CAP				M		0000		EA	47E382605G1	02.000	02.000	001193
47E382602P3	BRACKET				M		0000		EA	47E382602G1	06.000	06.000	000163
47E382602P4	BRACKET				M		0000		EA	47E382602G1	01.000	01.000	000164
47E382602P5	BRACKET				M		0000		EA	47E382602G1	01.000	01.000	000165
47E382603G1	TEETER RSTR BK ASSY				M		0000		EA	47E382601G1	02.000	02.000	000215
47E382603G2	TEETER RSTR BK ASSY				M		0000		EA	47E382601G1	02.000	02.000	000243
47D382604G1	SHAFT ALIGNMENT FTG				M		0000		EA	47E382601G1	04.000	04.000	000288
47D382604P1	SHOE				M		0000		EA	47D382604G1	01.000	04.000	000289
47D382604P2	ADJUSTING SCREW				M		0000		EA	47D382604G1	01.000	04.000	000290
47D382604P3	BRACKET				M		0000		EA	47D382604G1	01.000	04.000	000291
47D382604P4	PIN,6.00-LG X.50 DIA				M		0000		EA	47D382604G1	02.000	08.000	000292
47D382604P9	PAD,NYLON				M		0000		EA	47D382604G1	02.000	08.000	000297
47E382605G1	TEETER BRG/RSTR INST				M		0000		EA	47E382590G1	01.000	01.000	001192
47E382605P19	PIN				M		0000		EA	47E382605G1	04.000	04.000	001219
47D382606G1	FAIRING INSTALLATION				M		0000		EA	47E382597G1	01.000	01.000	000377
47D382606P2	SEALING STRIP				M		0000		EA	47D382606G1	AR		000379
47D382606P3	ADHESIVE(SEE NOTE 4)				B		0000		EA	47D382606G1	AR		000380
47E382607G1	YOKE / NACELLE INSTL				M		0000		EA	47E382304G1	01.000	01.000	001229
47E382608G1	ROTOR BLADE INSTL				M		0000		EA	47E382304G1	01.000	01.000	001289
47D382609P1	YOKE BRG CAP,WLDMT				M		0000		EA	47E382602G1	02.000	02.000	000162

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47E382610G1	AILERON INSTALLATION				M		0000		EA	47E382590G1	02.000	02.000	001011
47A387005	I&C SIGNAL LIST				X		0000		EA	47E382304G1	X		001869
47D387009P1	GROUNDING XFMR				M		0000		EA	47E387060G1	01.000	01.000	000964
47D387010P1	CURRENT XFMR				M		0000		EA	47E387060G1	06.000	06.000	000966
47D387011P1	POTENTIAL XFMR				M		0000		EA	47E387060G1	03.000	03.000	000967
47C387013P1	GROUNDING RESISTOR				M		0000		EA	47E387060G1	02.000	02.000	000965
47E387014	SCHEM,NACELLE,GEN				X		0000		EA	47E382304G1	X		001872
47E387018	POWER DISTBR SCHEM				X		0000		EA	47E387081G1	X		001859
47D387022	SCHEMATIC				X		0000		EA	47D387121G1	X		000876
47E387027G1	ASSY,WTG CONTROL PAN*				*		0000		EA	47E387112G1	01.000	01.000	001328
47D387028P1	PANEL,FRONT,WTG CONT*				*		0000		EA	47E387027G1	01.000	01.000	001329
47D387029P1	CONNECTOR PANEL, WTG*				*		0000		EA	47E387027G1	01.000	01.000	001330
47D387030	SCHEMATIC DIAGRAM EL*				X	5	0000		EA	47E387027G1	X		001369
47D387032G1	GEAR BOX SIGNAL COND*				*		0000		EA	47E387072G1	01.000	01.000	000683
47D387034G1	WIND SIGNAL CONDITIO*				*		0000		EA	47E387072G1	01.000	01.000	000684
47E387037G1	ASSY,SYN SIG COND BD				*		0000		EA	47E387072G1	02.000	02.000	000685
47D387038	SCHEMATIC				X		0000		EA	47E387037G1	X		000702
47A387039	WIRE LIST				X		0000		EA	47E387037G1	X		000687
47D387040G1	POWER SIGNAL CONDITI*				*		0000		EA	47E387072G1	01.000	01.000	000681
47D387043G1	SYNCRO TO CURRENT CO*				*		0000		EA	47E387072G1	02.000	02.000	000682
47E387060G1	HIGH VOLTAGE CG ASSY				M		0000		EA	47E382597G1	01.000	01.000	000962
47E387061	SCHEMATIC				X		0000		EA	47E387072G1	X		000778
47E387062G1	CONT ELEK CAB, (CEC)				M		0000		EA	47E382597G1	01.000	01.000	000553
47D387063P1	PANEL				M		0000		EA	47D387121G1	01.000	01.000	000857
47D387063P2	MOUNTING CHASIS				M		0000		EA	47D387121G1	01.000	01.000	000858

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47E387064	SCHEMATIC				X		0000		EA	47E387062G1		X	000562
47F387064	SCHEMATIC				X		0000		EA	47E387095G1		X	000637
												00.000	
47E387065G1	PANEL, RIGHT SIDE				*		0000		EA	47E387062G1	01.000	01.000	000816
47E387065P1	PANEL,RIGHT SIDE				*		0000		EA	47E387065G1	01.000	01.000	000817
47E387069G1	HIGH V CG DRILL ASSY				M		0000		EA	47E387060G1	01.000	01.000	000963
47D387070G1	CENTER PANEL				*		0000		EA	47E387062G1	01.000	01.000	000582
47D387070P1	PANEL				*		0000		EA	47D387070G1	01.000	01.000	000583
47D387070P2	SPACER STRIP				*		0000		EA	47D387070G1	02.000	02.000	000584
47E387072G1	I&C SIG CONDITIONER				*		0000		EA	47E387062G1	01.000	01.000	000645
47D387073P1	PANEL,FRONT				*		0000		EA	47E387072G1	01.000	01.000	000646
47D387074P1	PANEL,RIGHT SIDE				*		0000		EA	47E387072G1	01.000	01.000	000647
47D387074P2	PANEL,LEFT SIDE				*		0000		EA	47E387072G1	01.000	01.000	000648
47C387075P1	PANEL,REAR				*		0000		EA	47E387072G1	01.000	01.000	000649
47B387076G1	MTG. BRACKET,CIRCUIT*				*		0000		EA	47E387072G1	02.000	02.000	000664
47B387076G2	MTG. BRACKET,CIRCUIT*				*		0000		EA	47E387072G1	02.000	02.000	000668
47B387076P1	BRACKET				*		0000		EA	47B387076G1	01.000	02.000	000665
47B387076P2	BRACKET				*		0000		EA	47B387076G2	01.000	02.000	000669
47B387078P1	SUPPORT ANGLE,CABLE				*		0000		EA	47E387072G1	01.000	01.000	000678
47B387079P1	MTG. BRACKET				*		0000		EA	47E387072G1	02.000	02.000	000679
47E387081G1	ELEC EQUIP BUILDING				M		0000		EA	47E382304G1	01.000	01.000	001308
47B387082P1	SHIELD				*		0000		EA	47E387072G1	01.000	01.000	000748
47B387082P1	SHIELD				*		0000		EA	47E387095G1	01.000	01.000	000611
												02.000	
47D387083G1	ASSY, MOTHER BD-SIGN*				*		0000		EA	47E387072G1	01.000	01.000	000651
47D387083P4	TERMINAL BLOCK				*		0000		EA	47D387083G1	01.000	01.000	000655
47D387083P5	TERMINAL BLOCK				*		0000		EA	47D387083G1	01.000	01.000	000656

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47E387084G1	ASSY, STATUS PANEL				M		0000		EA	47E387112G1	01.000	01.000	001666
47E387084P2	PANEL, SIDE				B		0000		EA	47E387084G1	02.000	02.000	001668
47E387085G1	ASSY, UTILITY PANEL				M		0000		EA	47E387112G1	01.000	01.000	001544
47E387085P2	PANEL, SIDE				M		0000		EA	47E387085G1	02.000	02.000	001546
47B387086P1	ANGLE				*		0000		EA	47D387083G1	02.000	02.000	000653
47D387087G1	ASSY, COLOR CODED FL*				*		0000		EA	47E387072G1	07.000	07.000	000738
47A387088	WIRE LIST				X		0000		EA	47E387072G1	X		000770
47D387089G1	ASSY,MTR SIG CONDTNR				M		0000		EA	47E387084G1	05.000	05.000	001675
47D387089G1	ASSY,MTR SIG CONDTNR				M		0000		EA	47E387085G1	03.000	03.000	001553
47D387089G1	ASSY,MTR SIG CONDTNR				M		0000		EA	47E387091G1	03.000	03.000 11.000	001380
47E387090P1	DRILL & TRIM				*		0000		EA	47D387083G1	01.000	01.000	000652
47E387091G1	ASSY,GENERATOR PANEL				M		0000		EA	47E387112G1	01.000	01.000	001371
47E387091P2	PANEL, SIDE				B		0000		EA	47E387091G1	01.000	01.000	001373
47D387092	SCHEMATIC				X		0000		EA	47D387089G1	X		001682
47E387093G1	WIND TRANSLATOR				M		0000		EA	47E387062G1	01.000	01.000	000800
47E387095G1	CONTROLLER ASSY				M		0000		EA	47E387062G1	01.000	01.000	000589
47E387095P42	BUSHING, STRAIN RLF				M		0000		EA	47E387095G1	01.000	01.000	000631
47E387095P43	BUSHING, STRAIN RLF				M		0000		EA	47E387095G1	08.000	08.000	000632
47E387095P47	PLUG, SNAP OUT				M		0000		EA	47E387095G1	03.000	03.000	000636
47C387096G1	MTG BRACKET ASSY				M		0000		EA	47E387062G1	02.000	02.000	000824
47C387096P1	MTG BRACKET				M		0000		EA	47C387096G1	01.000	02.000	000825
47E387097	SCHEMATIC				X		0000		EA	47E387085G1	X		001637
47E387098P1	PANEL, FRONT				M		0000		EA	47E387085G1	01.000	01.000	001545
47C387099P1	PANEL, REAR				M		0000		EA	47E387085G1	01.000	01.000	001547
47D387100	SCHEMATIC				X		0000		EA	47D387113G1	X		001772

IDENTIFICATION NO.	NOMENCLATURE	--- ECN ---- DWG INC	DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47E387101	SCHEMATIC				X		0000		EA	47E387084G1	X		001812
47E387103	SCHEMATIC				X		0000		EA	47E387091G1	X		001514
47E387104P1	PANEL, FRONT				B		0000		EA	47E387084G1	01.000	01.000	001667
47E387105P1	PANEL, FRONT				B		0000		EA	47E387091G1	01.000	01.000	001372
47D387106P1	PANEL, REAR				B		0000		EA	47E387084G1	01.000	01.000	001669
47D387106P1	PANEL, REAR				B		0000		EA	47E387091G1	01.000	01.000	001374
												02.000	
47D387107P1	SGL CD FR.,MODIFIED				B		0000		EA	47E387084G1	01.000	01.000	001671
47D387107P1	SGL CD FR.,MODIFIED				B		0000		EA	47E387091G1	01.000	01.000	001376
												02.000	
47D387108P1	BRACKET, CARD FRAME				B		0000		EA	47E387084G1	01.000	01.000	001672
47D387108P1	BRACKET, CARD FRAME				B		0000		EA	47E387091G1	01.000	01.000	001377
												02.000	
47D387109G1	FRONT PANEL				M		0000		EA	47E387060G1	01.000	01.000	000971
47D387110P1	BUS BAR				M		0000		EA	47E387060G1	01.000	01.000	000969
47E387112G1	SYS DISPLAY PNL ASSY				M		0000		EA	47E387081G1	01.000	01.000	001326
47D387113G1	SECURITY ALARM BOARD				M		0000		EA	47E387084G1	01.000	01.000	001763
47D387113G1	SECURITY ALARM BOARD				M		0000		EA	47E387091G1	01.000	01.000	001464
												02.000	
47E387114	CONTROL SYSTEM SCHEM				X		0000		EA	47E382304G1	X		001865
47E387115P1	MOUNTING FRAME				M		0000		EA	47E387095G1	01.000	01.000	000590
47E387116P1	DRILL & TRIM				M		0000		EA	47D387089G1	03.000	11.000	001381
47D387121G1	ESD ELECT ASSY				M		0000		EA	47E387062G1	01.000	01.000	000856
47D387122	SCHEMATIC				X		0000		EA	47D387130G1	X		000903
47A387124	WIRE LIST				X		0000		EA	47E387095G1	X		000630
47A387125	WIRE LIST				X		0000		EA	47D387121G1	X		000869
47A387128	WIRE LIST				X		0000		EA	47D387130G1	X		000902
47D387129P1	PANEL				M		0000		EA	47D387130G1	01.000	01.000	000883
47D387129P2	MOUNTING CHASSIS				M		0000		EA	47D387130G1	01.000	01.000	000884

IDENTIFICATION NO.	NOMENCLATURE	--- ECN --- DWG INC	--- ECN --- DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
47D387130G1	"G" SWITCH TEST ELEK				M		0000		EA	47E387062G1	01.000	01.000	000882
47D387132G1	ICE DETECTOR ELEK				M		0000		EA	47E387062G1	01.000	01.000	000922
4HP	PLUG				B		0000	97576	EA	47J382313G1	03.000	03.000	000099
4PN-SS	NIPPLE, PIPE				B		0000	97576	EA	47J382313G1	03.000	03.000	000079
4PT-SS	TEE, PIPE				B		0000	97576	EA	47J382313G1	03.000	03.000	000081
41F2R0	RESISTOR, 2 OHM				M		0000	03615	EA	47D387130G1	01.000	01.000	000897
415G-14-1	TERMINAL				M		0000	17117	EA	47D387130G1	08.000	08.000	000886
427D-SIZE-4	ELBOW,LONG				B		0000	14959	EA	47E382570G1	06.000	06.000	000505
427D-SIZE-5	ELBOW,LONG				B		0000	14959	EA	47E382570G1	03.000	03.000	000506
44A0111-16-9	WIRE, AWG #16				B	5	0000	06090	FT	47E387027G1	AR		001364
44A0111-16-9	WIRE, AWG #16				B	5	0000	06090	FT	47E387062G1	AR		000957
44A0111-16-9	WIRE, AWG #16				B	5	0000	06090	FT	47E387072G1	AR		000775
												00.000	
44A0111-20-9	WIRE, AWG #20				B	5	0000	06090	FT	47D387121G1	AR		000874
44A0111-20-9	WIRE, AWG #20				B	5	0000	06090	FT	47D387130G1	AR		000915
44A0111-20-9	WIRE, AWG #20				B	5	0000	06090	FT	47E387062G1	AR		000958
												00.000	
44A0111-22-9	WIRE, #22 AWG				B	5	0000	06090	FT	47E387072G1	AR		000783
44A0111-24-9	WIRE, AWG 24				B	5	0000	06090	FT	47E387084G1	AR		001816
44A0111-24-9	WIRE, AWG 24				B	5	0000	06090	FT	47E387085G1	AR		001640
44A0111-24-9	WIRE, AWG 24				B	5	0000	06090	FT	47E387091G1	AR		001518
												00.000	
44A0811-12-9	WIRE, AWG #12				B	5	0000	06090	FT	47E387062G1	AR		000956
4538K1	TFE SEALER, TEFLON				B		0000	39428	EA	47J382313G1	01.000	01.000	000076
4697-1032-SS-20	HEX M & F STANDOFF				M		0000	55566	EA	47E387062G1	12.000	12.000	000934
47-61-201-10	CAPTIVE SCREW				M		0000	94222	EA	47D387121G1	04.000	04.000	000861
47-61-201-10	CAPTIVE SCREW				M		0000	94222	EA	47D387130G1	04.000	04.000	000885
												08.000	
53451-1	RELAY				B	7	0000	18342	EA	47D387089G1	09.000	33.000	001595
5596A-8	TERMINAL BOARD				*		0000	75382	EA	47E387072G1	01.000	01.000	000750

WTG - MOD 5A

TOP DOWN

BREAK DOWN

7241-1 TOPDOWN BREAKDOWN FOR ASSEMBLY 47E382304G1 WTG ASSY, MOD-5A 06/15/84 PAGE 01
MODEL EA UNIT 000001

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM CROSS REF
00	47E382304G1	WTG ASSY, MOD-5A	1			M		0000	EA		1.00	-	000001
01	47D382356G1	TOWER ASSY, WTG				M		0000	EA	1.00	1.00	1-00	000002
02	47E382297G1	TWR/FOUNDATION INSTL				M		0000	EA	1.00	1.00	1-00	000003
03	47E382355P1	TWR STRUCTURE ASSY				M		0000	EA	1.00	1.00	1-00	000004
03	47C382499P1	TOWER ACCESS DOOR				M		0000	EA	1.00	1.00	2-00	000005
03	47E381112G1	FOUNDATION REQT				M		0000	EA	1.00	1.00	3-00	000006
04	47E381112P1	FOUNDATION ASSEMBLY				M		0000	EA	1.00	1.00	1-00	000007
04	47B382585P1	ANCHOR STUD				M		0000	EA	96.00	96.00	2-00	000008
04	47E381112P3	NUT				B		0000	EA	192.00	192.00	3-00	000009
04	47B382586P1	ANCHOR PLATE				M		0000	EA	48.00	48.00	4-00	000010
04	47E381112P5	RECT. WIREWAY				M		0000	EA	3.00	3.00	5-00	000011
04	47E381112P6	CONDUIT SECTION				M		0000	EA	1.00	1.00	6-00	000012
04	47E381112P7	CONDUIT SECTION				M		0000	EA	2.00	2.00	7-00	000013
04	47E381112P8	CONDUIT SECTION				M		0000	EA	1.00	1.00	8-00	000014
04	47E381112P9	#09 REINFORCING ROD				M		0000	FT	AR		9-00	000015
04	47E381112P10	#11 REINFORCING ROD				M		0000	FT	AR		10-00	000016
03	47E382303P1	TWR/ FDN PLATF REQT				M		0000	EA	1.00	1.00	4-00	000017
03	N214P58B	NUT 2 1/2 DIA.				B		0000	EA	96.00	96.00	5-00	000018
03	N402P58B	WASHER				B		0000	EA	96.00	96.00	6-00	000019
03	47E382297P7	GROUT				M		0000	LB	AR		7-00	000020
02	47D382593G1	YAW S/S ASSY				M		0000	EA	1.00	1.00	2-00	000021
03	47E382133G1	YAW STRUCTURE ASSY				M		0000	EA	1.00	1.00	1-00	000022
04	47E382050P1	YAW HSG STRUCT,UPPER				M		0000	EA	1.00	1.00	1-00	000023
04	47E382219P1	YAW HSG STRUCT,LOWER				M		0000	EA	1.00	1.00	2-00	000024
04	47D381002P1	BEARING, YAW				M		0000	EA	1.00	1.00	3-00	000025
04	47C381036P32	BOLT				M		0000	EA	144.00	144.00	4-00	000026
04	47C381087P13	NUT, FATIGUE RATED				B		0000	EA	144.00	144.00	5-00	000027
04	47C381088P13	WASHER, HARDENED STL				B		0000	EA	144.00	144.00	6-00	000028
04	47C381088P14	WASHER, HARDENED STL				B		0000	EA	144.00	144.00	7-00	000029
03	47E382165G1	YAW DRIVE INSTL				M		0000	EA	1.00	1.00	2-00	000030
04	47D381010P1	BRAKE ASSY				M		0000	EA	8.00	8.00	1-00	000031
04	47D381003P1	ACTUATOR,HYDRAULIC				M		0000	EA	4.00	4.00	2-00	000032
04	47C382181P1	TRACK MTG BRACKET				M		0000	EA	4.00	4.00	3-00	000033
04	47E381107P1	TROLLEY ASSY				M		0000	EA	2.00	2.00	4-00	000034
04	47D382563G1	TORQUE PLATE ASSY				M		0000	EA	4.00	4.00	5-00	000035
05	47D382563P1	TORQUE PLATE				M		0000	EA	1.00	4.00	1-00	000036
05	47B382564P1	BEARING ANGLE				M		0000	EA	2.00	8.00	2-00	000037
05	N23P25012B	SCREW,CAP				B		0000	EA	6.00	24.00	3-00	000038

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
05	N400P13B	WASHER,PLAIN				B		0000	EA	6.00	24.00	4-00		000039
05	N406P43B	LOCKWASHER				B		0000	EA	6.00	24.00	5-06		000040
04	47D382192P1	BRAKE MTG PLATE				M		0000	EA	2.00	2.00	6-00		000041
04	47D382198P1	CLEVIS BLOCK				M		0000	EA	2.00	2.00	7-00		000042
04	47B382200P1	RETAINER, PIN				M		0000	EA	4.00	4.00	8-00		000043
04	47B382193P1	PIN, CLEVIS - BRAKE				M		0000	EA	4.00	4.00	9-00		000044
04	47C381036P15	BOLT,FATIGUE RATED				B		0000	EA	36.00	36.00	10-00		000045
04	47C381036P16	BOLT,FATIGUE RATED				B		0000	EA	12.00	12.00	11-00		000046
04	N733P33112B	SCREW,12 POINT				B		0000	EA	12.00	12.00	12-00		000047
04	BLFR-22	SPHERICAL BEARING				B		0000	EA	4.00	4.00	13-00	81376	000048
04	DREM-20-080	ROD END BEARING				B		0000	EA	4.00	4.00	14-00	81376	000049
04	47B382419P1	WASHER				B		0000	EA	96.00	96.00	15-00		000050
04	N727P33040B	CAPSCREW				B		0000	EA	24.00	24.00	16-00		000051
04	N265P33B	LOCKNUT				B		0000	EA	32.00	32.00	17-00		000052
04	N265P34B	LOCKNUT				B		0000	EA	12.00	12.00	18-00		000053
04	N214P34B	HEX NUT				B		0000	EA	12.00	12.00	19-00		000054
04	N266P43B	LOCKNUT				B		0000	EA	48.00	48.00	20-00		000055
04	47B382420P1	JAM NUT				B		0000	EA	4.00	4.00	21-00		000056
04	N402AP17B	PLAIN WASHER, NARROW				B		0000	EA	64.00	64.00	22-00		000057
04	N402AP48B	PLAIN WASHER, REG.				B		0000	EA	24.00	24.00	23-00		000058
04	**47E382165-24	BOLT				B		0000	EA	24.00	24.00	24-00		000059
04	N22BP21016B	CAPSCREW				B		0000	EA	16.00	16.00	26-00		000060
04	47B382196P1	SPACER, CLEVIS BLOCK				M		0000	EA	4.00	4.00	27-00		000061
04	47B382196P2	SPCR,ACTUATOR CLEVIS.				M		0000	EA	8.00	8.00	28-00		000062
04	47C382181P2	TRACK, MTG BRACKET				M		0000	EA	2.00	2.00	29-00		000063
04	47D382198P2	CLEVIS BLOCK				M		0000	EA	2.00	2.00	30-00		000064
04	47C382278P1	MANIFOLD FITTING				M		0000	EA	2.00	2.00	31-00		000065
04	N22P25036B	CAPSCREW				B		0000	EA	8.00	8.00	32-00		000066
04	N402AP13B	PLAIN WASHER, NARROW				B		0000	EA	8.00	8.00	33-00		000067
04	N405P43B	LOCKWASHER - MEDIUM				B	5	0000	EA	8.00	8.00	34-00		000068
04	47B382277P1	DRIP TROUGH				M		0000	EA	2.00	2.00	35-00		000069
04	47B382277P2	DRIP TROUGH				M		0000	EA	2.00	2.00	36-00		000070
04	A100-4	TUBE FTG, MALE CONN.				B		0000	EA	4.00	4.00	37-00	97576	000071
04	A400-4	TUBE FTG, MALE ELBOW				B		0000	EA	16.00	16.00	38-00	97576	000072
04	700-4	TUBE FTG, TEE UNION				B		0000	EA	8.00	8.00	39-00	97576	000073
04	B7A17B	.250 O.D X .035 WALL				M		0000	FT	20.00	20.00	40-00		000074
03	47J382313G1	HYDR PIPING, YAW DR				M		0000	EA	1.00	1.00	3-00		000075
04	4538K1	TFE SEALER, TEFLON				B		0000	EA	1.00	1.00	1-00	39428	000076
04	**47J382313-2	ACCUMULATOR & V PKG				M		0000	EA	1.00	1.00	2-00		000077
04	**47J382313-3	YAW POWER UNIT				M		0000	EA	1.00	1.00	3-00		000078
04	4PN-SS	NIPPLE, PIPE				B		0000	EA	3.00	3.00	4-00	97576	000079
04	3043T18	"U" BOLT & NUTS				B	5	0000	EA	6.00	6.00	5-00	39428	000080
04	4PT-SS	TEE, PIPE				B		0000	EA	3.00	3.00	6-00	97576	000081
04	B7A17B-.035	TUBING, .250 OD				B		0000	FT	4.00	4.00	7-00		000082
04	B7A17B-.065	TUBING, .500 OD				B		0000	FT	200.00	200.00	8-00		000083
04	47C381075P1	HOSE ASSY				M		0000	EA	4.00	4.00	9-00		000084

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	47C381075P2	HOSE ASSY				M		0000	EA	4.00	4.00	10-00		000085
04	47B381074P1	HOSE ASSY				M		0000	EA	2.00	2.00	11-00		000086
04	C9612-3	PRESSURE, SWITCH				B		0000	EA	3.00	3.00	12-00	89326	000087
04	HP36GT	VALVE, .50 NPT				B		0000	EA	3.00	3.00	13-00	01029	000088
04	22617-8	O-RING				B		0000	EA	10.00	10.00	14-00	01276	000089
04	980-8-8SS	CONNECTOR, BULKHEAD				B		0000	EA	2.00	2.00	15-00	97576	000090
04	100-8-4SS	CONNECTOR, MALE				B		0000	EA	3.00	3.00	16-00	97576	000091
04	100-8-8SS	CONNECTOR, MALE				B		0000	EA	3.00	3.00	17-00	97576	000092
04	8TFNSS	NIPPLE				B		0000	EA	8.00	8.00	18-00	97576	000093
04	A400-8SS	ELBOW, MALE				B		0000	EA	8.00	8.00	19-00	97576	000094
04	A600-8SS	TEE BRANCH, MALE				B		0000	EA	3.00	3.00	20-00	97576	000095
04	140-8-4SS	ADAPTER, REDUCER				B		0000	EA	4.00	4.00	21-00	97576	000096
04	700-8SS	TEE, UNION				B		0000	EA	16.00	16.00	22-00	97576	000097
04	100C-8SS	TUBE CAP				B		0000	EA	4.00	4.00	23-00	97576	000098
04	4HP	PLUG				B		0000	EA	3.00	3.00	24-00	97576	000099
04	100025	CLAMP ASSY				B		0000	EA	5.00	5.00	25-00	55017	000100
04	100050	CLAMP ASSY				B		0000	EA	103.00	103.00	26-00	55017	000101
04	8PRC-SS	CONNECTOR, REDUCING				B		0000	EA	3.00	3.00	27-00	97576	000102
04	300H1-15CG-04-K	PRESSURE TRANSDUCER				B		0000	EA	3.00	3.00	28-00	89326	000103
04	N405P418	LOCK WASHER				B	5	0000	EA	12.00	12.00	29-00		000104
04	47E382314	HYDRAULIC SYS SCHEM				X		0000	EA	X		30-00		000105
03	**47D382593-4	GREASE SHIELD INSTL				M		0000	EA	1.00	1.00	4-00		000106
03	47E382594G1	YAW SLIP RING INSTL				M		0000	EA	1.00	1.00	5-00		000107
04	47D381019P1	SLIP RNG UN YAW AXIS				M		0000	EA	1.00	1.00	1-00		000108
04	47E381017	YAW SR ELECT INTFC				X		0000	EA	X		2-00		000109
04	**47E382594-3	CROSS BEAM				M		0000	EA	2.00	2.00	3-00		000110
04	**47E382594-4	MOUNTING BRACKET				M		0000	EA	1.00	1.00	4-00		000111
04	**47E382594-5	SUPPORT ANGLE				M		0000	EA	4.00	4.00	5-00		000112
04	**47E382594-6	YAW ELEC&INSTR INSTL				M		0000	EA	1.00	1.00	6-00		000113
04	N22P35052B	HEX HD BOLT				B		0000	EA	24.00	24.00	7-00		000114
04	N22AP35040B	HEX HD BOLT				B		0000	EA	12.00	12.00	8-00		000115
04	N265P35B	LOCK NUT, 3/4 DIA.				*		0000	EA	24.00	24.00	9-00		000116
04	N402P18B	WASHER, 3/4 DIA.				B		0000	EA	36.00	36.00	10-00		000117
04	N22P39068B	HEX HD BOLT				B		0000	EA	8.00	8.00	11-00		000118
04	N265P39B	LOCK NUT - 1 DIA.				B	5	0000	EA	8.00	8.00	12-00		000119
04	N402P20B	WASHER				B		0000	EA	8.00	8.00	13-00		000120
04	MS20995C20	LOCK WIRE				B	5	0000	FT	AR		14-00		000121
04	650LR-HAB350	POWER DISTR CONN				B		0000	EA	14.00	14.00	15-00	11117	000122
04	600BE	EXTENDER				B		0000	EA	6.00	6.00	16-00	11117	000123
04	**47E382594-17	DRAG LINK				M		0000	EA	2.00	2.00	17-00		000124
03	**47D382593-6	BRG, AUTO LUBE INSTL				M		0000	EA	1.00	1.00	6-00		000125
02	**47D382356-3	ELEC WIRE WAY INSTL				M		0000	EA	1.00	1.00	3-00		000126
02	47E382595G1	TWR PLATFORM INSTL				M		0000	EA	1.00	1.00	4-00		000127
03	**47E382595-1	LOWER PLATFORM ASSY				M		0000	EA	1.00	1.00	1-00		000128

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM CROSS REF
03	**47E382595-2	MID PLATFORM ASSY				M		0000	EA	1.00	1.00	2-00	000129
03	**47E382595-3	UPR (YAW) PLATF ASSY				M		0000	EA	1.00	1.00	3-00	000130
03	**47E382595-4	STAIRWAY ASSY				M		0000	EA	1.00	1.00	4-00	000131
03	**47E382595-5	PRIMARY LADDER ASSY				M		0000	EA	1.00	1.00	5-00	000132
03	**47E382595-6	ALTN LADDER ASSY				M		0000	EA	1.00	1.00	6-00	000133
03	**47E382595-7	GUARDRAIL ASSY				M		0000	EA	1.00	1.00	7-00	000134
03	**47E382595-8	HGR CABLE ASSY - UPR				M		0000	EA	12.00	12.00	8-00	000135
03	**47E382595-9	HGR CABLE ASSY - LWR				M		0000	EA	6.00	6.00	9-00	000136
03	**47E382595-10	ACCESS COVER HATCH				M		0000	EA	1.00	1.00	10-00	000137
03	**47E382595-11	HGR CLEVIS FITTING				M		0000	EA	12.00	12.00	11-00	000138
03	**47E382595-12	BEARING PADS				M		0000	EA	12.00	12.00	12-00	000139
03	N22P35036B	BLT,HEX HD, 3/4 DIA.				B		0000	EA	36.00	36.00	13-00	000140
03	N264P35B	LOCKNUT, 3/4 DIA.				B		0000	EA	36.00	36.00	14-00	000141
03	N402P18B	WASHER, 3/4 DIA.				B		0000	EA	36.00	36.00	15-00	000142
02	**47D382356-5	TWR INSTM INSTL				M		0000	EA	1.00	1.00	5-00	000143
02	**47D382356-6	TOWER MARKINGS				M		0000	EA	1.00	1.00	6-00	000144
02	**47D382356-7	GND WIRE WAY INSTL				M		0000	EA	1.00	1.00	7-00	000145
02	47E382592G1	PERS ELEV/SUPT INSTL				M		0000	EA	1.00	1.00	8-00	000146
03	**47E382592-1	LWR G TWR SECT ASSY				M		0000	EA	1.00	1.00	1-00	000147
03	**47E382592-2	UPR G TWR SECT ASSY				M		0000	EA	1.00	1.00	2-00	000148
03	47D382591P1	STRUCTURE FRAME UNIT				M		0000	EA	4.00	4.00	3-00	000149
03	15AS650	PERS ELEVATOR UNIT				M		0000	EA	1.00	1.00	4-00	000150
03	47E382592P5	ANGLE SECTION				M		0000	EA	20.00	20.00	5-00	000151
03	47D382587P1	FLOATING MT BRACKET				M		0000	EA	4.00	4.00	6-00	000152
03	N14P35060B	HEX HD BOLT,3/4 DIA.				B		0000	EA	16.00	16.00	7-00	000153
03	N265P35B	LOCK NUT, 3/4 DIA.				*		0000	EA	16.00	16.00	8-00	000154
03	N402P18B	WASHER, 3/4 DIA.				B		0000	EA	16.00	16.00	9-00	000155
03	PB34-414	PARA BLT,CONC ANCHOR				B		0000	EA	16.00	16.00	10-00	000156
02	47E382571	LIFT REQT, TWR CMPNT				X		0000	EA	X		9-00	000157
01	47E382601G1	YOKE ASSY				M		0000	EA	1.00	1.00	2-00	000158
02	47E382441G1	YOKE / SPINDLE ASSY				M		0000	EA	1.00	1.00	1-00	000159
03	47E382602G1	MACHINING ASSY, YOKE				M		0000	EA	1.00	1.00	1-00	000160
04	47E382600P1	YOKE STRL,WELDMENT				M		0000	EA	1.00	1.00	1-00	000161
04	47D382609P1	YOKE BRG CAP,WLDMT				M		0000	EA	2.00	2.00	2-00	000162
04	47E382602P3	BRACKET				M		0000	EA	6.00	6.00	3-00	000163
04	47E382602P4	BRACKET				M		0000	EA	1.00	1.00	4-00	000164
04	47E382602P5	BRACKET				M		0000	EA	1.00	1.00	5-00	000165
04	N500P12464C	PIN,TAPERED DOWEL#13				M		0000	EA	8.00	8.00	6-00	000166
04	47C381036P14	BOLT,FATIGUE RATED				B		0000	EA	16.00	16.00	7-00	000167
04	47C381088P5	WASHER,1.25 DIA				B		0000	EA	16.00	16.00	8-00	000168
04	N405P52B	LOCK WASHER				M		0000	EA	16.00	16.00	9-00	000169
04	47C381036P6	BOLT,FATIGUE RATED				B		0000	EA	20.00	20.00	10-00	000170

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	47C381088P1	WASHER,1.00 DIA				M		0000	EA	40.00	40.00	11-00		000171
04	47C381088P2	WASHER,1.00 DIA				M		0000	EA	40.00	40.00	12-00		000172
04	47C381087P2	LOCKNUT				B		0000	EA	40.00	40.00	13-00		000173
04	47C381036P2	BOLT,FATIGUE RATED				B		0000	EA	20.00	20.00	14-00		000174
04	CHOCKFAST-ORANGE	GROUTING				B		0000	EA	AR		15-00	20420	000175
04	47E382602P16	YOKE BRG CAP MACH				X		0000	EA	X		16-00		000176
03	47E382333P1	SPINDLE SHAFT				M		0000	EA	1.00	1.00	2-00		000177
03	47D381080P1	TPR RLR BRG,SPDL/AFT				M		0000	EA	1.00	1.00	3-00	80657	000178
03	47D381081P1	TPR RLR BRG,SPDL/FWD				M		0000	EA	1.00	1.00	4-00	80657	000179
03	47C382458P1	RETAINER, AFT				M		0000	EA	6.00	6.00	5-00		000180
03	47B381106P1	"O" RING SEAL, AFT				M		0000	EA	1.00	1.00	6-00		000181
03	47D382456P1	RTR SEAL RTNR, AFT				M		0000	EA	1.00	1.00	7-00		000182
03	47B382454P1	ANTI-ROTATION PIN				M		0000	EA	2.00	2.00	8-00		000183
03	47D382372P1	RTR BRG RETAINER,FWD				M		0000	EA	1.00	1.00	9-00		000184
03	47D382457P1	LOW SPEED BRAKE DISC				M		0000	EA	1.00	1.00	10-00		000185
03	47C382557P1	ROTOR BRG SHIM				M		0000	EA	4.00	4.00	11-00		000186
03	47B382558P1	INSERT, BRAKE DISC				M		0000	EA	120.00	120.00	12-00		000187
03	47C382559P1	RTR SEAL RTNR, FWD				M		0000	EA	1.00	1.00	13-00		000188
03	47C381102P1	ROTOR SEAL FWD				M		0000	EA	2.00	2.00	14-00	03668	000189
03	47C381103P1	ROTOR SEAL AFT				M		0000	EA	2.00	2.00	15-00	03668	000190
03	47D382455P1	DISC, RTR SPEED SNSR				M		0000	EA	1.00	1.00	16-00		000191
03	47C381104P1	STUD				M		0000	EA	120.00	120.00	17-00		000192
03	47C381104P2	STUD				M		0000	EA	120.00	120.00	18-00		000193
03	47C382560P1	PLUG, TORQUE PLATE				M		0000	EA	2.00	2.00	19-00		000194
03	47D381082P2	TORQUE PLATE				M		0000	EA	1.00	1.00	20-00		000195
03	47C381036P24	BOLT,FATIGUE RATED				B		0000	EA	36.00	36.00	21-00		000196
03	47C381088P9	WASHER,1.50 DIA				M		0000	EA	72.00	72.00	22-00		000197
03	47C381087P9	NUT				B		0000	EA	36.00	36.00	23-00		000198
03	47B381109P1	WSHR, BELLEVILLE SPR				B		0000	EA	120.00	120.00	24-00	92830	000199
03	47C381087P5	NUT				B		0000	EA	360.00	360.00	25-00		000200
03	47C381088P5	WASHER,1.25 DIA				B		0000	EA	240.00	240.00	26-00		000201
03	N2800P2	FITTING, LUBE				B		0000	EA	4.00	4.00	27-00		000202
03	N733P25016B	SCREW, TWELVE-POINT				B		0000	EA	78.00	78.00	28-00		000203
03	N405P43B	LOCKWASHER - MEDIUM				B	5	0000	EA	78.00	78.00	29-00		000204
03	N5700P6053B	PLUG, PIPE				B		0000	EA	4.00	4.00	30-00		000205
03	N733P29024B	SCREW, TWELVE-POINT				B		0000	EA	36.00	36.00	31-00		000206
03	N405P45B	WASHER, LOCK				B	5	0000	EA	36.00	36.00	32-00		000207
02	47D382435G1	LOW SPEED SHAFT ASSY				*		0000	EA	1.00	1.00	2-00		000208
03	47D382296P1	LOW SPEED SHAFT				*		0000	EA	1.00	1.00	1-00		000209
03	47D381082P1	COUPLING HUB, FWD				*		0000	EA	1.00	1.00	2-00		000210
03	47C381083P1	COUPLING HUB, AFT				*		0000	EA	1.00	1.00	3-00		000211
02	47C382436P1	SEAL RTNR, COUPLING				M		0000	EA	2.00	2.00	3-00		000212
02	47C382437P1	SEAL PL, FWD CPLG				M		0000	EA	6.00	6.00	4-00		000213
02	47C381110P1	SEAL, FWD, COUPLING				M		0000	EA	4.00	4.00	5-00		000214
02	47E382603G1	TEETER RSTR BK ASSY				M		0000	EA	2.00	2.00	6-00		000215

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	**47E382603-1	HOUSING WALL,LH				M		0000	EA	1.00	2.00	1-00		000216
03	**47E382603-2	HOUSING WALL,RH				M		0000	EA	1.00	2.00	2-00		000217
03	47D381010P2	BRAKE ASSY				M		0000	EA	2.00	4.00	3-00		000218
03	**47E382603-4	HOUSING COVER				M		0000	EA	1.00	2.00	4-00		000219
03	**47E382603-5	TEETER ARM				M		0000	EA	1.00	2.00	5-00		000220
03	**47E382603-6	HOUSING COVER				M		0000	EA	2.00	4.00	6-00		000221
03	**47E382603-7	OUTBD BELLOWS COVER				M		0000	EA	1.00	2.00	7-00		000222
03	**47E382603-8	INBD BELLOWS COVER				M		0000	EA	1.00	2.00	8-00		000223
03	**47E382603-9	ROLLER GUIDE ASSY				M		0000	EA	1.00	2.00	9-00		000224
03	**47E382603-10	BRKT ASSY,LIMIT SW				M		0000	EA	1.00	2.00	10-00		000225
03	**47E382603-11	BRKT,MTG,LIMIT SW				M		0000	EA	1.00	2.00	11-00		000226
03	CR115GM101	SWITCH,LIMIT				B		0000	EA	1.00	2.00	12-00	02295	000227
03	N14P21012B	SCREW,CAP,HEX HD				B		0000	EA	4.00	8.00	13-00		000228
03	N405P111B	LOCKWASHER				B		0000	EA	4.00	8.00	14-00		000229
03	N14P25016B	SCREW,HEX HD				B		0000	EA	34.00	68.00	15-00		000230
03	N405P113B	LOCKWASHER				B		0000	EA	34.00	68.00	16-00		000231
03	N14P29016B	SCREW HEX HD				B		0000	EA	2.00	4.00	17-00		000232
03	N405P115B	LOCKWASHER				B		0000	EA	2.00	4.00	18-00		000233
03	N14P35032B	SCREW,HEX HD				B		0000	EA	4.00	8.00	19-00		000234
03	N405P118B	LOCKWASHER				B		0000	EA	4.00	8.00	20-00		000235
03	N14P39048B	SCREW,HEX HD				B		0000	EA	10.00	20.00	21-00		000236
03	N266P39B	LOCKNUT				B		0000	EA	10.00	20.00	22-00		000237
03	47C381036P14	BOLT,FATIGUE RATED				B		0000	EA	12.00	24.00	23-00		000238
03	47C381087P5	NUT				B		0000	EA	12.00	24.00	24-00		000239
03	**47E382603-25	HYDR FLUID LINE ASSY				M		0000	EA	1.00	2.00	25-00		000240
03	271	LOCKTITE				B		0000	EA	AR		26-00	05972	000241
03	47C381088P6	WASHER,1.25 DIA				B		0000	EA	24.00	48.00	28-00		000242
02	47E382603G2	TEETER RSTR BK ASSY				M		0000	EA	2.00	2.00	7-00		000243
03	**47E382603-1	HOUSING WALL,LH				M		0000	EA	1.00	2.00	1-00		000244
03	**47E382603-2	HOUSING WALL,RH				M		0000	EA	1.00	2.00	2-00		000245
03	47D381010P2	BRAKE ASSY				M		0000	EA	2.00	4.00	3-00		000246
03	**47E382603-4	HOUSING COVER				M		0000	EA	1.00	2.00	4-00		000247
03	**47E382603-5	TEETER ARM				M		0000	EA	1.00	2.00	5-00		000248
03	**47E382603-6	HOUSING COVER				M		0000	EA	2.00	4.00	6-00		000249
03	**47E382603-7	OUTBD BELLOWS COVER				M		0000	EA	1.00	2.00	7-00		000250
03	**47E382603-8	INBD BELLOWS COVER				M		0000	EA	1.00	2.00	8-00		000251
03	**47E382603-9	ROLLER GUIDE ASSY				M		0000	EA	1.00	2.00	9-00		000252
03	**47E382603-11	BRKT,MTG,LIMIT SW				M		0000	EA	1.00	2.00	11-00		000253
03	CR115GM101	SWITCH,LIMIT				B		0000	EA	1.00	2.00	12-00	02295	000254
03	N14P21012B	SCREW,CAP,HEX HD				B		0000	EA	4.00	8.00	13-00		000255
03	N405P111B	LOCKWASHER				B		0000	EA	4.00	8.00	14-00		000256
03	N14P25016B	SCREW,HEX HD				B		0000	EA	34.00	68.00	15-00		000257
03	N405P113B	LOCKWASHER				B		0000	EA	34.00	68.00	16-00		000258
03	N14P29016B	SCREW HEX HD				B		0000	EA	2.00	4.00	17-00		000259
03	N405P115B	LOCKWASHER				B		0000	EA	2.00	4.00	18-00		000260
03	N14P35032B	SCREW,HEX HD				B		0000	EA	4.00	8.00	19-00		000261

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	N405P118B	LOCKWASHER				B		0000	EA	4.00	8.00	20-00		000262
03	N14P39048B	SCREW,HEX HD				B		0000	EA	10.00	20.00	21-00		000263
03	N266P39B	LOCKNUT				B		0000	EA	10.00	20.00	22-00		000264
03	47C381036P14	BOLT,FATIGUE RATED				B		0000	EA	12.00	24.00	23-00		000265
03	47C381087P5	NUT				B		0000	EA	12.00	24.00	24-00		000266
03	**47E382603-25	HYDR FLUID LINE ASSY				M		0000	EA	1.00	2.00	25-00		000267
03	271	LOCKTITE				B		0000	EA	AR		26-00	05972	000268
03	**47E382603-27	BRKT ASSY,LIMIT SW				M		0000	EA	1.00	2.00	27-00		000269
03	47C381088P6	WASHER,1.25 DIA				B		0000	EA	24.00	48.00	28-00		000270
02	**47E382601-8	DRAG LINK				M		0000	EA	4.00	4.00	8-00		000271
02	**47E382601-9	CLAMP RING				M		0000	EA	1.00	1.00	9-00		000272
02	**47E382601-10	RTR BLADE HYD ASSY				M		0000	EA	1.00	1.00	10-00		000273
02	**47E382601-11	RTR BLADE ELECT ASSY				M		0000	EA	1.00	1.00	11-00		000274
02	N22BP29020B	BOLT, SLFLKG				B		0000	EA	48.00	48.00	12-00		000275
02	N22BP25016B	BOLT, SLFLKG				B		0000	EA	72.00	72.00	13-00		000276
02	N402P15B	WASHER				B		0000	EA	48.00	48.00	14-00		000277
02	N402P13B	WASHER				B		0000	EA	72.00	72.00	15-00		000278
02	N22P39048B	BOLT, HEX HD				B		0000	EA	12.00	12.00	16-00		000279
02	N402P20B	WASHER				B		0000	EA	20.00	20.00	17-00		000280
02	N22P39052B	BOLT, HEX HD				B		0000	EA	8.00	8.00	18-00		000281
02	N214P39B	NUT				B		0000	EA	8.00	8.00	19-00		000282
02	N22P45112B	BOLT, HEX HD				B		0000	EA	32.00	32.00	20-00		000283
02	N402P22B	WASHER				B		0000	EA	32.00	32.00	21-00		000284
02	N264P45B	LOCKNUT				B		0000	EA	32.00	32.00	22-00		000285
02	TA-30	PHILLYBOND ADHESIVE				B		0000	GA	AR		23-00	20420	000286
02	**47E382601-24	MTG BRACKET				B		0000	EA	4.00	4.00	24-00		000287
02	47D382604G1	SHAFT ALIGNMENT FTG				M		0000	EA	4.00	4.00	25-00		000288
03	47D382604P1	SHOE				M		0000	EA	1.00	4.00	1-00		000289
03	47D382604P2	ADJUSTING SCREW				M		0000	EA	1.00	4.00	2-00		000290
03	47D382604P3	BRACKET				M		0000	EA	1.00	4.00	3-00		000291
03	47D382604P4	PIN,6.00-LG X.50 DIA				M		0000	EA	2.00	8.00	4-00		000292
03	N504P2264	COTTER PIN				B		0000	EA	1.00	4.00	5-00		000293
03	N504P2224	COTTER PIN				B		0000	EA	1.00	4.00	6-00		000294
03	N402P20B	WASHER				B		0000	EA	1.00	4.00	7-00		000295
03	N402P81B	WASHER,FLAT				B		0000	EA	1.00	4.00	8-00		000296
03	47D382604P9	PAD,NYLON				M		0000	EA	2.00	8.00	9-00		000297
03	A15B60B1	ADH,ECCOBOND 281				B		0000	EA	AR		10-00		000298
02	**47E382601-26	HYD PIPING INSTL				M		0000	EA	1.00	1.00	26-00		000299
02	47E382601P27	GREASE				B		0000	LB	AR		27-00		000300
02	**47E382601-28	BLADE BUMPER ASSY				M		0000	EA	2.00	2.00	28-00		000301
01	47E382597G1	NACELLE OVERALL ASSY	1			M		0000	EA	1.00	1.00	3-00		000302
02	47E382363G1	NACELLE STRUCT ASSY	1			M		0000	EA	1.00	1.00	1-00		000303
03	47E382306G1	BED PL.,MACH.&DRILL.	01			M		0000	EA	1.00	1.00	1-00		000304

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	47E382429P1	BED PL. STRUCT. WELD				M		0000	EA	1.00	1.00	1-00		000305
04	47E382450P1	GEARBOX MTG. STRUCT.				M		0000	EA	1.00	1.00	2-00		000306
04	47C381036P40	BOLT, STRUCT. 2-12				M		0000	EA	24.00	24.00	3-00		000307
04	47C381087P18	NUT 2-12				M		0000	EA	24.00	24.00	4-00		000308
04	47C381088P18	WASHER 2.00				B		0000	EA	24.00	24.00	5-00		000309
04	47C381036P4	BOLT,FATIGUE RATED				M		0000	EA	20.00	20.00	6-00		000310
04	47C381087P1	NUT				M		0000	EA	20.00	20.00	7-00		000311
04	47C381088P2	WASHER,1.00 DIA				M		0000	EA	20.00	20.00	8-00		000312
04	47D382554P1	FLOORING, BEDPLATE				M		0000	EA	1.00	1.00	9-00		000313
04	N733P35040B	BOLT, STRUCT. .75-10				M		0000	EA	36.00	36.00	10-00		000314
04	N272P35	LOCKNUT .75-10				M		0000	EA	36.00	36.00	11-00		000315
04	N402P48B	WASHER .75				*		0000	EA	36.00	36.00	12-00		000316
04	A15F6C18	RTV SILICONE SEALANT				M		0000	OZ	AR		13-00		000317
04	47C381088P17	WASHER 2.00				M		0000	EA	24.00	24.00	14-00		000318
04	47C381088P1	WASHER,1.00 DIA				M		0000	EA	20.00	20.00	15-00		000319
03	47E382265P1	SIDE SUPPORT				M		0000	EA	1.00	1.00	2-00		000320
03	47E382265P2	SIDE SUPPORT				M		0000	EA	1.00	1.00	3-00		000321
03	47D382577P1	TOP STRUCTURE,AFT				M		0000	EA	1.00	1.00	4-00		000322
03	47E382272P1	ROTOR ADAPTER STRL				M		0000	EA	1.00	1.00	5-00		000323
03	47C381036P2	BOLT,FATIGUE RATED				B		0000	EA	32.00	32.00	6-00		000324
03	47C381036P6	BOLT,FATIGUE RATED				B		0000	EA	60.00	60.00	7-00		000325
03	47C381036P20	BOLT, FATIGUE RATED				B		0000	EA	88.00	88.00	8-00		000326
03	47C381036P10	BOLT,FATIGUE RATED				B		0000	EA	12.00	12.00	9-00		000327
03	47C381036P25	BOLT,FATIGUE RATED				B		0000	EA	36.00	36.00	10-00		000328
03	47C381087P2	LOCKNUT				B		0000	EA	92.00	92.00	11-00		000329
03	47C381087P6	LOCKNUT				B		0000	EA	12.00	12.00	12-00		000330
03	47C381087P10	LOCKNUT				B		0000	EA	124.00	124.00	13-00		000331
03	47C381088P1	WASHER,1.00 DIA				M		0000	EA	92.00	92.00	14-00		000332
03	47C381088P5	WASHER,1.25 DIA				B		0000	EA	12.00	12.00	15-00		000333
03	47C381088P9	WASHER,1.50 DIA				M		0000	EA	136.00	136.00	16-00		000334
03	90681A487	PIN,TAPER				B		0000	EA	6.00	6.00	17-00	39428	000335
03	47D382575P1	TOP STRUCTURE FWD				M		0000	EA	1.00	1.00	18-00		000336
03	47E382578P1	CRANE,MOUNTING STRL				M		0000	EA	1.00	1.00	19-00		000337
03	47D382572P1	SPACER,ADAPTER				M		0000	EA	1.00	1.00	20-00		000338
03	47D382572P2	SPACER,ADAPTER				M		0000	EA	1.00	1.00	21-00		000339
03	47D382572P3	SPACER,ADAPTER				M		0000	EA	1.00	1.00	22-00		000340
03	47D382572P4	SPACER,ADAPTER				M		0000	EA	1.00	1.00	23-00		000341
03	47D382572P5	SPACER,SIDE SUPPORT				M		0000	EA	4.00	4.00	24-00		000342
03	47D382572P6	SPACER,SIDE SUPPORT				M		0000	EA	2.00	2.00	25-00		000343
03	47D382572P7	SPACER,SIDE SUPPORT				M		0000	EA	2.00	2.00	26-00		000344
03	47C381088P2	WASHER,1.00 DIA				M		0000	EA	105.00	105.00	27-00		000345
03	47C381088P10	WASHER,1.50 DIA				B		0000	EA	136.00	136.00	28-00		000346
03	47C381088P6	WASHER,1.25 DIA				B		0000	EA	12.00	12.00	29-00		000347
03	47C381036P26	BOLT,FATIGUE RATED				B		0000	EA	12.00	12.00	30-00		000348
03	47C381087P9	NUT				B		0000	EA	12.00	12.00	31-00		000349
03	47C381036P1	BOLT,FATIGUE RATED				B		0000	EA	14.00	14.00	32-00		000350
03	47B382580P1	SEAL,TOP STRUCTURE				M		0000	EA	1.00	1.00	33-00		000351

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	47D382588P1	CROSS SPRT TOP STRL				M		0000	EA	1.00	1.00	34-00		000352
03	47B382580P2	SEAL,TOP STRUCTURE				M		0000	EA	1.00	1.00	35-00		000353
03	47B382580P3	SEAL,TOP STRUCTURE				M		0000	EA	2.00	2.00	36-00		000354
03	N733P35040B	BOLT, STRUCT. .75-10				M		0000	EA	20.00	20.00	37-00		000355
03	N733P35064B	BOLT,STRL				B		0000	EA	8.00	8.00	38-00		000356
03	N402P18B	WASHER, 3/4 DIA.				B		0000	EA	56.00	56.00	39-00		000357
03	N272P35	LOCKNUT .75-10				M		0000	EA	28.00	28.00	40-00		000358
03	47D382576P1	TOP,STRL,AFT,WLDMT				M		0000	EA	1.00	1.00	41-00		000359
03	47D382574P1	TOP,STRL,FWD,WLDMT				M		0000	EA	1.00	1.00	42-00		000360
03	47E382264P1	SIDE SUPPORT,WLDMT				M		0000	EA	1.00	1.00	43-00		000361
03	47E382271P1	ROTOR ADAPTER,WLDMT				M		0000	EA	1.00	1.00	44-00		000362
02	47E382553G1	GEARBOX INSTALLATION				M		0000	EA	1.00	1.00	2-00		000363
03	47E381046P1	GEARBOX ENVELOPE				B		0000	EA	1.00	1.00	1-00		000364
03	NUMBER-14	TAPER PIN 6.00 LG				B		0000	EA	4.00	4.00	2-00	76054	000365
03	47C381036P50	BOLT				B		0000	EA	36.00	36.00	3-00		000366
03	47C381088P21	WASHER				B		0000	EA	36.00	36.00	4-00		000367
03	47C381087P22	LOCKNUT				B		0000	EA	36.00	36.00	5-00		000368
03	47C381088P22	WASHER				B		0000	EA	36.00	36.00	6-00		000369
02	47D382589G1	GEN & HS SFT INSTL				M		0000	EA	1.00	1.00	3-00		000370
03	**47D382589-1	GENERATOR				B		0000	EA	1.00	1.00	1-00		000371
03	47D381078P1	HIGH SPEED SFT ASSY				B		0000	EA	1.00	1.00	2-00		000372
02	47D382596G1	AUX CRANE INSTL				M		0000	EA	1.00	1.00	4-00		000373
03	P20-10-30-20	CRANE				B		0000	EA	1.00	1.00	1-00	58811	000374
03	N405P49B	LOCKWASHER				B		0000	EA	36.00	36.00	2-00		000375
03	N22P36064B	BOLT				B		0000	EA	36.00	36.00	3-00		000376
02	47D382606G1	FAIRING INSTALLATION				M		0000	EA	1.00	1.00	5-00		000377
03	47E381113P1	FAIRING ENVELOPE				B		0000	EA	1.00	1.00	1-00		000378
03	47D382606P2	SEALING STRIP				M		0000	EA	AR		2-00		000379
03	47D382606P3	ADHESIVE(SEE NOTE 4)				B		0000	EA	AR		3-00		000380
03	BN360-813-3	BLIND NUT ASSY				B	5	0000	EA	56.00	56.00	4-00	73197	000381
03	N24P29048C	SCREW,HEX HD				B		0000	EA	48.00	48.00	5-00		000382
03	N405P15C	WASHER,LOCK				B	5	0000	EA	56.00	56.00	6-00		000383
03	N402P15C	WASHER 1/2 DIA				B	5	0000	EA	56.00	56.00	7-00		000384
03	N24P29024C	SCREW,HEX HD				B		0000	EA	8.00	8.00	8-00		000385
03	**47D382606-9	WINT SENSOR MAST				M		0000	EA	2.00	2.00	9-00		000386
02	**47E382597-6	ELECT EQUIP INSTL				M		0000	EA	1.00	1.00	6-00		000387
02	47E382472G1	LAD & FALSE FL INSTL				M		0000	EA	1.00	1.00	7-00		000388
03	47D382430G1	TRAP DR, BEDPL / TWR				M		0000	EA	2.00	2.00	1-00		000389
04	47D382430P1	COVER				M		0000	EA	1.00	2.00	1-00		000390

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM CROSS REF
04	47D382430P2	ANGLE				M		0000	EA	2.00	4.00	2-00	000391
04	47D382430P3	ANGLE				M		0000	EA	2.00	4.00	3-00	000392
04	47D382430P4	RIB				M		0000	EA	2.00	4.00	4-00	000393
04	47D382430P5	PLATE				M		0000	EA	1.00	2.00	5-00	000394
04	47D382430P6	BAR				M		0000	EA	1.00	2.00	6-00	000395
04	47B382131P1	ENCLOSURE, DOOR				*		0000	EA	1.00	2.00	7-00	000396
04	47C381030P1	HINGE, TRAP DOOR				*		0000	EA	1.00	2.00	8-00	000397
03	47D382430G2	TRAP DR, BEDPL / TWR				M		0000	EA	2.00	2.00	2-00	000398
04	47D382430P1	COVER				M		0000	EA	1.00	2.00	1-00	000399
04	47D382430P2	ANGLE				M		0000	EA	2.00	4.00	2-00	000400
04	47D382430P3	ANGLE				M		0000	EA	2.00	4.00	3-00	000401
04	47D382430P4	RIB				M		0000	EA	2.00	4.00	4-00	000402
04	47D382430P6	BAR				M		0000	EA	1.00	2.00	6-00	000403
04	47B382131P1	ENCLOSURE, DOOR				*		0000	EA	1.00	2.00	7-00	000404
04	47C381030P1	HINGE, TRAP DOOR				*		0000	EA	1.00	2.00	8-00	000405
03	47D382474G1	TRAP DR,BEDPL / LUBE				M		0000	EA	1.00	1.00	3-00	000406
04	47D382474P1	COVER				M		0000	EA	1.00	1.00	1-00	000407
04	47D382474P2	ANGLE				M		0000	EA	2.00	2.00	2-00	000408
04	47D382474P3	ANGLE				M		0000	EA	2.00	2.00	3-00	000409
04	47D382474P4	RIB				M		0000	EA	2.00	2.00	4-00	000410
04	47D382474P5	PLATE				M		0000	EA	1.00	1.00	5-00	000411
04	47D382474P6	BAR				M		0000	EA	1.00	1.00	6-00	000412
04	47B382131P1	ENCLOSURE, DOOR				*		0000	EA	1.00	1.00	7-00	000413
04	47C381030P1	HINGE, TRAP DOOR				*		0000	EA	1.00	1.00	8-00	000414
03	47D382474G2	TRAP DR,BEDPL / LUBE				M		0000	EA	1.00	1.00	4-00	000415
04	47D382474P1	COVER				M		0000	EA	1.00	1.00	1-00	000416
04	47D382474P2	ANGLE				M		0000	EA	2.00	2.00	2-00	000417
04	47D382474P3	ANGLE				M		0000	EA	2.00	2.00	3-00	000418
04	47D382474P4	RIB				M		0000	EA	2.00	2.00	4-00	000419
04	47D382474P6	BAR				M		0000	EA	1.00	1.00	6-00	000420
04	47B382131P1	ENCLOSURE, DOOR				*		0000	EA	1.00	1.00	7-00	000421
04	47C381030P1	HINGE, TRAP DOOR				*		0000	EA	1.00	1.00	8-00	000422
03	47D382465P1	FRAME,TRAP DOOR				M		0000	EA	2.00	2.00	5-00	000423
03	47C382475P1	MOUNTING BLOCK				M		0000	EA	2.00	2.00	6-00	000424
03	**47E382472-7	FALSE FLOOR				M		0000	EA	1.00	1.00	7-00	000425
03	47E382472P8	ROOF SCUTTLE				B		0000	EA	1.00	1.00	8-00	000426
03	**47E382472-9	LADDER,ROOF				M		0000	EA	1.00	1.00	9-00	000427
03	**47E382472-10	LADDER,TOWER				M		0000	EA	2.00	2.00	10-00	000428
03	47E382472P11	SEALING STRIP				M		0000	EA	AR		11-00	000429
03	N727P29016B	BOLT,STRUCTURAL				B		0000	EA	32.00	32.00	12-00	000430
03	N402P45B	WASHER				B		0000	EA	72.00	72.00	13-00	000431
03	N265P29B	NUT,SELF-LOCKING .50*				*		0000	EA	112.00	112.00	14-00	000432

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG		FSCM CROSS REF
03	N727P29036B	BOLT,STRUCTURAL				B		0000	EA	48.00	48.00	15-00		000433
03	91151A033	WASHER,BEVEL				B		0000	EA	40.00	40.00	16-00	39428	000434
03	N727P29052B	BOLT,STRUCTURAL				B		0000	EA	28.00	28.00	17-00		000435
03	**47E382472-18	BRACKET,LADDER				M		0000	EA	8.00	8.00	18-00		000436
03	**47E382472-19	BRACKET,LADDER				M		0000	EA	1.00	1.00	19-00		000437
03	**47E382472-20	BRACKET,LADDER				M		0000	EA	1.00	1.00	20-00		000438
03	**47E382472-21	BRACKET,LADDER				M		0000	EA	2.00	2.00	21-00		000439
03	N727P29028B	BOLT,STRUCTURAL				B		0000	EA	24.00	24.00	22-00		000440
03	A15F6C18	RTV SILICONE SEALANT				M		0000	OZ	AR		23-00		000441
02	47E382570G1	LUBE PLATFORM INSTL				M		0000	EA	1.00	1.00	8-00		000442
03	47E382579G1	COOLING PLATFORM ASM				M		0000	EA	1.00	1.00	1-00		000443
04	47E382556G1	GEARBOX/CLG PLATFORM				M		0000	EA	1.00	1.00	1-00		000444
05	47E382556P1	ANGLE,4 X 4 X 3/8				M		0000	EA	4.00	4.00	1-00		000445
05	47E382556P2	CHANNEL,8~20 LB				M		0000	EA	2.00	2.00	2-00		000446
05	47E382556P3	CHANNEL,6~16.3 LB				M		0000	EA	4.00	4.00	3-00		000447
05	47E382556P4	ANGLE,3X3~7.2 LB				M		0000	EA	4.00	4.00	4-00		000448
05	47E382556P5	CHANNEL,8~20 LB				M		0000	EA	4.00	4.00	5-00		000449
05	47E382556P6	9-IN X 2 1/2 DP DECK				M		0000	EA	14.00	14.00	6-00		000450
05	47E382556P7	6-IN X 2 1/2 DP DECK				M		0000	EA	1.00	1.00	7-00		000451
05	47E382556P8	9-IN X 2 1/2 DP DECK				M		0000	EA	1.00	1.00	8-00		000452
05	47E382556P9	END PLATE 4.0 HT				M		0000	EA	2.00	2.00	9-00		000453
05	47E382556P10	SIDE PLATE 4.0 HT				M		0000	EA	2.00	2.00	10-00		000454
05	47E382556P11	ANGLE,3 X 3 X 3/8				M		0000	EA	4.00	4.00	11-00		000455
05	47E382556P12	ANGLE,3 X 3 X 3/8				M		0000	EA	4.00	4.00	12-00		000456
05	47E382556P13	ANGLE,3 X 3 X 3/8				M		0000	EA	2.00	2.00	13-00		000457
05	47E382556P14	ANGLE,3 X 3 X 3/8				M		0000	EA	2.00	2.00	14-00		000458
05	N22P28024B	SCREW,HEX HD,1/2-13				B		0000	EA	130.00	130.00	15-00		000459
05	N405P15B	LOCKWASHER				B		0000	EA	130.00	130.00	16-00		000460
05	N214FP29B	NUT,HEX,1/2-13				B		0000	EA	130.00	130.00	17-00		000461
05	1-700	CRIMPING TOOL				B		0000	EA	1.00	1.00	18-00	09098	000462
05	1-600	J-BOLT/NUT/WASHER				B		0000	EA	12.00	12.00	19-00	09098	000463
04	47C382584G1	MOT/PUMP/CLR PLATF				M		0000	EA	1.00	1.00	2-00		000464
05	47C382584P1	PLATE,BASE				M		0000	EA	1.00	1.00	1-00		000465
05	47C382584P2	BEAM,4 W 13#				M		0000	EA	2.00	2.00	2-00		000466
05	47C382584P3	BEAM,6 W 9#				M		0000	EA	2.00	2.00	3-00		000467
05	N22P33020B	SCREW,HEX HD				B		0000	EA	16.00	16.00	4-00		000468
05	N405P77B	LOCKWASHER				B		0000	EA	16.00	16.00	5-00		000469
04	350-SERIES-3DC	PUMP				B		0000	EA	1.00	1.00	3-00	59180	000470
04	326T-FRAME	MOTOR,TEFC				B		0000	EA	1.00	1.00	4-00		000471
04	N620B-SERIES-N600	COUPLING				B		0000	EA	1.00	1.00	5-00	89040	000472
04	OCS-2000D	OIL COOLER				B		0000	EA	3.00	3.00	6-00	67049	000473
04	89281/2F	CHECKVALVE,SWG,125LB				B		0000	EA	1.00	1.00	7-00	63686	000474

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	MODEL-400-D	FILTER,DUPLEX,4-IN				B		0000	EA	1.00	1.00	8-00	61424	000475
04	**47E382579-9	BASE,FILTER SUPPORT				M		0000	EA	1.00	1.00	9-00		000476
04	47C381084P1	VALVE,THERMO,AMOT				M		0000	EA	1.00	1.00	10-00		000477
04	47C381086P1	VALVE,RELIEF,4-IN				M		0000	EA	1.00	1.00	11-00		000478
04	FIG-258-32IN-LONG	SADDLE SUPPORT,4 IN				B		0000	EA	2.00	2.00	12-00	92959	000479
04	FIG-258-12.5IN-LONG	SADDLE SUPPORT,4 IN				B		0000	EA	1.00	1.00	13-00	92959	000480
04	FIG-277	PIPE ROLL & PLATE				B		0000	EA	1.00	1.00	14-00	92959	000481
04	105E-SIZE-4	TEE,FLANGED,250 LB				B		0000	EA	1.00	1.00	15-00	40475	000482
04	47E382579P16	PIPE,SCHED 40,5-IN				M		0000	FT	7.00	7.00	16-00		000483
04	290E-SIZE-5	FLANGE,SLIP-ON 300LB				B		0000	EA	2.00	2.00	17-00	40475	000484
04	47E382579P18	PIPE,SCHED 40				M		0000	FT	90.00	90.00	18-00		000485
04	290E-SIZE-4	FLANGE,SLIP-ON,300LB				B		0000	EA	12.00	12.00	19-00	40475	000486
04	264E-SIZE-4	TEE,STRAIGHT,300LB				B		0000	EA	4.00	4.00	20-00	40475	000487
04	264E-SIZE-4-X-3	TEE,REDUCING,300LB				B		0000	EA	3.00	3.00	21-00	40475	000488
04	260E-SIZE-4	ELBOW,STRAIGHT,300LB				B		0000	EA	10.00	10.00	22-00	40475	000489
04	1981/2E	UNION-3IN,300LB				B		0000	EA	6.00	6.00	23-00	40475	000490
04	47E382579P24	PIPE,SCHED 40,3IN				M		0000	FT	5.00	5.00	24-00		000491
04	FIG-268E-SIZE-3	ELBOW,STREET,300LB				B		0000	EA	6.00	6.00	25-00	40475	000492
04	260E-SIZE-4-X-3	ELBOW,REDUCING,300LB				B		0000	EA	3.00	3.00	26-00	40475	000493
04	N22P35056B	SCREW,HEX HD				B		0000	EA	120.00	120.00	27-00		000494
04	N405P48B	LOCKWASHER				B		0000	EA	120.00	120.00	28-00		000495
04	N214P35B	NUT				B		0000	EA	120.00	120.00	29-00		000496
04	N22P33036B	SCREW,HEX HD				B		0000	EA	8.00	8.00	30-00		000497
04	N405P47B	LOCKWASHER				B		0000	EA	50.00	50.00	31-00		000498
04	N214P33B	NUT				B		0000	EA	50.00	50.00	32-00		000499
04	N22P33032B	SCREW,HEX HD				B		0000	EA	10.00	10.00	33-00		000500
04	N402AP17B	PLAIN WASHER, NARROW				B		0000	EA	50.00	50.00	34-00		000501
04	N22P33020B	SCREW,HEX HD				B		0000	EA	40.00	40.00	35-00		000502
04	N22P29018B	SCREW,HEX HD				B		0000	EA	8.00	8.00	36-00		000503
04	N405P45B	WASHER, LOCK				B	5	0000	EA	8.00	8.00	37-00		000504
03	427D-SIZE-4	ELBOW,LONG				B		0000	EA	6.00	6.00	2-00	14959	000505
03	427D-SIZE-5	ELBOW,LONG				B		0000	EA	3.00	3.00	3-00	14959	000506
03	47E382570P4	PIPE ASSY				M		0000	EA	1.00	1.00	4-00		000507
03	47E382570P5	PIPE ASSY				M		0000	EA	1.00	1.00	5-00		000508
03	47E382570P6	PIPE ASSY				M		0000	EA	1.00	1.00	6-00		000509
03	47E382570P7	PIPE ASSY				M		0000	EA	1.00	1.00	7-00		000510
03	47E382570P8	PIPE ASSY				M		0000	EA	1.00	1.00	8-00		000511
03	47E382570P9	PIPE ASSY				M		0000	EA	1.00	1.00	9-00		000512
03	47E382570P10	PIPE ASSY				M		0000	EA	1.00	1.00	10-00		000513
03	47E382570P11	PIPE ASSY				M		0000	EA	1.00	1.00	11-00		000514
03	47E382570P12	PIPE ASSY				M		0000	EA	1.00	1.00	12-00		000515
03	47E382570P13	PIPE ASSY				M		0000	EA	1.00	1.00	13-00		000516
03	294E-SIZE-4	FLANGE,SLIP ON				B		0000	EA	14.00	14.00	14-00	14959	000517
03	294E-SIZE-5	FLANGE,SLIP ON				B		0000	EA	6.00	6.00	15-00	14959	000518
03	47C381039P1	EXPANSION JOINT				M		0000	EA	2.00	2.00	16-00		000519
03	47C381039P2	EXPANSION JOINT				M		0000	EA	1.00	1.00	17-00		000520
03	FIG-88-SIZE-4	U-BOLT				B		0000	EA	2.00	2.00	18-00	96723	000521
03	FIG-88-SIZE-5	U-BOLT				B		0000	EA	1.00	1.00	19-00	96723	000522

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	91151A031	WASHER,BEVEL				B		0000	EA	4.00	4.00	20-00	39428	000523
03	91151A33	WASHER,BEVEL				B		0000	EA	2.00	2.00	21-00	39428	000524
03	FIG-9-SIZE-5	HANGER,PEAR				B		0000	EA	1.00	1.00	22-00	96723	000525
03	FIG-500-5/8-DIA	ROD,THREADED				B		0000	EA	1.00	1.00	23-00	96723	000526
03	N214P33B	NUT				B		0000	EA	2.00	2.00	24-00		000527
03	N727P35056B	BOLT,STRUCTURAL				B		0000	EA	200.00	200.00	25-00		000528
03	N405P48B	LOCKWASHER				B		0000	EA	200.00	200.00	26-00		000529
03	N214P35B	NUT				B		0000	EA	200.00	200.00	27-00		000530
03	N727P35048B	BOLT,STRUCTURAL				B		0000	EA	32.00	32.00	28-00		000531
03	N402P48B	WASHER .75				*		0000	EA	32.00	32.00	29-00		000532
03	N265P35B	LOCK NUT, 3/4 DIA.				*		0000	EA	32.00	32.00	30-00		000533
03	91151A036	WASHER,BEVEL				B		0000	EA	32.00	32.00	31-00	39428	000534
03	47C382020	LUBRICATION SCHEM				X		0000	EA	X		32-00		000535
02	**47E382597-9	ELECT WW & CND INSTL				M		0000	EA	1.00	1.00	9-00		000536
02	47C381036P20	BOLT, FATIGUE RATED				B		0000	EA	120.00	120.00	10-00		000537
02	47C381087P13	NUT, FATIGUE RATED				B		0000	EA	120.00	120.00	11-00		000538
02	47C381088P14	WASHER, HARDENED STL				B		0000	EA	120.00	120.00	12-00		000539
02	47C381088P13	WASHER, HARDENED STL				B		0000	EA	120.00	120.00	13-00		000540
02	A15F6C18	RTV SILICONE SEALANT				M		0000	OZ	AR		14-00		000541
02	47D382598G1	LFT BRACKETS INSTL				M		0000	EA	1.00	1.00	15-00		000542
03	47C382485P1	LIFTING,BRKT				M		0000	EA	2.00	2.00	1-00		000543
03	47D382555P1	LIFTING BRKT				M		0000	EA	2.00	2.00	2-00		000544
03	47C381088P9	WASHER,1.50 DIA				M		0000	EA	24.00	24.00	3-00		000545
03	47C381087P9	NUT				B		0000	EA	24.00	24.00	4-00		000546
03	47C381036P24	BOLT,FATIGUE RATED				B		0000	EA	8.00	8.00	5-00		000547
03	47C381036P20	BOLT, FATIGUE RATED				B		0000	EA	8.00	8.00	6-00		000548
03	47C381036P22	BOLT,FATIGUE RATED				B		0000	EA	8.00	8.00	7-00		000549
03	47D382598P8	SPACER,STA 227.5				M		0000	EA	4.00	4.00	8-00		000550
03	47D382598P9	SPACER,STA 227.5				M		0000	EA	2.00	2.00	9-00		000551
03	47C381088P10	WASHER,1.50 DIA				B		0000	EA	24.00	24.00	10-00		000552
02	47E387062G1	CONT ELEK CAB, (CEC)				M		0000	EA	1.00	1.00	16-00		000553
03	47E381100P1	CABINET				M		0000	EA	1.00	1.00	1-00		000554
03	47D381040P1	HEAT EXCHANGER				M		0000	EA	2.00	2.00	2-00		000555
03	47E382491G1	AIR DUCT UNIT				M		0000	EA	2.00	2.00	3-00		000556
03	NP136931-A1	SIGNATURE STRIP				B	5	0000	EA	1.00	1.00	4-00		000557
03	N530P405G	SCR,DR RD HD,#4 X.31				B		0000	EA	4.00	4.00	5-00		000558
03	NP-206417	NAMEPLATE				B	5	0000	EA	1.00	1.00	6-00		000559
03	47A380070P3	NPL, AN/REV STATUS				*		0000	EA	1.00	1.00	7-00		000560
03	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		8-00		000561
03	47E387064	SCHEMATIC				X		0000	EA	X		9-00		000562
03	**47E387062-10	WIRE LIST				X		0000	EA	X		10-00		000563
03	47A380046	CONT ELEK CAB SPEC				X		0000	EA	X		11-00		000564
03	47C382234P1	GASKET				M		0000	EA	2.00	2.00	12-00		000565
03	**47E387062-13	PANEL, REAR RIGHT				M		0000	EA	1.00	1.00	13-00		000566
03	**47E387062-14	PANEL, REAR LEFT				M		0000	EA	1.00	1.00	14-00		000567

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LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	47A381067P8	I/O TRACK				M		0000	EA	8.00	8.00	15-00		000568
03	47A381067P9	120 VAC TRK INP MDL				M		0000	EA	81.00	81.00	16-00		000569
03	47A381067P10	120 VAC TRK OUT MDL				M		0000	EA	47.00	47.00	17-00		000570
03	47A381067P31	TERMINATOR PLUG				M		0000	EA	1.00	1.00	18-00		000571
03	**47E387062-19	CABLE ASSY				M		0000	EA	3.00	3.00	19-00		000572
03	47B382248P1	AIR BAF, RIGHT SIDE				M		0000	EA	1.00	1.00	20-00		000573
03	47B382248P2	AIR BAF, LEFT SIDE				M		0000	EA	1.00	1.00	21-00		000574
03	47A381067P23	CABLE, I/O TRACK				M		0000	EA	1.00	1.00	22-00		000575
03	**47E387062-23	CABLE CLAMP SUPPORT				M		0000	EA	1.00	1.00	23-00		000576
03	**47E387062-24	CABLE CLAMP SUPPORT				M		0000	EA	1.00	1.00	24-00		000577
03	**47E387062-25	CABLE CLAMP SUPPORT				M		0000	EA	1.00	1.00	25-00		000578
03	47A381045PAR	CLAMP,LOOP-CUSHIONED				M		0000	EA	AR		26-00		000579
03	A-72FSCPS	CENTER PANEL SUPPORT				M		0000	EA	2.00	2.00	27-00	00843	000580
03	A-72RP24F5	RELAY RACK ANGLE				M		0000	EA	1.00	1.00	28-00	00843	000581
03	47D387070G1	CENTER PANEL				*		0000	EA	1.00	1.00	29-00		000582
04	47D387070P1	PANEL				*		0000	EA	1.00	1.00	1-00		000583
04	47D387070P2	SPACER STRIP				*		0000	EA	2.00	2.00	2-00		000584
04	SS-024-3-ZI	SELF CLINCHING FASTE*				*		0000	EA	29.00	29.00	3-00	46384	000585
04	S-832-3-ZI	SELF CLINCHING FASTE*				*		0000	EA	6.00	6.00	4-00	46384	000586
04	S-632-3-ZI	SELF CLINCHING FASTE*				B	5	0000	EA	28.00	28.00	5-00	46384	000587
03	**47E387062-30	CABLE RETAINER				M		0000	EA	1.00	1.00	30-00		000588
03	47E387095G1	CONTROLLER ASSY				M		0000	EA	1.00	1.00	31-00		000589
04	47E387115P1	MOUNTING FRAME				M		0000	EA	1.00	1.00	1-00		000590
04	47A381067P16	POWER SUPPLY				M		0000	EA	1.00	1.00	2-00		000591
04	47A381067P18	CHASSIS				M		0000	EA	2.00	2.00	3-00		000592
04	SS00-30	HDL,RND 30 SET-OFF				B		0000	EA	2.00	2.00	4-00	08730	000593
04	47A381067P1	CTL PROCESSING UNIT				M		0000	EA	1.00	1.00	5-00		000594
04	47A381067P17	CHASSIS INTERFACE				M		0000	EA	1.00	1.00	6-00		000595
04	47A381067P3	16K EXECUTIVE MEMORY				M		0000	EA	1.00	1.00	7-00		000596
04	47A381067P5	16K RAM MEMORY				M		0000	EA	1.00	1.00	8-00		000597
04	47A381067P4	12K PROM, 4K RAM MEM				M		0000	EA	1.00	1.00	9-00		000598
04	47A381067P2	ARITH. PROCESSING				M		0000	EA	1.00	1.00	10-00		000599
04	47A381067P15	ERROR DETECTOR				M		0000	EA	1.00	1.00	11-00		000600
04	47A381067P14	WATCHDOG TIMER				M		0000	EA	1.00	1.00	12-00		000601
04	47A381067P20	FILLER BLANK				M		0000	EA	15.00	15.00	13-00		000602
04	47A381067P11	12-BIT A/D CONVERTER				M		0000	EA	2.00	2.00	14-00		000603
04	47A381067P12	12-BIT SS ANLG INPUT				M		0000	EA	3.00	3.00	15-00		000604
04	47A381067P13	12-BIT ANALOG OUTPUT				M		0000	EA	2.00	2.00	16-00		000605
04	47A381067P6	TTY & EIA INTFC MDL				M		0000	EA	3.00	3.00	17-00		000606
04	47A381067P7	I/O SYS DRIVER MDL				M		0000	EA	1.00	1.00	18-00		000607
04	3596A-3	TERMINAL BOARD				*		0000	EA	1.00	1.00	19-00	75382	000608
04	MS3596A-XP-3-38C	MARKER STRIP				*		0000	EA	1.00	1.00	20-00	75382	000609
04	9083	SPACER, THREADED				*		0000	EA	2.00	2.00	21-00	83330	000610
04	47B387082P1	SHIELD				*		0000	EA	1.00	1.00	22-00		000611
04	24205	COMPOUND, (LOCKTITE)				*		0000	OZ	AR		23-00	05972	000612
04	74755	PRIMER				*		0000	OZ	AR		24-00	05972	000613

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	N153P13024	SCREW, PAN HD, #6-32				*		0000	EA	2.00	2.00	25-00		000614
04	N415P13	WASHER, LOCK, #6				*		0000	EA	4.00	4.00	26-00		000615
04	N400P37	WASHER, FL. #6				*		0000	EA	2.00	2.00	27-00		000616
04	N226P13	NUT,PLAIN HEX, #6-32				*		0000	EA	2.00	2.00	28-00		000617
04	N416P13	WSHR,LOCK, INTL T #6				*		0000	EA	2.00	2.00	29-00		000618
04	SFSW-10F-CP-G02NA	PAN-L-SCREW, #10-32				B		0000	EA	12.00	12.00	30-00		000619
04	N153P16006	SCR, PH, #10-32				*		0000	EA	4.00	4.00	31-00		000620
04	N415P19	WASHER, LOCK, #10				*		0000	EA	4.00	4.00	32-00		000621
04	DC-37P	CONNECTOR				B		0000	EA	4.00	4.00	33-00	71468	000622
04	3341-1L	JACK SOCKET KIT				*		0000	EA	4.00	4.00	34-00	52760	000623
04	CP700-51	CONN HOUSING KIT				B		0000	EA	9.00	9.00	35-00	19006	000624
04	9158	CABLE, 5TP				B		0000	FT	AR		36-00	07903	000625
04	9160	CABLE, 8TP				B		0000	FT	AR		37-00	07903	000626
04	8741	CABLE, 2TP				B		0000	FT	AR		38-00	07907	000627
04	8740	CABLE, 1TP				B		0000	FT	AR		39-00	07907	000628
04	47A381043PAR	SLEEVING, VINYL				*		0000	FT	AR		40-00		000629
04	47A387124	WIRE LIST				X		0000	EA	X		41-00		000630
04	47E387095P42	BUSHING, STRAIN RLF				M		0000	EA	1.00	1.00	42-00		000631
04	47E387095P43	BUSHING, STRAIN RLF				M		0000	EA	8.00	8.00	43-00		000632
04	AML31EBA4AC	SWITCH, PUSH BUTTON				B		0000	EA	1.00	1.00	44-00	91929	000633
04	AML76F10T01P	SWITCH GUARD				B	5	0000	EA	1.00	1.00	45-00	91929	000634
04	**47E387095-46	LENS (RESET)				M		0000	EA	1.00	1.00	46-00		000635
04	47E387095P47	PLUG, SNAP OUT				M		0000	EA	3.00	3.00	47-00		000636
04	47E387064	SCHEMATIC				X		0000	EA	X		48-00		000637
04	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		49-00		000638
04	NP-206417	NAMEPLATE				B	5	0000	EA	1.00	1.00	50-00		000639
04	47A380070P3	NPL, AN/REV STATUS				*		0000	EA	1.00	1.00	51-00		000640
04	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		52-00		000641
04	47A381037P1	LACING TAPE				*		0000	FT	AR		53-00		000642
04	47A380071PAR	SLEEVING, SHRINK				*		0000	FT	AR		54-00		000643
03	**47E387062-32	TACHOMETER PANEL				M		0000	EA	1.00	1.00	32-00		000644
03	47E387072G1	I&C SIG CONDITIONER				*		0000	EA	1.00	1.00	33-00		000645
04	47D387073P1	PANEL,FRONT				*		0000	EA	1.00	1.00	1-00		000646
04	47D387074P1	PANEL,RIGHT SIDE				*		0000	EA	1.00	1.00	2-00		000647
04	47D387074P2	PANEL,LEFT SIDE				*		0000	EA	1.00	1.00	3-00		000648
04	47C387075P1	PANEL,REAR				*		0000	EA	1.00	1.00	4-00		000649
04	FCA4	HANDLE				B	5	0000	EA	2.00	2.00	5-00	08730	000650
04	47D387083G1	ASSY, MOTHER BD-SIGN*				*		0000	EA	1.00	1.00	6-00		000651
05	47E387090P1	DRILL & TRIM				*		0000	EA	1.00	1.00	1-00		000652
05	47B387086P1	ANGLE				*		0000	EA	2.00	2.00	2-00		000653
05	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		3-00		000654
05	47D387083P4	TERMINAL BLOCK				*		0000	EA	1.00	1.00	4-00		000655
05	47D387083P5	TERMINAL BLOCK				*		0000	EA	1.00	1.00	5-00		000656
05	RC36-8542-5	RECEPTACLE				*		0000	EA	10.00	10.00	6-00	57856	000657
05	3432-4205	HEADER				*		0000	EA	10.00	10.00	7-00	52760	000658
05	N153P9010	SCREW,PAN HD #4-40X5*				*		0000	EA	20.00	20.00	8-00		000659

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
05	N415P11	WASHER, LOCK, #4				*		0000	EA	20.00	20.00	9-00		000660
05	N226P9	NUT, HEX, #4-40				*		0000	EA	20.00	20.00	10-00		000661
05	AD34BS	RIVET				*		0000	EA	9.00	9.00	11-00	7707	000662
05	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		12-00		000663
04	47B387076G1	MTG. BRACKET,CIRCUIT*				*		0000	EA	2.00	2.00	7-00		000664
05	47B387076P1	BRACKET				*		0000	EA	1.00	2.00	1-00		000665
05	CLSS-032-3ZI	SELF CLINCHING FASTE*				*		0000	EA	1.00	2.00	3-00	46384	000666
05	CLS-832-3ZI	SELF CLINCHING FASTE*				*		0000	EA	2.00	4.00	4-00	46384	000667
04	47B387076G2	MTG. BRACKET,CIRCUIT*				*		0000	EA	2.00	2.00	8-00		000668
05	47B387076P2	BRACKET				*		0000	EA	1.00	2.00	2-00		000669
05	CLSS-032-3ZI	SELF CLINCHING FASTE*				*		0000	EA	1.00	2.00	3-00	46384	000670
05	CLS-832-3ZI	SELF CLINCHING FASTE*				*		0000	EA	2.00	4.00	4-00	46384	000671
04	HE215	POWER SUPPLY				B	5	0000	EA	1.00	1.00	9-00	18655	000672
04	PM345	POWER SUPPLY				*		0000	EA	1.00	1.00	10-00	18655	000673
04	RGR17-.250	GUIDE RAIL,CARD				*		0000	EA	4.00	4.00	11-00	57856	000674
04	051-64-002-41	GUIDE				B	5	0000	EA	20.00	20.00	12-00	57856	000675
04	NP-206417	NAMEPLATE				B	5	0000	EA	1.00	1.00	13-00		000676
04	47A380070P3	NPL, AN/REV STATUS				*		0000	EA	1.00	1.00	14-00		000677
04	47B387078P1	SUPPORT ANGLE,CABLE				*		0000	EA	1.00	1.00	15-00		000678
04	47B387079P1	MTG. BRACKET				*		0000	EA	2.00	2.00	16-00		000679
04	47B381059P4	CONNECTOR CUTOUT COV*				*		0000	EA	3.00	3.00	17-00		000680
04	47D387040G1	POWER SIGNAL CONDITI*				*		0000	EA	1.00	1.00	18-00		000681
04	47D387043G1	SYNCRO TO CURRENT CO*				*		0000	EA	2.00	2.00	19-00		000682
04	47D387032G1	GEAR BOX SIGNAL COND*				*		0000	EA	1.00	1.00	20-00		000683
04	47D387034G1	WIND SIGNAL CONDITIO*				*		0000	EA	1.00	1.00	21-00		000684
04	47E387037G1	ASSY,SYN SIG COND BD				*		0000	EA	2.00	2.00	22-00		000685
05	BB03-0501	BOARD				B		0000	EA	1.00	2.00	1-00	57856	000686
05	47A387039	WIRE LIST				X		0000	EA	X		2-00		000687
05	IC-308-WGG	SOCKET, 8-PIN				B		0000	EA	6.00	12.00	3-00	55322	000688
05	SC-1W3-GG	SOCKET				B		0000	EA	16.00	32.00	4-00	55322	000689
05	SC-1W1-GG-1	TERMINAL				B		0000	EA	15.00	30.00	5-00	55322	000690
05	DSS-C4	SWITCH COVER				M		0000	EA	1.00	2.00	6-00	95146	000691
05	AP 616-G-E	ADAPTER PLUG				M		0000	EA	2.00	4.00	7-00	55322	000692
05	BB248	TERMINAL				B		0000	EA	21.00	42.00	8-00	57856	000693
05	T-1S5-G	TERMINAL				B		0000	EA	6.00	12.00	9-00	55322	000694
05	N153P9006	SCR,PNH 4-40 X.375LG				B		0000	EA	2.00	4.00	10-00		000695
05	N400P35	WASHER,FLAT, NO. 4				*		0000	EA	2.00	4.00	11-00		000696
05	N415P11	WASHER, LOCK, #4				*		0000	EA	2.00	4.00	12-00		000697
05	47B381099PAR	WIRE,AWG 30,SLDRLESS				B		0000	FT	AR		13-00		000698
05	T-1S1-G	TERMINAL				B		0000	EA	21.00	42.00	14-00	55322	000699
05	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		15-00		000700
05	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		16-00		000701
05	47D387038	SCHEMATIC				X		0000	EA	X		17-00		000702

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
05	AWG-26-TYPE-S	BUS WIRE / QQ-W-343				B		0000	FT	AR		18-00		000703
05	CK06BX104K	CAPACITOR, .1 MFD				B	5	0000	EA	1.00	2.00 C1	-00	95275	000704
05	CK06BX104K	CAPACITOR, .1 MFD				B	5	0000	EA	1.00	2.00 C2	-00	95275	000705
05	150D106X9035R2	CAPACITOR, 10 MFD				B	5	0000	EA	1.00	2.00 C3	-00	56289	000706
05	CK06BX104K	CAPACITOR, .1 MFD				B	5	0000	EA	1.00	2.00 C4	-00	95275	000707
05	CK06BX104K	CAPACITOR, .1 MFD				B	5	0000	EA	1.00	2.00 C5	-00	95275	000708
05	RNC55H4530FS	RESISTOR, 453 OHMS				B		0000	EA	1.00	2.00 R1	-00		000709
05	RNC55H1102FS	RESISTOR, 11 K				B	5	0000	EA	1.00	2.00 R10	-00		000710
05	RNC55H1102FS	RESISTOR, 11 K				B	5	0000	EA	1.00	2.00 R11	-00		000711
05	3009P-1-202	POTENTIOMETER, 2 K				B		0000	EA	1.00	2.00 R12	-00	32997	000712
05	RNC55H9091FS	RESISTOR, 9.09 K				B	5	0000	EA	1.00	2.00 R13	-00		000713
05	RNC55H1001FS	RESISTOR				B	5	0000	EA	1.00	2.00 R14	-00		000714
05	3009P-1-202	POTENTIOMETER, 2 K				B		0000	EA	1.00	2.00 R15	-00	32997	000715
05	RNC55H1912FS	RESISTOR, 19.1 K				B	5	0000	EA	1.00	2.00 R16	-00		000716
05	3009P-1-501	POTENTIOMTR 500 OHMS				B		0000	EA	1.00	2.00 R17	-00	32997	000717
05	3009P-1-501	POTENTIOMTR 500 OHMS				B		0000	EA	1.00	2.00 R18	-00	32997	000718
05	3009P-1-501	POTENTIOMTR 500 OHMS				B		0000	EA	1.00	2.00 R19	-00	32997	000719
05	3009P-1-102	POTENTIOMETER, 1 K				B	7	0000	EA	1.00	2.00 R2	-00	32997	000720
05	3009P-1-501	POTENTIOMTR 500 OHMS				B		0000	EA	1.00	2.00 R20	-00	32997	000721
05	RNC55H1003FS	RESISTOR, 100 K				B	5	0000	EA	1.00	2.00 R3	-00		000722
05	RNC55H1271FS	RESISTOR, 1.27 K				B		0000	EA	1.00	2.00 R4	-00		000723
05	RNC55H1003FS	RESISTOR, 100 K				B	5	0000	EA	1.00	2.00 R5	-00		000724
05	RNC55H1003FS	RESISTOR, 100 K				B	5	0000	EA	1.00	2.00 R6	-00		000725
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	2.00 R7	-00		000726
05	RNC55H1333FS	RESISTOR, 133 K				B		0000	EA	1.00	2.00 R8	-00		000727
05	RNC55H3922FS	RESISTOR, 39.2 K				B	5	0000	EA	1.00	2.00 R9	-00		000728
05	DSS-4	SWITCH				B		0000	EA	1.00	2.00 S1	-00	95146	000729
05	SA810-C-96-0	SYN TO DC CONVERTER				M		0000	EA	1.00	2.00 U1	-00	14352	000730
05	TL087CP	OPERATIONAL AMPL				M		0000	EA	1.00	2.00 U2	-00	01295	000731
05	TL087CP	OPERATIONAL AMPL				M		0000	EA	1.00	2.00 U3	-00	01295	000732
05	TL087CP	OPERATIONAL AMPL				M		0000	EA	1.00	2.00 U4	-00	01295	000733
05	TL087CP	OPERATIONAL AMPL				M		0000	EA	1.00	2.00 U5	-00	01295	000734
05	2B20B	VOLT TO CUR CONV				M		0000	EA	1.00	2.00 U6	-00	24355	000735
05	2B20B	VOLT TO CUR CONV				M		0000	EA	1.00	2.00 U7	-00	24355	000736
05	TL087CP	OPERATIONAL AMPL				M		0000	EA	1.00	2.00 U8	-00	01295	000737
04	47D387087G1	ASSY, COLOR CODED FL*				*		0000	EA	7.00	7.00	23-00		000738
05	3502-1000	CONNECTOR				*		0000	EA	1.00	7.00	1-00	75037	000739
05	3417-7040	CONNECTOR				B	5	0000	EA	1.00	7.00	2-00	75037	000740
05	3302-37	CABLE 12" LG				*		0000	EA	1.00	7.00	3-00	75037	000741
04	3341-1L	JACK SOCKET KIT				*		0000	EA	7.00	7.00	24-00	52760	000742
04	47A381045P3	CLAMP,CABLE (.187 DI*				*		0000	EA	2.00	2.00	25-00		000743
04	47A381045P6	CLAMP,CABLE (.375 DI*				*		0000	EA	4.00	4.00	26-00		000744
04	3596A-3	TERMINAL BOARD				*		0000	EA	1.00	1.00	27-00	75382	000745
04	MS3596A-XP-3-38C	MARKER STRIP				*		0000	EA	1.00	1.00	28-00	75382	000746
04	9083	SPACER, THREADED				*		0000	EA	2.00	2.00	29-00	83330	000747
04	47B387082P1	SHIELD				*		0000	EA	1.00	1.00	30-00		000748

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	24205	COMPOUND, (LOCKTITE)				*		0000	OZ	AR		31-00	05972	000749
04	5596A-8	TERMINAL BOARD				*		0000	EA	1.00	1.00	32-00	75382	000750
04	N153P15010	SCR, PH, #8-32				*		0000	EA	4.00	4.00	33-00		000751
04	N415P16	WASHER, LOCK, #8				*		0000	EA	30.00	30.00	34-00		000752
04	N678P15008	SCREW, FLAT HD				B	5	0000	EA	2.00	2.00	35-00		000753
04	N226P15	NUT, HEX, #8-32				B	5	0000	EA	6.00	6.00	36-00		000754
04	N153P16010	SCREW,PAN HD #10-32X*				*		0000	EA	4.00	4.00	37-00		000755
04	N415P19	WASHER, LOCK, #10				*		0000	EA	20.00	20.00	38-00		000756
04	N226P16	NUT, HEX, #10-32				*		0000	EA	16.00	16.00	39-00		000757
04	N153P15005	SCREW,PAN HD #8-32X5*				*		0000	EA	12.00	12.00	40-00		000758
04	N153P9003	SCREW,PAN HD #4-40X3*				*		0000	EA	4.00	4.00	41-00		000759
04	N415P11	WASHER, LOCK, #4				*		0000	EA	6.00	6.00	42-00		000760
04	N153P16007	SCREW, PAN HD				*		0000	EA	8.00	8.00	43-00		000761
04	N153P15005	SCREW,PAN HD #8-32X5*				*		0000	EA	4.00	4.00	44-00		000762
04	N153P13024	SCREW, PAN HD, #6-32				*		0000	EA	2.00	2.00	45-00		000763
04	N415P13	WASHER, LOCK, #6				*		0000	EA	6.00	6.00	46-00		000764
04	N400P37	WASHER, FL. #6				*		0000	EA	2.00	2.00	47-00		000765
04	N226P13	NUT,PLAIN HEX, #6-32				*		0000	EA	2.00	2.00	48-00		000766
04	N153P16005	SCREW,PAN HD #10-32X*				*		0000	EA	6.00	6.00	49-00		000767
04	N153P9012	SCREW,PAN HD #4-40X3*				*		0000	EA	2.00	2.00	50-00		000768
04	N226P9	NUT, HEX, #4-40				*		0000	EA	2.00	2.00	51-00		000769
04	47A387088	WIRE LIST				X		0000	EA	X		52-00		000770
04	L10BP12012	SCREW,PAN HD.M4X12				*		0000	EA	8.00	8.00	53-00		000771
04	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		54-00		000772
04	47A381037P1	LACING TAPE				*		0000	FT	AR		55-00		000773
04	47A381043PAR	SLEEVING, VINYL				*		0000	FT	AR		56-00		000774
04	44A0111-16-9	WIRE, AWG #16				B	5	0000	FT	AR		57-00	06090	000775
04	N400P39	WASHER, FLAT, #10				*		0000	EA	2.00	2.00	58-00		000776
04	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		59-00		000777
04	47E387061	SCHEMATIC				X		0000	EA	X		60-00		000778
04	N416P13	WSHR,LOCK, INTL T #6				*		0000	EA	1.00	1.00	61-00		000779
04	74755	PRIMER				*		0000	OZ	AR		62-00	05972	000780
04	MS5596-XP-8-8C	MARKER STRIP				*		0000	EA	1.00	1.00	63-00	75382	000781
04	47A380069P52	NAMEPLATE, IDENT (TB*				*		0000	EA	1.00	1.00	64-00		000782
04	44A0111-22-9	WIRE, #22 AWG				B	5	0000	FT	AR		65-00	06090	000783
04	47A380071PAR	SLEEVING, SHRINK				*		0000	FT	AR		66-00		000784
04	1488-6	SOLDER LUG				*		0000	EA	2.00	2.00	67-00	83330	000785
04	18RA-6	TERMINAL, LUG				*		0000	EA	8.00	8.00	68-00	59730	000786
04	18RA-6FLX	TERMINAL LUG, CRIMP				B	5	0000	EA	8.00	8.00	69-00	56501	000787
04	18RA-10	TERMINAL LUG, RING (*				*		0000	EA	4.00	4.00	70-00	56501	000788
04	30B-010	WIRE WRAP WIRE (1")				*		0000	FT	AR		71-00	8666	000789
04	30W-020	WIRE WRAP WIRE (2")				*		0000	FT	AR		72-00	8666	000790
04	30Y-030	WIRE WRAP WIRE (3")				*		0000	FT	AR		73-00	8666	000791
04	30R-040	WIRE WRAP WIRE (4")				*		0000	FT	AR		74-00	8666	000792
04	30BLK-050	WIRE WRAP WIRE (5")				*		0000	FT	AR		75-00	8666	000793
04	30B-060	WIRE WRAP WIRE (6")				*		0000	FT	AR		76-00	8666	000794
04	30W-070	WIRE WRAP WIRE (7")				*		0000	FT	AR		77-00	8666	000795
04	30Y-080	WIRE WRAP WIRE (8")				*		0000	FT	AR		78-00	8666	000796
04	30R-090	WIRE WRAP WIRE (9")				*		0000	FT	AR		79-00	8666	000797

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	30BLK-100	WIRE WRAP WIRE,(10")				*		0000	FT	AR		80-00	8666	000798
04	WB-16	WIRE WRAP WIRE, ROLL				*		0000	FT	AR		81-00	8666	000799
03	47E387093G1	WIND TRANSLATOR				M		0000	EA	1.00	1.00	34-00		000800
03	**47E387062-35	SPCR, CABLE RETAINER				M		0000	EA	1.00	1.00	35-00		000801
03	**47E387062-36	WIRE DUCT				M		0000	EA	2.00	2.00	36-00		000802
03	**47E387062-37	WIRE DUCT COVER				M		0000	EA	2.00	2.00	37-00		000803
03	722140	TERMINAL STRIP				M		0000	EA	8.00	8.00	38-00	52458	000804
03	**47E387062-39	MARKER STRIP				M		0000	EA	8.00	8.00	39-00		000805
03	**47E387062-40	CABLE ASSY, W1				M		0000	EA	1.00	1.00	40-00		000806
03	**47E387062-41	CABLE ASSY, W2				M		0000	EA	1.00	1.00	41-00		000807
03	**47E387062-42	CABLE ASSY, W3				M		0000	EA	1.00	1.00	42-00		000808
03	**47E387062-43	CABLE ASSY, W4				M		0000	EA	1.00	1.00	43-00		000809
03	**47E387062-44	CABLE ASSY, W5				M		0000	EA	1.00	1.00	44-00		000810
03	**47E387062-45	CABLE ASSY, W6				M		0000	EA	1.00	1.00	45-00		000811
03	**47E387062-46	CABLE ASSY, W7				M		0000	EA	1.00	1.00	46-00		000812
03	**47E387062-47	CABLE ASSY, W8				M		0000	EA	1.00	1.00	47-00		000813
03	**47E387062-48	CABLE ASSY, W9				M		0000	EA	1.00	1.00	48-00		000814
03	**47E387062-49	CABLE ASSY, W10				M		0000	EA	1.00	1.00	49-00		000815
03	47E387065G1	PANEL, RIGHT SIDE				*		0000	EA	1.00	1.00	50-00		000816
04	47E387065P1	PANEL,RIGHT SIDE				*		0000	EA	1.00	1.00	1-00		000817
04	S-0420-2-ZI	SELF CLINCHING FASTE*				*		0000	EA	12.00	12.00	2-00	46384	000818
04	SS-024-3-ZI	SELF CLINCHING FASTE*				*		0000	EA	45.00	45.00	3-00	46384	000819
04	S-832-3-ZI	SELF CLINCHING FASTE*				*		0000	EA	2.00	2.00	4-00	46384	000820
04	S-632-3-ZI	SELF CLINCHING FASTE*				B	5	0000	EA	6.00	6.00	5-00	46384	000821
03	**47E387062-51	WIRE DUCT				M		0000	EA	1.00	1.00	51-00		000822
03	**47E387062-52	WIRE DUCT COVER				M		0000	EA	1.00	1.00	52-00		000823
03	47C387096G1	MTG BRACKET ASSY				M		0000	EA	2.00	2.00	53-00		000824
04	47C387096P1	MTG BRACKET				M		0000	EA	1.00	2.00	1-00		000825
04	CLS-632-3	SELF CLINCHING FSTNR				B		0000	EA	8.00	16.00	2-00	46384	000826
04	47A380102	FINISH				X		0000	PT	X		3-00		000827
03	**47E387062-54	BLANK PANEL				M		0000	EA	1.00	1.00	54-00		000828
03	N30AP16010	SCR, HEX HD, #10-32				B		0000	EA	151.00	151.00	55-00		000829
03	N415P19	WASHER, LOCK, #10				*		0000	EA	187.00	187.00	56-00		000830
03	N226P16	NUT, HEX, #10-32				*		0000	EA	103.00	103.00	57-00		000831
03	N30AP21010	SCR, HEX HD, #1/4-20				B		0000	EA	37.00	37.00	58-00		000832
03	N415P25	WASHER, LOCK, (1/4)				B		0000	EA	37.00	37.00	59-00		000833
03	N400P39	WASHER, FLAT, #10				*		0000	EA	60.00	60.00	60-00		000834
03	SFSW10F16CP-G02NA	SCR, PANEL, #10-32				B		0000	EA	12.00	12.00	61-00	12324	000835
03	SFSW10F8CP-G02NA	SCR, PANEL, #10-32				B	5	0000	EA	12.00	12.00	62-00	12324	000836
03	N678P15016	SCR, FLAT HD, #8-32				B		0000	EA	9.00	9.00	63-00		000837
03	N415P16	WASHER, LOCK, #8				*		0000	EA	19.00	19.00	64-00		000838
03	N226P15	NUT, HEX, #8-32				B	5	0000	EA	9.00	9.00	65-00		000839
03	N153P9014	SCR, PH, #4-40				B		0000	EA	32.00	32.00	66-00		000840
03	N415P11	WASHER, LOCK, #4				*		0000	EA	32.00	32.00	67-00		000841

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	N226P9	NUT, HEX, #4-40				*		0000	EA	32.00	32.00	68-00		000842
03	N334P1502	RIVET,DOMED HD,BLIND				B		0000	EA	50.00	50.00	69-00		000843
03	N30AP16007	SCR, HEX HD, #10-32				B		0000	EA	30.00	30.00	70-00		000844
03	A-PS1420CM	CLAMPING NUT				B		0000	EA	9.00	9.00	71-00	00843	000845
03	N153P16006	SCR, PH, #10-32				*		0000	EA	18.00	18.00	72-00		000846
03	N153P15010	SCR, PH, #8-32				*		0000	EA	6.00	6.00	73-00		000847
03	N153P13016	SCR, PH, #6-32				B		0000	EA	13.00	13.00	74-00		000848
03	N415P13	WASHER, LOCK, #6				*		0000	EA	29.00	29.00	75-00		000849
03	N153P15006	SCR, PH, #8-32				*		0000	EA	4.00	4.00	76-00		000850
03	N153P13004	SCR, PH, #6-32				*		0000	EA	16.00	16.00	77-00		000851
03	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		78-00		000852
03	47A381037P1	LACING TAPE				*		0000	FT	AR		79-00		000853
03	**47E387062-80	BRKT,PWR SUPPLY SPRT				M		0000	EA	8.00	8.00	80-00		000854
03	7022AD	RELAY				B		0000	EA	1.00	1.00	81-00	72962	000855
03	47D387121G1	ESD ELECT ASSY				M		0000	EA	1.00	1.00	82-00		000856
04	47D387063P1	PANEL				M		0000	EA	1.00	1.00	1-00		000857
04	47D387063P2	MOUNTING CHASIS				M		0000	EA	1.00	1.00	2-00		000858
04	KHU17A11-120	RELAY				B	5	0000	EA	6.00	6.00	3-00	77342	000859
04	KHU17D11-28	RELAY				B		0000	EA	1.00	1.00	4-00	77342	000860
04	47-61-201-10	CAPTIVE SCREW				M		0000	EA	4.00	4.00	5-00	94222	000861
04	N678P13007	SCR,FLH 6-32 X .44LG				M		0000	EA	4.00	4.00	6-00		000862
04	N415P13	WASHER, LOCK, #6				*		0000	EA	6.00	6.00	7-00		000863
04	N226P13	NUT,PLAIN HEX, #6-32				*		0000	EA	4.00	4.00	8-00		000864
04	N226P7	NUT, HEX 3-48				M		0000	EA	7.00	7.00	9-00		000865
04	N415P9	WASHER,LOCK, EXT T #3				M		0000	EA	7.00	7.00	10-00		000866
04	IN4005	DIODE				B		0000	EA	1.00	1.00	11-00		000867
04	47A381044PAR	SLEEVING,TEFLON				*		0000	FT	AR		12-00		000868
04	47A387125	WIRE LIST				X		0000	EA	X		13-00		000869
04	MRA20PJ	CONNECTOR				M		0000	EA	1.00	1.00	14-00	79376	000870
04	6STV-15	TERMINAL STRIP				M		0000	EA	1.00	1.00	15-00	53337	000871
04	TC6-15	COVER, TERM STRIP				M		0000	EA	1.00	1.00	16-00	53337	000872
04	N195P1306	SCR,PNH 6-20 X .375LG				M		0000	EA	2.00	2.00	17-00		000873
04	44A0111-20-9	WIRE, AWG #20				B	5	0000	FT	AR		18-00	06090	000874
04	AWG-20-TYPE-S	WIRE, BUS/QQ-W-343				B		0000	FT	AR		19-00		000875
04	47D387022	SCHEMATIC				X		0000	EA	X		20-00		000876
04	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		21-00		000877
04	47A380102P1	FINISH				M		0000	QT	AR		22-00		000878
04	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		23-00		000879
04	47A381037P1	LACING TAPE				*		0000	FT	AR		24-00		000880
04	47A380071PAR	SLEEVING, SHRINK				*		0000	FT	AR		25-00		000881
03	47D387130G1	"G" SWITCH TEST ELEK				M		0000	EA	1.00	1.00	83-00		000882
04	47D387129P1	PANEL				M		0000	EA	1.00	1.00	1-00		000883
04	47D387129P2	MOUNTING CHASSIS				M		0000	EA	1.00	1.00	2-00		000884
04	47-61-201-10	CAPTIVE SCREW				M		0000	EA	4.00	4.00	3-00	94222	000885
04	4156-14-1	TERMINAL				M		0000	EA	8.00	8.00	4-00	17117	000886
04	KHU17A17-120	RELAY				M		0000	EA	6.00	6.00	5-00	77342	000887

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	MJ1000	TRANSISTOR				B	5	0000	EA	1.00	1.00	6-00	04713	000888
04	177-3-62	INSULATOR				B	5	0000	EA	1.00	1.00	7-00	05820	000889
04	MD-3452-G	SOCKET,TO-3				B	5	0000	EA	1.00	1.00	8-00	06770	000890
04	120-2	GREASE,THERMAL				B	5	0000	OZ	AR		9-00	05820	000891
04	LM10CH	OPERATIONAL AMPLIFIER				B	7	0000	EA	1.00	1.00	10-00	27014	000892
04	6140-188-1	SOCKET, 8 PIN				M		0000	EA	1.00	1.00	11-00	17117	000893
04	3059J-1-102M	POTENTIOMETER				M		0000	EA	2.00	2.00	12-00	32997	000894
04	WBR1000-50	CAPACITOR				B	5	0000	EA	1.00	1.00	13-00	14655	000895
04	150D105X9035A2	CAPACITOR				B	5	0000	EA	1.00	1.00	14-00	56289	000896
04	41F2R0	RESISTOR, 2 OHM				M		0000	EA	1.00	1.00	15-00	03615	000897
04	RN65C1004F	RESISTOR, 1M OHM				B	5	0000	EA	1.00	1.00	16-00		000898
04	MRA20PJ	CONNECTOR				M		0000	EA	1.00	1.00	17-00	79376	000899
04	6STV-10	TERMINAL STRIP				M		0000	EA	1.00	1.00	18-00	53337	000900
04	TC6-10	COVER, TERM. STRIP				M		0000	EA	1.00	1.00	19-00	53337	000901
04	47A387128	WIRE LIST				X		0000	EA	X		20-00		000902
04	47D387122	SCHEMATIC				X		0000	EA	X		21-00		000903
04	N678P13007	SCR,FLH 6-32 X .44LG				M		0000	EA	4.00	4.00	22-00		000904
04	N415P13	WASHER, LOCK, #6				*		0000	EA	8.00	8.00	23-00		000905
04	N226P13	NUT,PLAIN HEX, #6-32				*		0000	EA	4.00	4.00	24-00		000906
04	N226P7	NUT, HEX 3-48				M		0000	EA	6.00	6.00	25-00		000907
04	N415P9	WASHER,LOCK, EXT T #3				M		0000	EA	6.00	6.00	26-00		000908
04	N195P1306	SCR,PNH 6-20 X .375LG				M		0000	EA	2.00	2.00	27-00		000909
04	N153P13010	SCREW,PAN HD. #6-32				M		0000	EA	2.00	2.00	28-00		000910
04	N678P9008	SCREW,FLAT HD. #4-40				M		0000	EA	1.00	1.00	29-00		000911
04	N415P11	WASHER, LOCK, #4				*		0000	EA	1.00	1.00	30-00		000912
04	N226P9	NUT, HEX, #4-40				*		0000	EA	1.00	1.00	31-00		000913
04	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		32-00		000914
04	44A0111-20-9	WIRE, AWG #20				B	5	0000	FT	AR		33-00	06090	000915
04	AWG-20-TYPE-S	WIRE, BUS/QQ-W-343				B		0000	FT	AR		34-00		000916
04	47A380102P1	FINISH				M		0000	QT	AR		35-00		000917
04	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		36-00		000918
04	47A381037P1	LACING TAPE				*		0000	FT	AR		37-00		000919
04	47A380071PAR	SLEEVING, SHRINK				*		0000	FT	AR		38-00		000920
04	47A381044PAR	SLEEVING,TEFLON				*		0000	FT	AR		39-00		000921
03	47D387132G1	ICE DETECTOR ELEK				M		0000	EA	1.00	1.00	84-00		000922
03	MRA20SJH1	CONNECTOR				B		0000	EA	3.00	3.00	85-00	79376	000923
03	**47E387062-86	WIRE DUCT				M		0000	EA	4.00	4.00	86-00		000924
03	**47E387062-87	WIRE DUCT COVER				M		0000	EA	4.00	4.00	87-00		000925
03	**47E387062-88	CIRCUIT BKR PANEL				M		0000	EA	1.00	1.00	88-00		000926
03	112-220-101	CIRCUIT BKR (20A)				B		0000	EA	2.00	2.00	89-00	77342	000927
03	112-215-101	CIRCUIT BKR (15A)				B		0000	EA	7.00	7.00	90-00	77342	000928
03	112-210-101	CIRCUIT BKR (10A)				*		0000	EA	7.00	7.00	91-00	77342	000929
03	112-205-101	CIRCUIT BKR (5A)				B		0000	EA	2.00	2.00	92-00	77342	000930
03	1422552	POWER BLOCK (2 CKT)				M		0000	EA	1.00	1.00	93-00	26405	000931
03	1423552	POWER BLOCK (3 CKT)				M		0000	EA	1.00	1.00	94-00	26405	000932
03	**47E387062-95	SAFETY SHIELD				M		0000	EA	1.00	1.00	95-00		000933
03	4697-1032-SS-20	HEX M & F STANDOFF				M		0000	EA	12.00	12.00	96-00	55566	000934
03	24205	COMPOUND, (LOCKTITE)				*		0000	OZ	AR		97-00	05972	000935

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	74755	PRIMER				*		0000	OZ	AR		98-00	05972	000936
03	**47E387062-99	SPACER				M		0000	EA	13.00	13.00	99-00		000937
03	**47E387062-100	SUPPORT,(04-04-42-8)				M		0000	EA	13.00	13.00	100-00		000938
03	**47E387062-101	BUS BAR				M		0000	EA	1.00	1.00	101-00		000939
03	**47E387062-102	BUS BAR				M		0000	EA	1.00	1.00	102-00		000940
03	**47E387062-103	BUS BAR				M		0000	EA	1.00	1.00	103-00		000941
03	**47E387062-104	BUS BAR				M		0000	EA	1.00	1.00	104-00		000942
03	**47E387062-105	CONNECTION				M		0000	EA	130.00	130.00	105-00		000943
03	**47E387062-106	CONNECTION				M		0000	EA	62.00	62.00	106-00		000944
03	**47E387062-107	CONNECTION				M		0000	EA	4.00	4.00	107-00		000945
03	**47E387062-108	CONNECTION				M		0000	EA	1.00	1.00	108-00		000946
03	**47E387062-109	MARKERS (1 THRU 120)				M		0000	EA	1.00	1.00	109-00		000947
03	**47E387062-110	MARKERS (1 THRU 14)				M		0000	EA	1.00	1.00	110-00		000948
03	**47E387062-111	MARKERS (1 THRU 63)				M		0000	EA	1.00	1.00	111-00		000949
03	FD15-50	PWR SUPPLY,+/- 15VDC				M		0000	EA	1.00	1.00	112-00	14749	000950
03	B24N75	PWR SUPPLY, (24 VDC)				M		0000	EA	1.00	1.00	113-00	14749	000951
03	B28N70	PWR SUPPLY, (28 VDC)				M		0000	EA	1.00	1.00	114-00	14749	000952
03	B35FT40	PWR SUPPLY, (35 VDC)				M		0000	EA	1.00	1.00	115-00	14749	000953
03	47A380071PAR	SLEEVING, SHRINK				*		0000	FT	AR		116-00		000954
03	47A381043PAR	SLEEVING, VINYL				*		0000	FT	AR		117-00		000955
03	44A0811-12-9	WIRE, AWG #12				B	5	0000	FT	AR		118-00	06090	000956
03	44A0111-16-9	WIRE, AWG #16				B	5	0000	FT	AR		119-00	06090	000957
03	44A0111-20-9	WIRE, AWG #20				B	5	0000	FT	AR		120-00	06090	000958
03	18RA-6FLX	TERMINAL LUG, CRIMP				B	5	0000	EA	AR		121-00	56501	000959
03	10RC-10FLX	TERMINAL LUG, CRIMP				B		0000	EA	AR		122-00	56501	000960
03	**47E387062-123	BRKT, WIRING SUPPORT				M		0000	EA	1.00	1.00	123-00		000961
02	47E387060G1	HIGH VOLTAGE CG ASSY				M		0000	EA	1.00	1.00	17-00		000962
03	47E387069G1	HIGH V CG DRILL ASSY				M		0000	EA	1.00	1.00	1-00		000963
03	47D387009P1	GROUNDING XFMR				M		0000	EA	1.00	1.00	2-00		000964
03	47C387013P1	GROUNDING RESISTOR				M		0000	EA	2.00	2.00	3-00		000965
03	47D387010P1	CURRENT XFMR				M		0000	EA	6.00	6.00	4-00		000966
03	47D387011P1	POTENTIAL XFMR				M		0000	EA	3.00	3.00	5-00		000967
03	N24P25016	BOLT, HEX HEAD				B		0000	EA	12.00	12.00	6-00		000968
03	47D387110P1	BUS BAR				M		0000	EA	1.00	1.00	7-00		000969
03	N673P35	EYE BOLT				B		0000	EA	2.00	2.00	8-00		000970
03	47D387109G1	FRONT PANEL				M		0000	EA	1.00	1.00	9-00		000971
03	N227P25	NUT, HEX				B		0000	EA	12.00	12.00	10-00		000972
03	N415P75	WASHER, LOCK				B		0000	EA	2.00	2.00	11-00		000973
03	N227P35	NUT, HEX				B		0000	EA	2.00	2.00	12-00		000974
03	N415P37	WASHER, LOCK				B		0000	EA	36.00	36.00	13-00		000975
03	N24P25008	BOLT, HEX HD				B		0000	EA	24.00	24.00	14-00		000976
03	N24P29020	BOLT, HEX HD				B		0000	EA	36.00	36.00	15-00		000977
03	N415P50	WASHER, LOCK				B		0000	EA	36.00	36.00	16-00		000978
03	N227P29	NUT, HEX				B		0000	EA	36.00	36.00	17-00		000979
03	N27P21022	BOLT, HEX HD, SLOTTED				B		0000	EA	10.00	10.00	18-00		000980
03	N415P25	WASHER, LOCK, (1/4)				B		0000	EA	10.00	10.00	19-00		000981
03	N400P41	WASHER, FLAT				B	5	0000	EA	10.00	10.00	20-00		000982

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM CROSS REF
01	47E382590G1	ROTOR BLADE ASSY				M		0000	EA	1.00	1.00	4-00	000983
02	47J382287P1	CENTER BLADE SECT				M		0000	EA	1.00	1.00	1-00	000984
02	47E381105G1	BOLSTER ASSY				M		0000	EA	1.00	1.00	2-00	000985
03	47E382301P1	BOLSTER				M		0000	EA	2.00	2.00	1-00	000986
03	47D382550G1	SFT,TEETER BRG ASSY				M		0000	EA	1.00	1.00	2-00	000987
04	47D382550P1	CLOTH,FIBERGLASS				M		0000	FT	AR		1-00	000988
04	47D382550P2	ADHESIVE				M		0000	OZ	AR		2-00	000989
04	47D382397G1	TEETER PVT SFT ASSY				M		0000	EA	1.00	1.00	3-00	000990
05	47D382397P1	TEETER PIVOT SHAFT				M		0000	EA	1.00	1.00	1-00	000991
05	47C382390P1	PLUG, SHAFT TEETER				M		0000	EA	2.00	2.00	2-00	000992
03	47C382551G1	TEETER RESTR ASSY				M		0000	EA	4.00	4.00	3-00	000993
04	47C382551P1	CLOTH, FIBERGLASS				M		0000	FT	AR		1-00	000994
04	47C382551P2	ADHESIVE, EPOXY				M		0000	OZ	AR		2-00	000995
04	47C382351P1	TEETER SPRT INNER				M		0000	EA	1.00	4.00	3-00	000996
03	47C382551G2	TEETEER RESTR ASSY				M		0000	EA	4.00	4.00	4-00	000997
04	47C382551P1	CLOTH, FIBERGLASS				M		0000	FT	AR		1-00	000998
04	47C382551P2	ADHESIVE, EPOXY				M		0000	OZ	AR		2-00	000999
04	47C382350P1	TEETER SPRT OUTER				M		0000	EA	1.00	4.00	4-00	001000
03	47C382552G1	BOLSTER INSR ASSY				M		0000	EA	2.00	2.00	5-00	001001
04	47C382552P1	CLOTH,FIBERGLASS				M		0000	FT	AR		1-00	001002
04	47C382552P2	ADHESIVE				M		0000	OZ	AR		2-00	001003
04	47E382403P1	INSERT,BOLSTER				M		0000	EA	1.00	2.00	3-00	001004
03	**47E381105-6	EPOXY,THICKENED				B		0000	EA	AR		6-00	001005
02	47J381090P1	INNER BLADE SECTION				M		0000	EA	2.00	2.00	3-00	001006
02	47J381097P1	OUTER BLADE SECTION				M		0000	EA	2.00	2.00	4-00	001007
02	47E381089P1	TRAILING EDGE INSTL				M		0000	EA	2.00	2.00	5-00	001008
02	47E381089P2	TRAILING EDGE INSTL				M		0000	EA	2.00	2.00	6-00	001009
02	47E381089P3	TRAILING EDGE INSTL				M		0000	EA	2.00	2.00	7-00	001010
02	47E382610G1	AILERON INSTALLATION				M		0000	EA	2.00	2.00	8-00	001011
03	**47E382610-1	AIL SECT,INDB DRIVE				M		0000	EA	2.00	4.00	1-00	001012
03	**47E382610-2	AIL SECT,INBD TRAIL				M		0000	EA	2.00	4.00	2-00	001013
03	**47E382610-3	AIL SECT,CENTER DR				M		0000	EA	2.00	4.00	3-00	001014
03	**47E382610-4	AIL SECT,CENTER TR				M		0000	EA	2.00	4.00	4-00	001015
03	**47E382610-5	AIL SECT,OUTBD DRIVE				M		0000	EA	2.00	4.00	5-00	001016
03	**47E382610-6	AIL SECT,OUTBD TRAIL				M		0000	EA	2.00	4.00	6-00	001017

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	**47E382610-7	HINGE FITTING,INBD				M		0000	EA	2.00	4.00	7-00		001018
03	**47E382610-8	HINGE FITTING,INBD				M		0000	EA	2.00	4.00	8-00		001019
03	**47E382610-9	HINGE FITTING,CENTER				M		0000	EA	2.00	4.00	9-00		001020
03	**47E382610-10	HINGE FITTING,CENTER				M		0000	EA	2.00	4.00	10-00		001021
03	**47E382610-11	HINGE FITTING,OUTBD				M		0000	EA	2.00	4.00	11-00		001022
03	**47E382610-12	HINGE FITTING,OUTBD				M		0000	EA	2.00	4.00	12-00		001023
03	**47E382610-13	HINGE FITTING,TIP				M		0000	EA	2.00	4.00	13-00		001024
03	47C381115P1	ACTUATOR				B		0000	EA	6.00	12.00	14-00		001025
03	MXJRR-10AS	ROD END,MALE				B		0000	EA	6.00	12.00	15-00	73143	001026
03	FXJRR-10AS	ROD END,FEMALE				M		0000	EA	6.00	12.00	16-00	73143	001027
03	47C381087P1	NUT				M		0000	EA	28.00	56.00	17-00		001028
03	47C381088P1	WASHER,1.00 DIA				M		0000	EA	28.00	56.00	18-00		001029
03	**47E382610-19	PIN,SPECIAL				M		0000	EA	6.00	12.00	19-00		001030
03	N900P62C	RING,RETAINING				B		0000	EA	12.00	24.00	20-00		001031
03	N402P17C	WASHER,SHIM				B		0000	EA	6.00	12.00	21-00		001032
03	**47E382610-22	STUD,SPECIAL				M		0000	EA	6.00	12.00	22-00		001033
03	**47E382610-23	PIN,HOLLOW SPECIAL				M		0000	EA	6.00	12.00	23-00		001034
03	**47E382610-24	SPACER SLEEVE				M		0000	EA	12.00	24.00	24-00		001035
03	**47E382610-25	SPACER SLEEVE				M		0000	EA	6.00	12.00	25-00		001036
03	**47E382610-26	WASHER,SHIM				M		0000	EA	18.00	36.00	26-00		001037
03	**47E382610-27	WASHER,SPECIAL				M		0000	EA	24.00	48.00	27-00		001038
03	N271P35	NUT				B		0000	EA	24.00	48.00	28-00		001039
03	**47E382610-29	SHOULDER PIN				M		0000	EA	12.00	24.00	29-00		001040
03	**47E382610-30	SPACER SLEEVE				M		0000	EA	24.00	48.00	30-00		001041
03	**47E382610-31	PIN				M		0000	EA	6.00	12.00	31-00		001042
03	N900P75C	RING,RETAINING				B		0000	EA	12.00	24.00	32-00		001043
03	N402P18C	WASHER 3/4"DIA				B	5	0000	EA	12.00	24.00	33-00		001044
03	MODEL-RC	SHOCK ABSORBER				B		0000	EA	8.00	16.00	34-00	94389	001045
03	**47E382610-35	ACTUATOR ARM,ADJ				M		0000	EA	8.00	16.00	35-00		001046
03	N94P75024	SCREW,SHOULDER				B		0000	EA	8.00	16.00	36-00		001047
03	N264P338	LOCKNUT				B		0000	EA	40.00	80.00	37-00		001048
03	N402P17B	WASHER				B		0000	EA	40.00	80.00	38-00		001049
03	N22P33036B	SCREW,HEX HD				B		0000	EA	32.00	64.00	39-00		001050
02	47E382582G1	BLADE TIP ATCH ASSY				M		0000	EA	2.00	2.00	9-00		001051
03	**47E382582-1	ATCH STRIP-NOSE SECT				M		0000	EA	2.00	4.00	1-00		001052
03	47E382334P1	TIP,BLADE				M		0000	EA	2.00	4.00	2-00		001053
03	D170-RF-6-6-5	INSERT,DELRIN				B		0000	EA	10.00	20.00	3-00		001054
03	N50P24020C	SCREW,HEX HD				B		0000	EA	10.00	20.00	4-00		001055
03	N400P43	WASHER,FLAT				B		0000	EA	10.00	20.00	5-00		001056
03	**47E382582-6	ATCH STRIP-UPPER FWD				M		0000	EA	2.00	4.00	6-00		001057
03	**47E382582-7	ATCH STRIP-UPPER AFT				M		0000	EA	2.00	4.00	7-00		001058
03	**47E382582-8	ATCH STRIP-LOWER FWD				M		0000	EA	2.00	4.00	8-00		001059
03	**47E382582-9	ATCH STRIP-LOWER AFT				M		0000	EA	2.00	4.00	9-00		001060
03	47E382582P10	ADHESIVE,EPOXY				B		0000	PT	AR		10-00		001061
03	47E382582P11	GLASSFIBER CLOTH				B		0000	FT	AR		11-00		001062
03	A15F7A1	SILICONE POTTING RTV				B		0000	PT	AR		12-00		001063
03	N197P2440	SCERW,WOOD,FLAT HD				B		0000	EA	AR		13-00		001064

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
02	47E382469G1	ICE DETECTOR INSTL				M		0000	EA	2.00	2.00	10-00		001065
03	47C382464G1	RING & HOUSING ASSY				M		0000	EA	2.00	4.00	1-00		001066
04	47C382463G1	RING, MOUNTING				M		0000	EA	1.00	4.00	1-00		001067
05	47C382463P1	RING, MOUNTING				M		0000	EA	1.00	4.00	1-00		001068
05	TLC-4C-0500W	INSERT, COIL THREAD				B		0000	EA	5.00	20.00	2-00	26390	001069
04	ZTR-64D	CAN, HOUSING				M		0000	EA	1.00	4.00	2-00	19178	001070
03	47D381091P1	ICE DETECTOR				M		0000	EA	2.00	4.00	2-00		001071
03	47B382467P1	RETAINER				M		0000	EA	2.00	4.00	3-00		001072
03	47B382468P1	GASKET				M		0000	EA	2.00	4.00	4-00		001073
03	**47E382469-5	EPOXY, ASBESTOS				B		0000	QT	AR		5-00		001074
03	47B382467P2	RETAINER / COVER				M		0000	EA	2.00	4.00	6-00		001075
03	N678P21010	SCREW, 100 DEG CSK				B		0000	EA	10.00	20.00	7-00		001076
03	N678P9006	SCREW, 100 DEG CSK				B		0000	EA	10.00	20.00	8-00		001077
03	47B382470P1	GASKET, COVER				M		0000	EA	2.00	4.00	9-00		001078
02	47E382413G1	BALLAST INSTL				M		0000	EA	1.00	1.00	11-00		001079
03	47C382399P1	BLOCK,BALLAST				M		0000	EA	96.00	96.00	1-00		001080
03	47B382401P1	STUD				M		0000	EA	32.00	32.00	2-00		001081
03	47B382398P1	SPACER				M		0000	EA	AR		3-00		001082
03	N214DP44B	NUT				B		0000	EA	64.00	64.00	4-00		001083
03	**47E382413-5	WASHER				M		0000	EA	64.00	64.00	5-00		001084
03	**47E382413-6	HOUSING,BALLAST				M		0000	EA	2.00	2.00	6-00		001085
03	**47E382413-7	PLATE,RETAINER				M		0000	EA	2.00	2.00	7-00		001086
03	**47E382413-8	STEM,THREADED				M		0000	EA	2.00	2.00	8-00		001087
03	**47E382413-9	NUT				M		0000	EA	2.00	2.00	9-00		001088
03	**47E382413-10	WASHER				M		0000	EA	2.00	2.00	10-00		001089
03	**47E382413-11	SCREW,HEX HD				M		0000	EA	24.00	24.00	11-00		001090
03	**47E382413-12	PLATE,KEEPER				M		0000	EA	2.00	2.00	12-00		001091
03	**47E382413-13	SCREW,HEX HD				M		0000	EA	8.00	8.00	13-00		001092
03	**47E382413-14	INSERT				M		0000	EA	8.00	8.00	14-00		001093
03	**47E382413-15	INSERT				M		0000	EA	16.00	16.00	15-00		001094
02	47E382590P12	FIBERGLASS,CLOTH				B		0000	EA	AR		12-00		001095
02	47E382469G2	ICE DETECTOR INSTL				M		0000	EA	2.00	2.00	13-00		001096
03	47C382464G1	RING & HOUSING ASSY				M		0000	EA	2.00	4.00	1-00		001097
04	47C382463G1	RING, MOUNTING				M		0000	EA	1.00	4.00	1-00		001098
05	47C382463P1	RING, MOUNTING				M		0000	EA	1.00	4.00	1-00		001099
05	TLC-4C-0500W	INSERT, COIL THREAD				B		0000	EA	5.00	20.00	2-00	26390	001100
04	ZTR-64D	CAN, HOUSING				M		0000	EA	1.00	4.00	2-00	19178	001101

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	**47E382469-5	EPOXY, ASBESTOS				B		0000	QT	AR		5-00		001102
03	47B382467P2	RETAINER / COVER				M		0000	EA	2.00	4.00	6-00		001103
03	N678P21010	SCREW, 100 DEG CSK				B		0000	EA	10.00	20.00	7-00		001104
03	47B382470P1	GASKET, COVER				M		0000	EA	2.00	4.00	9-00		001105
02	47E382400G1	LIGHTING PROT INSTL				M		0000	EA	2.00	2.00	14-00		001106
03	**47E382400-1	GROUND STRAP,BRAIDED				M		0000	EA	6.00	12.00	1-00		001107
03	N46P20B	SCREW,STEEL CAP				B		0000	EA	6.00	12.00	2-00		001108
03	47E382400P3	LIGHTING STRIP				M		0000	FT	AR		3-00		001109
03	47E382400P4	SPLICE PLATE				M		0000	EA	16.00	32.00	4-00		001110
03	**47E382400-5	EPOXT,WEST SYSTEM				B		0000	PT	AR		5-00		001111
03	47E382400P6	SHIM				M		0000	EA	2.00	4.00	6-00		001112
03	N197P816	SCREW,WOOD				B		0000	EA	32.00	64.00	7-00		001113
03	72-08116	EPOXY,CONDUCTIVE				B		0000	PT	AR		8-00	07700	001114
03	72-00005	CAULKING,CONDUCTIVE				B		0000	PT	AR		9-00	07700	001115
03	**47E382400-10	R.T.V,TEFLON				B		0000	PT	AR		10-00		001116
03	**47E382400-11	JOINT COMPOUND,ELEC				B		0000	PT	AR		11-00	09922	001117
03	47A380009	DES. REQMTS,ROTOR BL				X		0000	EA	X		12-00		001118
02	**47E382590-15	BUMPER INSTL				M		0000	EA	1.00	1.00	15-00		001119
02	**47E382590-16	TETHER RETENN INSTL				M		0000	EA	2.00	2.00	16-00		001120
02	**47E382590-17	ELEC INSTM INSTL				M		0000	EA	1.00	1.00	17-00		001121
02	47J382330G1	BLADE HYDRAULIC INST				M		0000	EA	1.00	1.00	18-00		001122
03	47J382330P1	TUBING HYDRAULIC				M		0000	FT	720.00	720.00	1-00		001123
03	47J382330P2	TUBING HYDRAULIC				M		0000	FT	480.00	480.00	2-00		001124
03	47C381066P2	HOSE ASSY				M		0000	EA	6.00	6.00	3-00		001125
03	47C381066P1	HOSE ASSY				M		0000	EA	4.00	4.00	4-00		001126
03	47E382357G1	BRACKET,INBOARD				M		0000	EA	2.00	2.00	5-00		001127
04	47E382357P1	BRACKET				M		0000	EA	1.00	2.00	1-00		001128
04	N926P225	INSERT,COIL THD				B		0000	EA	5.00	10.00	2-00		001129
03	47D382358P1	BRKT,OUTBOARD				M		0000	EA	2.00	2.00	6-00		001130
03	47C382336G1	BRKT,CLAMP MODIFIED				M		0000	EA	38.00	38.00	7-00		001131
04	47C382336P1	BRACKET,ANGLE				M		0000	EA	2.00	76.00	1-00		001132
04	47C381072P3	CLAMP UNIT				M		0000	EA	1.00	38.00	2-00		001133
03	47C382336G2	BRKT,CLAMP MODIFIED				M		0000	EA	8.00	8.00	8-00		001134
04	47C382336P1	BRACKET,ANGLE				M		0000	EA	2.00	16.00	1-00		001135
04	47C381072P3	CLAMP UNIT				M		0000	EA	1.00	8.00	2-00		001136
03	47C381072P2	CLAMP UNIT				M		0000	EA	52.00	52.00	9-00		001137
03	47C381072P1	CLAMP UNIT				M		0000	EA	4.00	4.00	10-00		001138
03	47C382335P2	TUBE ADAPTER				M		0000	EA	6.00	6.00	11-00		001139

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	47C382335P1	TUBE ADAPTER				M		0000	EA	4.00	4.00	12-00		001140
03	C-MA-32	ADAPTER,MOUNTING				B		0000	EA	8.00	8.00	13-00	30780	001141
03	47B382338P1	STUD,MOUNTING				M		0000	EA	10.00	10.00	14-00		001142
03	C-SN-32	NUT,STACKING				B	5	0000	EA	332.00	332.00	15-00	30780	001143
03	C-TA-32	ADAPTER,THREADED				B	5	0000	EA	166.00	166.00	16-00	30780	001144
03	47C382337P1	ADAPTER,TUBE				M		0000	EA	12.00	12.00	17-00		001145
03	100-8-F8SS	ADAPTER,TUBE				B		0000	EA	8.00	8.00	18-00	97576	001146
03	900-14SS	UNION,BULKHEAD				B		0000	EA	6.00	6.00	19-00	97576	001147
03	900-8SS	UNION,BULKHEAD				B		0000	EA	4.00	4.00	20-00	97576	001148
03	47C382349P1	SLEEVE,SPLIT				M		0000	EA	150.00	150.00	21-00		001149
03	47C382349P2	SLEEVE,SPLIT				M		0000	EA	100.00	100.00	22-00		001150
03	C-SB-32-16	BUSHING,SPLIT				B	5	0000	EA	150.00	150.00	23-00	30780	001151
03	C-SB-32-14	BUSHING,SPLIT				B		0000	EA	6.00	6.00	24-00	30780	001152
03	C-SB-32-10	BUSHING,SPLIT				B		0000	EA	100.00	100.00	25-00	30780	001153
03	C-SB-32-8	BUSHING,SPLIT				B	5	0000	EA	4.00	4.00	26-00	30780	001154
03	47D382361G1	BASE,HOSE SUPPORT				M		0000	EA	2.00	2.00	27-00		001155
04	47D382361P1	PLATE				M		0000	EA	1.00	2.00	1-00		001156
04	47D382361P2	PAD				M		0000	EA	1.00	2.00	2-00		001157
04	N926P225	INSERT,COIL THD				B		0000	EA	4.00	8.00	3-00		001158
04	**47D382361-4	ADHESIVE				B		0000	PT	AR		4-00		001159
03	47C382360G1	SUPPORT,HOSE				M		0000	EA	2.00	2.00	28-00		001160
04	47C382360P1	PLATE				M		0000	EA	1.00	2.00	1-00		001161
04	47C382360P2	PAD				M		0000	EA	1.00	2.00	2-00		001162
04	N926P225	INSERT,COIL THD				B		0000	EA	2.00	4.00	3-00		001163
04	**47C382360-4	ADHESIVE				B		0000	PT	AR		4-00		001164
03	47C382359P1	PLATE				M	M	0000	EA	4.00	4.00	29-00		001165
03	47B382373P1	SPACER				M		0000	EA	8.00	8.00	30-00		001166
03	47B382373P2	SPACER				M		0000	EA	8.00	8.00	31-00		001167
03	47B382373P3	SPACER				M		0000	EA	8.00	8.00	32-00		001168
03	C-B-32	BOLT,.375-16 1.00 LG				B	5	0000	EA	322.00	322.00	33-00	30780	001169
03	C-N-32	NUT,.375-16				B	5	0000	EA	8.00	8.00	34-00	30780	001170
03	C-LW-32	LOCKWASHER				B	5	0000	EA	330.00	330.00	35-00	30780	001171
03	N727P29024B	BOLT,.500-13 1.50 LG				B		0000	EA	16.00	16.00	36-00		001172
03	N405P45B	WASHER, LOCK				B	5	0000	EA	16.00	16.00	37-00		001173
03	N405P43B	LOCKWASHER - MEDIUM				B	5	0000	EA	248.00	248.00	38-00		001174
03	N22P25012B	BOLT,.375-16 .75 LG				B		0000	EA	104.00	104.00	39-00		001175
03	N22P25020B	BOLT 3/8-16 X 1-1/4"*				B	5	0000	EA	28.00	28.00	40-00		001176
03	N22P25038B	BOLT,.375-16 2.38 LG				B		0000	EA	4.00	4.00	41-00		001177
03	N22P25042B	BOLT,.375-16 2.88 LG				B		0000	EA	4.00	4.00	42-00		001178
03	N22P25074B	BOLT,.375-16 4.62 LG				B		0000	EA	4.00	4.00	43-00		001179
03	**47J382330-44	SLEEVING				M		0000	EA	4.00	4.00	44-00		001180
03	**47J382330-45	SLEEVING,SHRINK				M		0000	EA	8.00	8.00	45-00		001181
03	N22P25034B	BOLT,.375-16 2.12 LG				B		0000	EA	8.00	8.00	46-00		001182
03	**47J382330-47	BRAZING ALLOY				B		0000	EA	AR		47-00		001183
03	47C382336G3	BRKT,CLAMP				M		0000	EA	6.00	6.00	48-00		001184

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	47C382336P1	BRACKET,ANGLE				M		0000	EA	2.00	12.00	1-00		001185
04	47C381072P3	CLAMP UNIT				M		0000	EA	1.00	6.00	2-00		001186
02	47D382406	GEOMETRY DWG				X		0000	EA	X		19-00		001187
02	47E382460	BLADE TOLERANCE DWG				X		0000	EA	X		20-00		001188
02	**47E382590-21	CONNECTING PLATE				M		0000	EA	2.00	2.00	21-00		001189
02	**47E382590-22	CONNECTING PLATE				M		0000	EA	2.00	2.00	22-00		001190
02	47E382590P23	ADHESIVE,EPOXY				B		0000	PT	AR		23-00		001191
02	47E382605G1	TEETER BRG/RSTR INST				M		0000	EA	1.00	1.00	24-00		001192
03	47E382602P2	YOKE BRG CAP				M		0000	EA	2.00	2.00	1-00		001193
03	47E382583G1	TEETER HUB/BRG ASSY				M		0000	EA	2.00	2.00	2-00		001194
04	47D381114P1	BRG,RADIAL-TEETER				M		0000	EA	1.00	2.00	1-00		001195
04	47E382581P1	HUB, BRG - TEETER				M		0000	EA	1.00	2.00	2-00		001196
04	47E382583P3	DOWEL PIN				M		0000	EA	3.00	6.00	3-00		001197
03	47E381093P1	BGR THRUST TEETER				M		0000	EA	2.00	2.00	3-00		001198
03	47B382396P1	SHIM,BRG				M		0000	EA	2.00	2.00	4-00		001199
03	47D381101P1	SHRINK DISC				M		0000	EA	2.00	2.00	5-00		001200
03	N060	LOCKNUT,TYPE SD				B		0000	EA	2.00	2.00	6-00	80648	001201
03	P60	LOCK PLATE				B		0000	EA	2.00	2.00	7-00	80648	001202
03	V112OE	SEAL-VEE RING				B		0000	EA	2.00	2.00	8-00		001203
03	47D382352G1	TEETER ARM ASSY				M		0000	EA	4.00	4.00	9-00		001204
04	47D382352P1	TEETER ARM				M		0000	EA	1.00	4.00	1-00		001205
04	47D382352P2	RETAINING RING				M		0000	EA	1.00	4.00	2-00		001206
04	GE160TG3AS-2RS	MONO BEARING				B		0000	EA	1.00	4.00	3-00	52676	001207
04	N22BP21014B	BOLT,LOCK				B		0000	EA	8.00	32.00	4-00		001208
04	N402P11B	WASHER, NARROW				B	5	0000	EA	8.00	32.00	5-00		001209
03	47C382353P1	TEETER SUPPORT PIN				M		0000	EA	4.00	4.00	10-00		001210
03	N22BP82080B	BOLT,LOCK				B		0000	EA	36.00	36.00	11-00		001211
03	N402P20B	WASHER				B		0000	EA	36.00	36.00	12-00		001212
03	47E382488P1	PRE-LOAD FIXTURE				M		0000	EA	2.00	2.00	13-00		001213
03	**47E382605-14	PRE-LOAD COLLAR				M		0000	EA	2.00	2.00	14-00		001214
03	**47E382605-15	LOADING STUD				M		0000	EA	6.00	6.00	15-00		001215
03	**47E382605-16	HYDR EXTENDER				M		0000	EA	2.00	2.00	16-00		001216
03	N22BP29020B	BOLT, SLFLKG				B		0000	EA	24.00	24.00	17-00		001217
03	N402P15B	WASHER				B		0000	EA	24.00	24.00	18-00		001218
03	47E382605P19	PIN				M		0000	EA	4.00	4.00	19-00		001219
02	N197P2048	SCREW,WOOD				B		0000	EA	AR		25-00		001220
02	**47E382590-26	BUTT WEDGE-REAR SPAR				M		0000	EA	2.00	2.00	26-00		001221
02	**47E382590-27	JOINT WEDGE-UPPER				M		0000	EA	2.00	2.00	27-00		001222
02	**47E382590-28	JOINT WEDGE-LOWER				M		0000	EA	2.00	2.00	28-00		001223
02	47A380009	DES. REQMTS,ROTOR BL				X		0000	EA	X		29-00		001224
02	47D382406	GEOMETRY DWG				X		0000	EA	X		30-00		001225

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM CROSS REF
02	47E382460	BLADE TOLERANCE DWG				X		0000	EA	X		31-00	001226
02	47E382440	SCHEM ROTOR HYDR SYS				X		0000	EA	X		32-00	001227
02	47A382285	PROFILE COORDINATES				X		0000	EA	X		33-00	001228
01	47E382607G1	YOKE / NACELLE INSTL				M		0000	EA	1.00	1.00	5-00	001229
02	47E382597G1	NACELLE OVERALL ASSY	1			X		0000	EA	X		1-00	001230
02	47E382601G1	YOKE ASSY				X		0000	EA	X		2-00	001231
02	47E382599G1	SLIP RING INST				M		0000	EA	1.00	1.00	3-00	001232
03	**47E382599-1	SUPPORT TUBE				M		0000	EA	1.00	1.00	1-00	001233
03	**47E382599-2	SUPPORT PADS				M		0000	EA	2.00	2.00	2-00	001234
03	47E382486P1	SIDE SUPPORT				M		0000	EA	1.00	1.00	3-00	001235
03	47D381018	ELEC INTERFACE				X		0000	EA	X		4-00	001236
03	47D381020P1	ROTOR SLIPRING UNIT				M		0000	EA	1.00	1.00	5-00	001237
03	47C381111P1	BELLOWS JOINT				M		0000	EA	1.00	1.00	6-00	001238
03	**47E382599-7	CONDUIT TIE BLOCK				M		0000	EA	3.00	3.00	7-00	001239
03	**47E382599-8	CONDUIT SPACER PAD				M		0000	EA	6.00	6.00	8-00	001240
03	47E382599P9	CONDUIT 2.00 DIA				M		0000	EA	3.00	3.00	9-00	001241
03	47E382599P10	CONDUIT 1.50 DIA				M		0000	EA	6.00	6.00	10-00	001242
03	**47E382599-11	JUNCTION BOX				M		0000	EA	1.00	1.00	11-00	001243
03	**47E382599-12	SEALING COLLAR				M		0000	EA	1.00	1.00	12-00	001244
03	A15B36	ADHESIVE,EPOXY				B		0000	OZ	AR		13-00	001245
03	B12B33	ADHESIVE,AL TAPE				B		0000	FT	AR		14-00	001246
03	N22BP29016B	BOLT,LOCK				B		0000	EA	12.00	12.00	15-00	001247
03	N402P15B	WASHER				B		0000	EA	16.00	16.00	16-00	001248
03	N22P29032B	BOLT				B		0000	EA	4.00	4.00	17-00	001249
03	N264P29B	NUT 1/2				B	5	0000	EA	4.00	4.00	18-00	001250
03	47E382599P19	ANGLES				M		0000	EA	2.00	2.00	19-00	001251
03	47D381024P1	ROTARY POSITION SR				M		0000	EA	1.00	1.00	20-00	001252
02	47E382496G1	LOW SPEED BRAKE INST				M		0000	EA	1.00	1.00	4-00	001253
03	47E382495G1	LOW SP BK SPRT ASSY				M		0000	EA	2.00	2.00	1-00	001254
04	47E382407P1	LOW SP BK SPRT BRKT				M		0000	EA	1.00	2.00	1-00	001255
04	47D382461P1	LOW SPEED BRAKE				M		0000	EA	4.00	8.00	2-00	001256
04	47D382492P4	NUT PLATE				M		0000	EA	2.00	4.00	3-00	001257
04	47D382492P2	NUT PLATE				M		0000	EA	2.00	4.00	4-00	001258
04	47D382492P1	NUT PLATE				M		0000	EA	1.00	2.00	5-00	001259
04	47D382492P3	NUT PLATE				M		0000	EA	1.00	2.00	6-00	001260
04	47D382493P3	NUT PLATE				M		0000	EA	2.00	4.00	7-00	001261
04	47D382493P1	NUT PLATE				M		0000	EA	2.00	4.00	8-00	001262
04	47D382493P2	NUT PLATE				M		0000	EA	1.00	2.00	9-00	001263
04	47B382494P1	NUT PLATE				M		0000	EA	8.00	16.00	10-00	001264
04	N46P22032B	SCREW, FLAT HD				B		0000	EA	38.00	76.00	11-00	001265
04	N402AP20B	WASHER				B		0000	EA	24.00	48.00	12-00	001266
04	47C381036P5	BOLT,FATIGUE RATED				B		0000	EA	24.00	48.00	13-00	001267
03	47C381036P3	BOLT,FATIGUE RATED				B		0000	EA	84.00	84.00	2-00	001268

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
03	47C381088P1	WASHER,1.00 DIA				M		0000	EA	84.00	84.00	3-00		001269
03	47C381036P10	BOLT,FATIGUE RATED				B		0000	EA	8.00	8.00	4-00		001270
03	47C381088P5	WASHER,1.25 DIA				B		0000	EA	8.00	8.00	5-00		001271
03	81341EB-30	EYE BOLT				B		0000	EA	2.00	2.00	6-00		001272
03	A15F6C18	RTV SILICONE SEALANT				M		0000	OZ	AR		7-00		001273
02	47E382498G1	RTR SPEED SNSR INSTL				M		0000	EA	1.00	1.00	5-00		001274
03	47B382480P1	BRACKET, SENSOR				M		0000	EA	2.00	2.00	1-00		001275
03	47B381108P1	SENSOR, ROTOR SPEED				M		0000	EA	2.00	2.00	2-00	81692	001276
03	N733P25016B	SCREW, TWELVE-POINT				B		0000	EA	4.00	4.00	3-00		001277
03	N405P43B	LOCKWASHER - MEDIUM				B	5	0000	EA	4.00	4.00	4-00		001278
02	47C381036P26	BOLT,FATIGUE RATED				B		0000	EA	96.00	96.00	6-00		001279
02	47C381087P9	NUT				B		0000	EA	96.00	96.00	7-00		001280
02	47C381088P9	WASHER,1.50 DIA				M		0000	EA	96.00	96.00	8-00		001281
02	47C381088P10	WASHER,1.50 DIA				B		0000	EA	96.00	96.00	9-00		001282
02	**47E382607-10	SEAL,STATOR HALVES				M		0000	EA	2.00	2.00	10-00		001283
02	**47E382607-11	SEAL PLATE				M		0000	EA	6.00	6.00	11-00		001284
02	**47E382607-12	SEAL				M		0000	EA	1.00	1.00	12-00		001285
02	**47E382607-13	LOCKBOLT				M		0000	EA	AR		13-00		001286
02	**47E382607-14	WASHER				M		0000	EA	AR		14-00		001287
02	A15F6C18	RTV SILICONE SEALANT				M		0000	OZ	AR		15-00		001288
01	47E382608G1	ROTOR BLADE INSTL				M		0000	EA	1.00	1.00	6-00		001289
02	47B382396P1	SHIM,BRG				X		0000	EA	X		1-00		001290
02	47C381036P10	BOLT,FATIGUE RATED				B		0000	EA	60.00	60.00	2-00		001291
02	47C381087P6	LOCKNUT				B		0000	EA	60.00	60.00	3-00		001292
02	47C381088P9	WASHER,1.50 DIA				M		0000	EA	60.00	60.00	4-00		001293
02	47C381088P10	WASHER,1.50 DIA				B		0000	EA	60.00	60.00	5-00		001294
02	47C381036P21	BOLT				B		0000	EA	8.00	8.00	6-00		001295
02	47C381087P10	LOCKNUT				B		0000	EA	8.00	8.00	7-00		001296
02	47C381088P9	WASHER,1.50 DIA				M		0000	EA	8.00	8.00	8-00		001297
02	47C381088P10	WASHER,1.50 DIA				B		0000	EA	8.00	8.00	9-00		001298
02	N22BP82080B	BOLT,LOCK				B		0000	EA	36.00	36.00	10-00		001299
02	N402P20B	WASHER				B		0000	EA	36.00	36.00	11-00		001300
02	**47E382608-12	TEETER POSN IND				M		0000	EA	1.00	1.00	12-00		001301
02	**47E382608-13	TEETER MOTION INSTL				M		0000	EA	1.00	1.00	13-00		001302
02	**47E382608-14	FLEX HOSE				M		0000	EA	2.00	2.00	14-00		001303
02	**47E382608-15	FLEX HOSE				M		0000	EA	2.00	2.00	15-00		001304
02	**47E382608-16	FLEX HOSE				M		0000	EA	2.00	2.00	16-00		001305
01	**47E382304-7	GND SPRT EQUIP INSTL				M		0000	EA	1.00	1.00	7-00		001306
01	47E382045	GEOMETRY ENVELOPE				X		0000	EA	X		8-00		001307
01	47E387081G1	ELEC EQUIP BUILDING				M		0000	EA	1.00	1.00	9-00		001308
02	**47E387081-1	GRND ENCLOSURE BLDG				M		0000	EA	1.00	1.00	1-00		001309
02	**47E387081-2	TRANSFORMER				M		0000	EA	1.00	1.00	2-00		001310

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG		FSCM CROSS REF
02	**47E387081-3	P.F. CAPACITOR				M		0000	EA	1.00	1.00	3-00		001311
02	**47E387081-4	CYCLOCONVERTER				M		0000	EA	1.00	1.00	4-00		001312
02	**47E387081-5	SWITCHGEAR LINE-UP				M		0000	EA	1.00	1.00	5-00		001313
02	**47E387081-6	INTERFACE CABINET				M		0000	EA	1.00	1.00	6-00		001314
02	**47E387081-7	ELECTRONICS CABINET				M		0000	EA	1.00	1.00	7-00		001315
02	47A380068	30-KVA XFMR SPEC				M		0000	EA	1.00	1.00	8-00		001316
02	47A380014	STATION BATTERY SPEC				M		0000	EA	1.00	1.00	9-00		001317
02	47A380067	CONT SYST U.P.S.SPEC				M		0000	EA	1.00	1.00	10-00		001318
02	**47E387081-11	ENG INSTR SUBSYSTEM				M		0000	EA	1.00	1.00	11-00		001319
02	**47E387081-12	OFFICE EQPT INSTL				M		0000	EA	1.00	1.00	12-00		001320
02	**47E387081-13	HECO ELEC INTERFACE				M		0000	EA	1.00	1.00	13-00		001321
02	**47E387081-14	SITE OPERATOR TERM				M		0000	EA	1.00	1.00	14-00		001322
02	**47E387081-15	FUSE PANELS				M		0000	EA	2.00	2.00	15-00		001323
02	**47E387081-16	AIR COND & HEATER				M		0000	EA	1.00	1.00	16-00		001324
02	**47E387081-17	COM DATA SYSTEM				M		0000	EA	1.00	1.00	17-00		001325
02	47E387112G1	SYS DISPLAY PNL ASSY				M		0000	EA	1.00	1.00	18-00		001326
03	47D381060P1	VIDEO MONITOR				M		0000	EA	1.00	1.00	1-00		001327
03	47E387027G1	ASSY,WTG CONTROL PAN*				*		0000	EA	1.00	1.00	2-00		001328
04	47D387028P1	PANEL,FRONT,WTG CONT*				*		0000	EA	1.00	1.00	1-00		001329
04	47D387029P1	CONNECTOR PANEL, WTG*				*		0000	EA	1.00	1.00	2-00		001330
04	CS-A-3-17	CHASSIS, SIDE				B	5	0000	EA	1.00	1.00	3-00	6666	001331
04	BC-A-17	BOTTOM COVER				B	5	0000	EA	1.00	1.00	4-00	6666	001332
04	TC-A-17	TOP COVER				B	5	0000	EA	1.00	1.00	5-00	6666	001333
04	FCA8	HANDLE				B	5	0000	EA	2.00	2.00	6-00	08730	001334
04	CR104PBM92R6C	PUSHBUTTON,MUSHROOM *				*		0000	EA	1.00	1.00	7-00	2295	001335
04	CR104PSK47A92Z	SWITCH,4 POSITION NO*				*		0000	EA	1.00	1.00	8-00	2295	001336
04	20001	METER,120V,60HZ				B	5	0000	EA	1.00	1.00	9-00	74400	001337
04	CR103HC2001G	INDICATOR LIGHT, GRE*				*		0000	EA	1.00	1.00	10-00	2295	001338
04	CR103HC2001R	INDICATOR LIGHT, RED				*		0000	EA	1.00	1.00	11-00	2295	001339
04	GE327	LAMP				*		0000	EA	2.00	2.00	12-00	8806	001340
04	N7003P14250	RESISTOR, WIRE WOUND*				*		0000	EA	1.00	1.00	13-00		001341
04	PT07SE-18-11P	CONNECTOR ELEC 11 PIN				*		0000	EA	1.00	1.00	14-00	77820	001342
04	17236	POWER CORD				B	5	0000	EA	1.00	1.00	15-00	16428	001343
04	939	STRAIN RELIEF,SMITH				B	5	0000	EA	1.00	1.00	16-00	83330	001344
04	47A380069P31	NAMEPLATE,IDENT (J1)				*		0000	EA	1.00	1.00	17-00		001345
04	47A380069P71	NAMEPLATE,IDENT(GND)				*		0000	EA	1.00	1.00	18-00		001346
04	NP-206417	NAMEPLATE				B	5	0000	EA	1.00	1.00	19-00		001347
04	47A380070P3	NPL, AN/REV STATUS				*		0000	EA	1.00	1.00	20-00		001348
04	N153P13005	SCREW, PAN HD				*		0000	EA	2.00	2.00	21-00		001349
04	N153P15006	SCR, PH, #8-32				*		0000	EA	12.00	12.00	22-00		001350
04	N153P16006	SCR, PH, #10-32				*		0000	EA	4.00	4.00	23-00		001351
04	N153P16012	SCREW,PAN HD #10-32X*				*		0000	EA	1.00	1.00	24-00		001352
04	N678P15008	SCREW, FLAT HD				B	5	0000	EA	8.00	8.00	25-00		001353
04	N415P13	WASHER, LOCK, #6				*		0000	EA	2.00	2.00	26-00		001354
04	N415P16	WASHER, LOCK, #8				*		0000	EA	16.00	16.00	27-00		001355
04	N400P39	WASHER, FLAT, #10				*		0000	EA	2.00	2.00	28-00		001356
04	N415P19	WASHER, LOCK, #10				*		0000	EA	7.00	7.00	29-00		001357

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	N226P13	NUT,PLAIN HEX, #6-32				*		0000	EA	2.00	2.00	30-00		001358
04	N226P15	NUT, HEX, #8-32				B	5	0000	EA	4.00	4.00	31-00		001359
04	N226P16	NUT, HEX, #10-32				*		0000	EA	6.00	6.00	32-00		001360
04	18RA-8FLX	TERMINAL LUG,CRIMP(2*				B	5	0000	EA	3.00	3.00	33-00	56501	001361
04	18RA-10FLX	TERMINAL LUG,CRIMP(2*				B	5	0000	EA	1.00	1.00	34-00	56501	001362
04	RB4	WIRE JOINT				*		0000	EA	1.00	1.00	35-00	56501	001363
04	44A0111-16-9	WIRE, AWG #16				B	5	0000	FT	AR		36-00	06090	001364
04	RC6	WIRE JOINT				*		0000	EA	1.00	1.00	37-00	56501	001365
04	47A380071PAR	SLEEVING, SHRINK				*		0000	FT	AR		38-00		001366
04	47A381038P3	TAPE,LACING				*		0000	FT	AR		39-00		001367
04	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		40-00		001368
04	47D387030	SCHEMATIC DIAGRAM EL*				X	5	0000	EA	X		41-00		001369
04	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		42-00		001370
03	47E387091G1	ASSY,GENERATOR PANEL				M		0000	EA	1.00	1.00	3-00		001371
04	47E387105P1	PANEL, FRONT				B		0000	EA	1.00	1.00	1-00		001372
04	47E387091P2	PANEL, SIDE				B		0000	EA	1.00	1.00	2-00		001373
04	47D387106P1	PANEL, REAR				B		0000	EA	1.00	1.00	3-00		001374
04	FCA4	HANDLE				B	5	0000	EA	2.00	2.00	4-00	08730	001375
04	47D387107P1	SGL CD FR.,MODIFIED				B		0000	EA	1.00	1.00	5-00		001376
04	47D387108P1	BRACKET, CARD FRAME				B		0000	EA	1.00	1.00	6-00		001377
04	DM-3100N	DIGITAL, METER				B	5	0000	EA	6.00	6.00	7-00	50521	001378
04	58-2073082	EDGE CONNECTOR				B	5	0000	EA	6.00	6.00	8-00	50521	001379
04	47D387089G1	ASSY,MTR SIG CONDTNR				M		0000	EA	3.00	3.00	9-00		001380
05	47E387116P1	DRILL & TRIM				M		0000	EA	1.00	3.00	1-00		001381
05	AWG-22-TYPE-S	BUS WIRE/QQ-W-343				B	5	0000	FT	AR		2-00		001382
05	47A381044PAR	SLEEVING,TEFLON				*		0000	FT	AR		3-00		001383
05	IC-314-SGT	SOCKET, 14 PIN				B		0000	EA	2.00	6.00	4-00	55322	001384
05	IC-316-SGT	SOCKET, 16 PIN				B		0000	EA	4.00	12.00	5-00	55322	001385
05	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		6-00		001386
05	47D387092	SCHEMATIC				X		0000	EA	X		7-00		001387
05	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		8-00		001388
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00	CR1 -00	01295	001389
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00	CR2 -00	01295	001390
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00	CR3 -00	01295	001391
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00	CR4 -00	01295	001392
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00	CR5 -00	01295	001393
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00	CR6 -00	01295	001394
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00	CR7 -00	01295	001395
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00	CR8 -00	01295	001396
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00	CR9 -00	01295	001397
05	CKR05BX221KR	CAPACITOR, 200 PF				B		0000	EA	1.00	3.00	C1 -00		001398
05	199D106X0010BB1	CAPACITOR, 10 MFD				B		0000	EA	1.00	3.00	C2 -00	56289	001399
05	CKR06BX103KR	CAPACITOR, .01 MFD				B		0000	EA	1.00	3.00	C3 -00		001400
05	CKR06BX104KR	CAPACITOR, .1 MFD				B		0000	EA	1.00	3.00	C4 -00		001401
05	CKR06BX104KR	CAPACITOR, .1 MFD				B		0000	EA	1.00	3.00	C5 -00		001402
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E1 -00	55322	001403

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E10	-00 55322	001404
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E11	-00 55322	001405
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E12	-00 55322	001406
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E13	-00 55322	001407
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E14	-00 55322	001408
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E15	-00 55322	001409
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E16	-00 55322	001410
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E17	-00 55322	001411
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E18	-00 55322	001412
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E19	-00 55322	001413
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E2	-00 55322	001414
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E3	-00 55322	001415
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E4	-00 55322	001416
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E5	-00 55322	001417
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E6	-00 55322	001418
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E7	-00 55322	001419
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E8	-00 55322	001420
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E9	-00 55322	001421
05	53451-1	RELAY				B	7	0000	EA	1.00	3.00	K1	-00 18342	001422
05	53451-1	RELAY				B	7	0000	EA	1.00	3.00	K2	-00 18342	001423
05	53451-1	RELAY				B	7	0000	EA	1.00	3.00	K3	-00 18342	001424
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	3.00	R1	-00	001425
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R10	-00	001426
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R11	-00	001427
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R12	-00	001428
05	RNC55H1101FS	RESISTOR, 1.1K				B	5	0000	EA	1.00	3.00	R13	-00	001429
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R14	-00	001430
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R15	-00	001431
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R16	-00	001432
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R17	-00	001433
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R18	-00	001434
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R19	-00	001435
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	3.00	R2	-00	001436
05	64Y103	POTENTIOMETER, 10K				B		0000	EA	1.00	3.00	R20	-00 02111	001437
05	64Y102	POTENTIOMETER, 1K				B		0000	EA	1.00	3.00	R21	-00 02111	001438
05	64Y103	POTENTIOMETER, 10K				B		0000	EA	1.00	3.00	R22	-00 02111	001439
05	64Y102	POTENTIOMETER, 1K				B		0000	EA	1.00	3.00	R23	-00 02111	001440
05	64Y103	POTENTIOMETER, 10K				B		0000	EA	1.00	3.00	R24	-00 02111	001441
05	64Y102	POTENTIOMETER, 1K				B		0000	EA	1.00	3.00	R25	-00 02111	001442
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	3.00	R3	-00	001443
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	3.00	R4	-00	001444
05	RCR05G471JS	RESISTOR, 470				B	7	0000	EA	1.00	3.00	R5	-00	001445
05	RNC55H2490FS	RESISTOR, 249				B		0000	EA	1.00	3.00	R6	-00	001446
05	RNC55H2490FS	RESISTOR, 249				B		0000	EA	1.00	3.00	R7	-00	001447
05	RNC55H2490FS	RESISTOR, 249				B		0000	EA	1.00	3.00	R8	-00	001448
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R9	-00	001449
05	SN7475N	4-BIT BISTABLE LCH				B	5	0000	EA	1.00	3.00	U1	-00 01295	001450
05	UHP-407	DRIVER				B	7	0000	EA	1.00	3.00	U2	-00 56289	001451
05	TL084CN	QUAD JFET OPNL AMPL				B	7	0000	EA	1.00	3.00	U3	-00 01295	001452

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	AML12CBC3AA	SWITCH,(MOM)				B		0000	EA	9.00	9.00	10-00	91929	001453
04	**47E387091-11	LENS, ENGRAVED				M		0000	EA	1.00	1.00	11-00		001454
04	**47E387091-12	LENS, ENGRAVED				B		0000	EA	1.00	1.00	12-00		001455
04	**47E387091-13	LENS, ENGRAVED				B		0000	EA	1.00	1.00	13-00		001456
04	**47E387091-14	LENS, ENGRAVED				B		0000	EA	2.00	2.00	14-00		001457
04	**47E387091-15	LENS, ENGRAVED				B		0000	EA	2.00	2.00	15-00		001458
04	**47E387091-16	LENS, ENGRAVED				B		0000	EA	2.00	2.00	16-00		001459
04	**47E387091-17	LENS, ENGRAVED				B		0000	EA	3.00	3.00	17-00		001460
04	**47E387091-18	LENS, ENGRAVED				B		0000	EA	3.00	3.00	18-00		001461
04	AML21GBA2AC	SWITCH,(MOM)				B	5	0000	EA	6.00	6.00	19-00	91929	001462
04	86	LAMP,INCANDESCENT				B	5	0000	EA	12.00	12.00	20-00	91929	001463
04	47D387113G1	SECURITY ALARM BOARD				M		0000	EA	1.00	1.00	21-00		001464
05	11-DE-6P	COMPONENT CARD				M		0000	EA	1.00	1.00	1-00	50125	001465
05	E-1	CARD EJECTOR				M		0000	EA	1.00	1.00	2-00	50125	001466
05	T-1SF2-T	WIRE WRAP PIN				B	5	0000	EA	6.00	6.00	3-00	55322	001467
05	AWG-22-TYPE-S	BUS WIRE/QQ-W-343				B	5	0000	FT	AR		4-00		001468
05	47A381044P5	SLEEVING				B		0000	FT	AR		5-00		001469
05	IC-314-WWG	SOCKET, 14 PIN				B		0000	EA	7.00	7.00	6-00	55322	001470
05	IC-316-WWG	SOCKET, 16 PIN				B		0000	EA	3.00	3.00	7-00	55322	001471
05	AP-616-G-E	ADAPTER PLUG				M		0000	EA	2.00	2.00	8-00	55322	001472
05	47D387100	SCHEMATIC				X		0000	EA	X		9-00		001473
05	**47D387113-10	WIRE LIST				X		0000	EA	X		10-00		001474
05	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		11-00		001475
05	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		12-00		001476
05	47B381099PAR	WIRE,AWG 30,SLDRLESS				B		0000	FT	AR		13-00		001477
05	1N4148	DIODE				B	7	0000	EA	1.00	1.00	CR1 -00	01295	001478
05	CK06BX103K	CAPACITOR, .01 MFD				B	5	0000	EA	1.00	1.00	C1 -00	95275	001479
05	CK06BX104K	CAPACITOR, .1 MFD				B	5	0000	EA	1.00	1.00	C2 -00	95275	001480
05	CK06BX103K	CAPACITOR, .01 MFD				B	5	0000	EA	1.00	1.00	C3 -00	95275	001481
05	CK06BX473K	CAPACITOR, .47 MFD				B	7	0000	EA	1.00	1.00	C4 -00		001482
05	CK06BX104K	CAPACITOR, .1 MFD				B	5	0000	EA	1.00	1.00	C5 -00	95275	001483
05	RZ-12	RELAY				B		0000	EA	1.00	1.00	K1 -00	05292	001484
05	RCR05G203JS	RESISTOR, 20K				B		0000	EA	1.00	1.00	R1 -00		001485
05	RCR20G681JS	RES, 680 OHMS, 1/2 W				B	5	0000	EA	1.00	1.00	R10 -00		001486
05	RCR05G202JS	RESISTOR, 2K				B	7	0000	EA	1.00	1.00	R11 -00		001487
05	**47D387113-R12	VARISTOR				B		0000	EA	1.00	1.00	R12 -00		001488
05	3009-P-503	POTENTIOMETER, 50K				B		0000	EA	1.00	1.00	R2 -00	32997	001489
05	RCR05G563JS	RESISTOR, 56K				B		0000	EA	1.00	1.00	R3 -00		001490
05	RCR05G203JS	RESISTOR, 20K				B		0000	EA	1.00	1.00	R4 -00		001491
05	3009-P-104	POTENTIOMETER, 100 K				B		0000	EA	1.00	1.00	R5 -00	32997	001492
05	RCR05G753JS	RESISTOR, 75K				B		0000	EA	1.00	1.00	R6 -00		001493
05	RCR07G680JS	RES, 68 OHMS, 1/4 W				B		0000	EA	1.00	1.00	R7 -00		001494
05	RCR05G103JS	RESISTOR, 10K				B	7	0000	EA	1.00	1.00	R8 -00		001495
05	RCR05G103JS	RESISTOR, 10K				B	7	0000	EA	1.00	1.00	R9 -00		001496
05	MC14013BCP	DUAL D FLIP-FLOP				B		0000	EA	1.00	1.00	U1 -00	04713	001497
05	MC14081BCP	QUAD 2-INPUT AND G				M		0000	EA	1.00	1.00	U10 -00	04713	001498
05	MC14541BCP	PROGRAMMABLE OSC-TMR				M		0000	EA	1.00	1.00	U11 -00	04713	001499

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
05	MC14071BCP	QUAD 2-INPUT OR GATE				M		0000	EA	1.00	1.00	U12 -00	04713	001500
05	MC14490FP	CONTACT DEBOUNCER				B	5	0000	EA	1.00	1.00	U2 -00	04713	001501
05	UNC-4401A	LATCH/DRIVER				B		0000	EA	1.00	1.00	U4 -00	80183	001502
05	MC14528BCP	DUAL MONOSTABLE MV				B		0000	EA	1.00	1.00	U5 -00	04713	001503
05	MC14011BCP	QUAD 2-INPUT NAND G				B		0000	EA	1.00	1.00	U8 -00	04713	001504
05	MC14541BCP	PROGRAMMABLE OSC-TMR				M		0000	EA	1.00	1.00	U9 -00	04713	001505
04	2T1B215	RELAY				B		0000	EA	3.00	3.00	22-00	02289	001506
04	**47E387091-23	PANEL, SIDE				B		0000	EA	1.00	1.00	23-00		001507
04	108-0902-001	BANANA JACK (RED)				B	5	0000	EA	12.00	12.00	26-00	74970	001508
04	108-0903-001	BANANA JACK (BLK)				B	5	0000	EA	12.00	12.00	27-00	74970	001509
04	PT07A-14-5P	RECEPTACLE, JAM NUT				B		0000	EA	1.00	1.00	29-00	77820	001510
04	DBM-25P	CONNECTOR				B	5	0000	EA	2.00	2.00	30-00	71785	001511
04	3341-1L	JACK SOCKET KIT				*		0000	EA	2.00	2.00	31-00	52760	001512
04	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		32-00		001513
04	47E387103	SCHEMATIC				X		0000	EA	X		33-00		001514
04	**47E387091-34	WIRE LIST				X		0000	EA	X		34-00		001515
04	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		35-00		001516
04	AWG-22-TYPE-S	BUS WIRE/QQ-W-343				B	5	0000	FT	AR		36-00		001517
04	44A0111-24-9	WIRE, AWG 24				B	5	0000	FT	AR		37-00	06090	001518
04	47A381045P5	CABLE CLAMP				B		0000	EA	3.00	3.00	38-00		001519
04	47A380071PAR	SLEEVING, SHRINK				*		0000	FT	AR		39-00		001520
04	47A381044PAR	SLEEVING,TEFLON				*		0000	FT	AR		40-00		001521
04	47A381037P1	LACING TAPE				*		0000	FT	AR		41-00		001522
04	NP-206417	NAMEPLATE				B	5	0000	EA	1.00	1.00	42-00		001523
04	47A380069P31	NAMEPLATE,IDENT (J1)				*		0000	EA	1.00	1.00	43-00		001524
04	47A380069P32	NAMEPLATE,IDENT (J2)				*		0000	EA	1.00	1.00	44-00		001525
04	47A380069P33	NAMEPLATE,IDENT (J3)				B		0000	EA	1.00	1.00	45-00		001526
04	47A380070P3	NPL, AN/REV STATUS				*		0000	EA	1.00	1.00	46-00		001527
04	AWG-20-TYPE-S	WIRE, BUS/QQ-W-343				B		0000	FT	AR		47-00		001528
04	AWG-16-TYPE-S	WIRE, BUS/QQ-W-343				B	5	0000	FT	AR		48-00		001529
04	570-3650-02-01-00	TERMINAL, INSULATED				B	5	0000	EA	8.00	8.00	49-00	71279	001530
04	N153P16007	SCREW, PAN HD				*		0000	EA	4.00	4.00	53-00		001531
04	N153P13005	SCREW, PAN HD				*		0000	EA	15.00	15.00	54-00		001532
04	N415P19	WASHER, LOCK, #10				*		0000	EA	4.00	4.00	55-00		001533
04	N226P16	NUT, HEX, #10-32				*		0000	EA	4.00	4.00	56-00		001534
04	N678P15008	SCREW, FLAT HD				B	5	0000	EA	2.00	2.00	57-00		001535
04	N153P15008	SCREW, PAN HD				B		0000	EA	4.00	4.00	58-00		001536
04	N415P16	WASHER, LOCK, #8				*		0000	EA	6.00	6.00	59-00		001537
04	N226P15	NUT, HEX, #8-32				B	5	0000	EA	2.00	2.00	60-00		001538
04	N153P13004	SCR, PH, #6-32				*		0000	EA	8.00	8.00	61-00		001539
04	N153P13006	SCREW, PAN HD				B		0000	EA	6.00	6.00	62-00		001540
04	N400P37	WASHER, FL. #6				*		0000	EA	8.00	8.00	63-00		001541
04	N415P13	WASHER, LOCK, #6				*		0000	EA	29.00	29.00	64-00		001542
04	N226P13	NUT,PLAIN HEX, #6-32				*		0000	EA	21.00	21.00	65-00		001543
03	47E387085G1	ASSY, UTILITY PANEL				M		0000	EA	1.00	1.00	4-00		001544
04	47E387098P1	PANEL, FRONT				M		0000	EA	1.00	1.00	1-00		001545

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	47E387085P2	PANEL, SIDE				M		0000	EA	2.00	2.00	2-00		001546
04	47C387099P1	PANEL, REAR				M		0000	EA	1.00	1.00	3-00		001547
04	FCA8	HANDLE				B	5	0000	EA	2.00	2.00	4-00	08730	001548
04	108-0902-001	BANANA JACK (RED)				B	5	0000	EA	8.00	8.00	5-00	74970	001549
04	108-0903-001	BANANA JACK (BLK)				B	5	0000	EA	8.00	8.00	6-00	74970	001550
04	DM-3100N	DIGITAL, METER				B	5	0000	EA	3.00	3.00	7-00	50521	001551
04	58-2073082	EDGE CONNECTOR				B	5	0000	EA	3.00	3.00	8-00	50521	001552
04	47D387089G1	ASSY,MTR SIG CONDTNR				M		0000	EA	3.00	3.00	9-00		001553
05	47E387116P1	DRILL & TRIM				M		0000	EA	1.00	3.00	1-00		001554
05	AWG-22-TYPE-S	BUS WIRE/QQ-W-343				B	5	0000	FT	AR		2-00		001555
05	47A381044PAR	SLEEVING,TEFLON				*		0000	FT	AR		3-00		001556
05	IC-314-SGT	SOCKET, 14 PIN				B		0000	EA	2.00	6.00	4-00	55322	001557
05	IC-316-SGT	SOCKET, 16 PIN				B		0000	EA	4.00	12.00	5-00	55322	001558
05	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		6-00		001559
05	47D387092	SCHEMATIC				X		0000	EA	X		7-00		001560
05	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		8-00		001561
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00 CR1	-00	01295	001562
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00 CR2	-00	01295	001563
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00 CR3	-00	01295	001564
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00 CR4	-00	01295	001565
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00 CR5	-00	01295	001566
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00 CR6	-00	01295	001567
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00 CR7	-00	01295	001568
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00 CR8	-00	01295	001569
05	1N4148	DIODE				B	7	0000	EA	1.00	3.00 CR9	-00	01295	001570
05	CKR05BX221KR	CAPACITOR, 200 PF				B		0000	EA	1.00	3.00 C1	-00		001571
05	199D106X0010BB1	CAPACITOR, 10 MFD				B		0000	EA	1.00	3.00 C2	-00	56289	001572
05	CKR06BX103KR	CAPACITOR, .01 MFD				B		0000	EA	1.00	3.00 C3	-00		001573
05	CKR06BX104KR	CAPACITOR, .1 MFD				B		0000	EA	1.00	3.00 C4	-00		001574
05	CKR06BX104KR	CAPACITOR, .1 MFD				B		0000	EA	1.00	3.00 C5	-00		001575
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E1	-00	55322	001576
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E10	-00	55322	001577
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E11	-00	55322	001578
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E12	-00	55322	001579
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E13	-00	55322	001580
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E14	-00	55322	001581
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E15	-00	55322	001582
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E16	-00	55322	001583
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E17	-00	55322	001584
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E18	-00	55322	001585
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E19	-00	55322	001586
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E2	-00	55322	001587
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E3	-00	55322	001588
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E4	-00	55322	001589
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E5	-00	55322	001590
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E6	-00	55322	001591
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E7	-00	55322	001592
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00 E8	-00	55322	001593

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	3.00	E9 -00	55322	001594
05	53451-1	RELAY				B	7	0000	EA	1.00	3.00	K1 -00	18342	001595
05	53451-1	RELAY				B	7	0000	EA	1.00	3.00	K2 -00	18342	001596
05	53451-1	RELAY				B	7	0000	EA	1.00	3.00	K3 -00	18342	001597
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	3.00	R1 -00		001598
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R10 -00		001599
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R11 -00		001600
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R12 -00		001601
05	RNC55H1101FS	RESISTOR, 1.1K				B	5	0000	EA	1.00	3.00	R13 -00		001602
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R14 -00		001603
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R15 -00		001604
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R16 -00		001605
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R17 -00		001606
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R18 -00		001607
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R19 -00		001608
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	3.00	R2 -00		001609
05	64Y103	POTENTIOMETER, 10K				B		0000	EA	1.00	3.00	R20 -00	02111	001610
05	64Y102	POTENTIOMETER, 1K				B		0000	EA	1.00	3.00	R21 -00	02111	001611
05	64Y103	POTENTIOMETER, 10K				B		0000	EA	1.00	3.00	R22 -00	02111	001612
05	64Y102	POTENTIOMETER, 1K				B		0000	EA	1.00	3.00	R23 -00	02111	001613
05	64Y103	POTENTIOMETER, 10K				B		0000	EA	1.00	3.00	R24 -00	02111	001614
05	64Y102	POTENTIOMETER, 1K				B		0000	EA	1.00	3.00	R25 -00	02111	001615
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	3.00	R3 -00		001616
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	3.00	R4 -00		001617
05	RCR05G471JS	RESISTOR, 470				B	7	0000	EA	1.00	3.00	R5 -00		001618
05	RNC55H2490FS	RESISTOR, 249				B		0000	EA	1.00	3.00	R6 -00		001619
05	RNC55H2490FS	RESISTOR, 249				B		0000	EA	1.00	3.00	R7 -00		001620
05	RNC55H2490FS	RESISTOR, 249				B		0000	EA	1.00	3.00	R8 -00		001621
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	3.00	R9 -00		001622
05	SN7475N	4-BIT BISTABLE LCH				B	5	0000	EA	1.00	3.00	U1 -00	01295	001623
05	UHP-407	DRIVER				B	7	0000	EA	1.00	3.00	U2 -00	56289	001624
05	TL084CN	QUAD JFET OPNL AMPL				B	7	0000	EA	1.00	3.00	U3 -00	01295	001625
04	AML12CBC3AA	SWITCH,(MOM)				B		0000	EA	8.00	8.00	10-00	91929	001626
04	**47E387085-11	LENS, ENGRAVED				M		0000	EA	1.00	1.00	11-00		001627
04	**47E387085-12	LENS, ENGRAVED				M		0000	EA	1.00	1.00	12-00		001628
04	**47E387085-13	LENS, ENGRAVED				M		0000	EA	1.00	1.00	13-00		001629
04	**47E387085-14	LENS, ENGRAVED				M		0000	EA	1.00	1.00	14-00		001630
04	**47E387085-15	LENS, ENGRAVED				M		0000	EA	1.00	1.00	15-00		001631
04	**47E387085-16	LENS, ENGRAVED				M		0000	EA	1.00	1.00	16-00		001632
04	**47E387085-17	LENS, ENGRAVED				M		0000	EA	1.00	1.00	17-00		001633
04	**47E387085-18	LENS, ENGRAVED				M		0000	EA	1.00	1.00	18-00		001634
04	DB-25P	CONNECTOR, 25 PIN				B	5	0000	EA	1.00	1.00	19-00	71785	001635
04	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		20-00		001636
04	47E387097	SCHEMATIC				X		0000	EA	X		21-00		001637
04	**47E387085-22	WIRE LIST				X		0000	EA	X		22-00		001638
04	AWG-22-TYPE-S	BUS WIRE/QQ-W-343				B	5	0000	FT	AR		23-00		001639
04	44A0111-24-9	WIRE, AWG 24				B	5	0000	FT	AR		24-00	06090	001640
04	47A381045P5	CABLE CLAMP				B		0000	EA	3.00	3.00	25-00		001641

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	47A380071PAR	SLEEVING, SHRINK				*		0000	FT	AR		26-00		001642
04	47A381044PAR	SLEEVING,TEFLON				*		0000	FT	AR		27-00		001643
04	47A381037P1	LACING TAPE				*		0000	FT	AR		28-00		001644
04	NP-206417	NAMEPLATE				B	5	0000	EA	1.00	1.00	29-00		001645
04	47A380069P31	NAMEPLATE,IDENT (J1)				*		0000	EA	1.00	1.00	30-00		001646
04	47A380069P32	NAMEPLATE,IDENT (J2)				*		0000	EA	1.00	1.00	31-00		001647
04	47A380070P3	NPL, AN/REV STATUS				*		0000	EA	1.00	1.00	32-00		001648
04	AWG-20-TYPE-S	WIRE, BUS/QQ-W-343				B		0000	FT	AR		33-00		001649
04	PT07A-14-5P	RECEPTACLE, JAM NUT				B		0000	EA	1.00	1.00	34-00	77820	001650
04	570-3650-02-01-00	TERMINAL, INSULATED				B	5	0000	EA	8.00	8.00	35-00	71279	001651
04	3341-1L	JACK SOCKET KIT				*		0000	EA	1.00	1.00	36-00	52760	001652
04	AWG-16-TYPE-S	WIRE, BUS/QQ-W-343				B	5	0000	FT	AR		37-00		001653
04	N153P13005	SCREW, PAN HD				*		0000	EA	3.00	3.00	38-00		001654
04	N415P19	WASHER, LOCK, #10				*		0000	EA	4.00	4.00	39-00		001655
04	N226P16	NUT, HEX, #10-32				*		0000	EA	4.00	4.00	40-00		001656
04	N153P16007	SCREW, PAN HD				*		0000	EA	4.00	4.00	41-00		001657
04	N153P15008	SCREW, PAN HD				B		0000	EA	4.00	4.00	42-00		001658
04	N415P16	WASHER, LOCK, #8				*		0000	EA	6.00	6.00	43-00		001659
04	N678P15008	SCREW, FLAT HD				B	5	0000	EA	2.00	2.00	44-00		001660
04	N226P15	NUT, HEX, #8-32				B	5	0000	EA	2.00	2.00	45-00		001661
04	N415P13	WASHER, LOCK, #6				*		0000	EA	11.00	11.00	46-00		001662
04	N153P13004	SCR, PH, #6-32				*		0000	EA	8.00	8.00	47-00		001663
04	N400P37	WASHER, FL. #6				*		0000	EA	8.00	8.00	48-00		001664
04	N226P13	NUT,PLAIN HEX, #6-32				*		0000	EA	3.00	3.00	49-00		001665
03	47E387084G1	ASSY, STATUS PANEL				M		0000	EA	1.00	1.00	5-00		001666
04	47E387104P1	PANEL, FRONT				B		0000	EA	1.00	1.00	1-00		001667
04	47E387084P2	PANEL, SIDE				B		0000	EA	2.00	2.00	2-00		001668
04	47D387106P1	PANEL, REAR				B		0000	EA	1.00	1.00	3-00		001669
04	FCA4	HANDLE				B	5	0000	EA	2.00	2.00	4-00	08730	001670
04	47D387107P1	SGL CD FR.,MODIFIED				B		0000	EA	1.00	1.00	5-00		001671
04	47D387108P1	BRACKET, CARD FRAME				B		0000	EA	1.00	1.00	6-00		001672
04	DM-3100N	DIGITAL, METER				B	5	0000	EA	5.00	5.00	7-00	50521	001673
04	58-2073082	EDGE CONNECTOR				B	5	0000	EA	5.00	5.00	8-00	50521	001674
04	47D387089G1	ASSY,MTR SIG CONDTNR				M		0000	EA	5.00	5.00	9-00		001675
05	47E387116P1	DRILL & TRIM				M		0000	EA	1.00	5.00	1-00		001676
05	AWG-22-TYPE-S	BUS WIRE/QQ-W-343				B	5	0000	FT	AR		2-00		001677
05	47A381044PAR	SLEEVING,TEFLON				*		0000	FT	AR		3-00		001678
05	IC-314-SGT	SOCKET, 14 PIN				B		0000	EA	2.00	10.00	4-00	55322	001679
05	IC-316-SGT	SOCKET, 16 PIN				B		0000	EA	4.00	20.00	5-00	55322	001680
05	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		6-00		001681
05	47D387092	SCHEMATIC				X		0000	EA	X		7-00		001682
05	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		8-00		001683
05	1N4148	DIODE				B	7	0000	EA	1.00	5.00 CR1	-00	01295	001684
05	1N4148	DIODE				B	7	0000	EA	1.00	5.00 CR2	-00	01295	001685
05	1N4148	DIODE				B	7	0000	EA	1.00	5.00 CR3	-00	01295	001686
05	1N4148	DIODE				B	7	0000	EA	1.00	5.00 CR4	-00	01295	001687

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
05	1N4148	DIODE				B	7	0000	EA	1.00	5.00	CR5	-00 01295	001688
05	1N4148	DIODE				B	7	0000	EA	1.00	5.00	CR6	-00 01295	001689
05	1N4148	DIODE				B	7	0000	EA	1.00	5.00	CR7	-00 01295	001690
05	1N4148	DIODE				B	7	0000	EA	1.00	5.00	CR8	-00 01295	001691
05	1N4148	DIODE				B	7	0000	EA	1.00	5.00	CR9	-00 01295	001692
05	CKR05BX221KR	CAPACITOR, 200 PF				B		0000	EA	1.00	5.00	C1	-00	001693
05	199D106X0010BB1	CAPACITOR, 10 MFD				B		0000	EA	1.00	5.00	C2	-00 56289	001694
05	CKR06BX103KR	CAPACITOR, .01 MFD				B		0000	EA	1.00	5.00	C3	-00	001695
05	CKR06BX104KR	CAPACITOR, .1 MFD				B		0000	EA	1.00	5.00	C4	-00	001696
05	CKR06BX104KR	CAPACITOR, .1 MFD				B		0000	EA	1.00	5.00	C5	-00	001697
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E1	-00 55322	001698
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E10	-00 55322	001699
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E11	-00 55322	001700
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E12	-00 55322	001701
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E13	-00 55322	001702
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E14	-00 55322	001703
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E15	-00 55322	001704
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E16	-00 55322	001705
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E17	-00 55322	001706
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E18	-00 55322	001707
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E19	-00 55322	001708
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E2	-00 55322	001709
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E3	-00 55322	001710
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E4	-00 55322	001711
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E5	-00 55322	001712
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E6	-00 55322	001713
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E7	-00 55322	001714
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E8	-00 55322	001715
05	T-1R2-T	TERMINAL				B		0000	EA	1.00	5.00	E9	-00 55322	001716
05	53451-1	RELAY				B	7	0000	EA	1.00	5.00	K1	-00 18342	001717
05	53451-1	RELAY				B	7	0000	EA	1.00	5.00	K2	-00 18342	001718
05	53451-1	RELAY				B	7	0000	EA	1.00	5.00	K3	-00 18342	001719
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	5.00	R1	-00	001720
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R10	-00	001721
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R11	-00	001722
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R12	-00	001723
05	RNC55H1101FS	RESISTOR, 1.1K				B	5	0000	EA	1.00	5.00	R13	-00	001724
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R14	-00	001725
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R15	-00	001726
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R16	-00	001727
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R17	-00	001728
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R18	-00	001729
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R19	-00	001730
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	5.00	R2	-00	001731
05	64Y103	POTENTIOMETER, 10K				B		0000	EA	1.00	5.00	R20	-00 02111	001732
05	64Y102	POTENTIOMETER, 1K				B		0000	EA	1.00	5.00	R21	-00 02111	001733
05	64Y103	POTENTIOMETER, 10K				B		0000	EA	1.00	5.00	R22	-00 02111	001734
05	64Y102	POTENTIOMETER, 1K				B		0000	EA	1.00	5.00	R23	-00 02111	001735
05	64Y103	POTENTIOMETER, 10K				B		0000	EA	1.00	5.00	R24	-00 02111	001736

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	ECN PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/REF DESG	FSCM	CROSS REF
05	64Y102	POTENTIOMETER, 1K				B		0000	EA	1.00	5.00	R25 -00	02111	001737
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	5.00	R3 -00		001738
05	RCR05G102JS	RESISTOR, 1K				B	7	0000	EA	1.00	5.00	R4 -00		001739
05	RCR05G471JS	RESISTOR, 470				B	7	0000	EA	1.00	5.00	R5 -00		001740
05	RNC55H2490FS	RESISTOR, 249				B		0000	EA	1.00	5.00	R6 -00		001741
05	RNC55H2490FS	RESISTOR, 249				B		0000	EA	1.00	5.00	R7 -00		001742
05	RNC55H2490FS	RESISTOR, 249				B		0000	EA	1.00	5.00	R8 -00		001743
05	RNC55H1002FS	RESISTOR				B	5	0000	EA	1.00	5.00	R9 -00		001744
05	SN7475N	4-BIT BISTABLE LCH				B	5	0000	EA	1.00	5.00	U1 -00	01295	001745
05	UHP-407	DRIVER				B	7	0000	EA	1.00	5.00	U2 -00	56289	001746
05	TL084CN	QUAD JFET OPNL AMPL				B	7	0000	EA	1.00	5.00	U3 -00	01295	001747
04	AML12CBC3AA	SWITCH,(MOM)				B		0000	EA	15.00	15.00	10-00	91929	001748
04	**47E387084-11	LENS, ENGRAVED				M		0000	EA	2.00	2.00	11-00		001749
04	**47E387084-12	LENS, ENGRAVED				B		0000	EA	2.00	2.00	12-00		001750
04	**47E387084-13	LENS, ENGRAVED				B		0000	EA	2.00	2.00	13-00		001751
04	**47E387084-14	LENS, ENGRAVED				B		0000	EA	1.00	1.00	14-00		001752
04	**47E387084-15	LENS, ENGRAVED				B		0000	EA	1.00	1.00	15-00		001753
04	**47E387084-16	LENS, ENGRAVED				B		0000	EA	1.00	1.00	16-00		001754
04	**47E387084-17	LENS, ENGRAVED				B		0000	EA	1.00	1.00	17-00		001755
04	AML21GBA2AC	SWITCH,(MOM)				B	5	0000	EA	1.00	1.00	18-00	91929	001756
04	AML27ABK2AC02AA	SWITCH, KEY				B		0000	EA	1.00	1.00	19-00	91929	001757
04	86	LAMP,INCANDESCENT				B	5	0000	EA	2.00	2.00	20-00	91929	001758
04	**47E387084-21	LENS, ENGRAVED				B		0000	EA	1.00	1.00	21-00		001759
04	**47E387084-22	LENS, ENGRAVED				B		0000	EA	1.00	1.00	22-00		001760
04	SNP-428	ALARM				B	5	0000	EA	1.00	1.00	23-00	90201	001761
04	PW1	WASHER, COMPRESSION				B	5	0000	EA	1.00	1.00	24-00	90201	001762
04	47D387113G1	SECURITY ALARM BOARD				M		0000	EA	1.00	1.00	25-00		001763
05	11-DE-6P	COMPONENT CARD				M		0000	EA	1.00	1.00	1-00	50125	001764
05	E-1	CARD EJECTOR				M		0000	EA	1.00	1.00	2-00	50125	001765
05	T-1SF2-T	WIRE WRAP PIN				B	5	0000	EA	6.00	6.00	3-00	55322	001766
05	AWG-22-TYPE-S	BUS WIRE/QQ-W-343				B	5	0000	FT	AR		4-00		001767
05	47A381044P5	SLEEVING				B		0000	FT	AR		5-00		001768
05	IC-314-WWG	SOCKET, 14 PIN				B		0000	EA	7.00	7.00	6-00	55322	001769
05	IC-316-WWG	SOCKET, 16 PIN				B		0000	EA	3.00	3.00	7-00	55322	001770
05	AP-616-G-E	ADAPTER PLUG				M		0000	EA	2.00	2.00	8-00	55322	001771
05	47D387100	SCHEMATIC				X		0000	EA	X		9-00		001772
05	**47D387113-10	WIRE LIST				X		0000	EA	X		10-00		001773
05	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		11-00		001774
05	SN60WRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		12-00		001775
05	47B381099PAR	WIRE,AWG 30,SLDRLESS				B		0000	FT	AR		13-00		001776
05	1N4148	DIODE				B	7	0000	EA	1.00	1.00	CR1 -00	01295	001777
05	CK06BX103K	CAPACITOR, .01 MFD				B	5	0000	EA	1.00	1.00	C1 -00	95275	001778
05	CK06BX104K	CAPACITOR, .1 MFD				B	5	0000	EA	1.00	1.00	C2 -00	95275	001779
05	CK06BX103K	CAPACITOR, .01 MFD				B	5	0000	EA	1.00	1.00	C3 -00	95275	001780
05	CK06BX473K	CAPACITOR, .47 MFD				B	7	0000	EA	1.00	1.00	C4 -00		001781
05	CK06BX104K	CAPACITOR, .1 MFD				B	5	0000	EA	1.00	1.00	C5 -00	95275	001782
05	RZ-12	RELAY				B		0000	EA	1.00	1.00	K1 -00	05292	001783

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
05	RCR05G203JS	RESISTOR, 20K				B		0000	EA	1.00	1.00	R1 -00		001784
05	RCR20G681JS	RES, 680 OHMS, 1/2 W				B	5	0000	EA	1.00	1.00	R10 -00		001785
05	RCR05G202JS	RESISTOR, 2K				B	7	0000	EA	1.00	1.00	R11 -00		001786
05	**47D387113-R12	VARISTOR				B		0000	EA	1.00	1.00	R12 -00		001787
05	3009-P-503	POTENTIOMETER, 50K				B		0000	EA	1.00	1.00	R2 -00	32997	001788
05	RCR05G563JS	RESISTOR, 56K				B		0000	EA	1.00	1.00	R3 -00		001789
05	RCR05G203JS	RESISTOR, 20K				B		0000	EA	1.00	1.00	R4 -00		001790
05	3009-P-104	POTENTIOMETER, 100 K				B		0000	EA	1.00	1.00	R5 -00	32997	001791
05	RCR05G753JS	RESISTOR, 75K				B		0000	EA	1.00	1.00	R6 -00		001792
05	RCR07G680JS	RES, 68 OHMS, 1/4 W				B		0000	EA	1.00	1.00	R7 -00		001793
05	RCR05G103JS	RESISTOR, 10K				B	7	0000	EA	1.00	1.00	R8 -00		001794
05	RCR05G103JS	RESISTOR, 10K				B	7	0000	EA	1.00	1.00	R9 -00		001795
05	MC14013BCP	DUAL D FLIP-FLOP				B		0000	EA	1.00	1.00	U1 -00	04713	001796
05	MC14081BCP	QUAD 2-INPUT AND G				M		0000	EA	1.00	1.00	U10 -00	04713	001797
05	MC14541BCP	PROGRAMMABLE OSC-TMR				M		0000	EA	1.00	1.00	U11 -00	04713	001798
05	MC14071BCP	QUAD 2-INPUT OR GATE				M		0000	EA	1.00	1.00	U12 -00	04713	001799
05	MC14490FP	CONTACT DEBOUNCER				B	5	0000	EA	1.00	1.00	U2 -00	04713	001800
05	UNC-4401A	LATCH/DRIVER				B		0000	EA	1.00	1.00	U4 -00	80183	001801
05	MC14528BCP	DUAL MONOSTABLE MV				B		0000	EA	1.00	1.00	U5 -00	04713	001802
05	MC14011BCP	QUAD 2-INPUT NAND G				B		0000	EA	1.00	1.00	U8 -00	04713	001803
05	MC14541BCP	PROGRAMMABLE OSC-TMR				M		0000	EA	1.00	1.00	U9 -00	04713	001804
04	108-0902-001	BANANA JACK (RED)				B	5	0000	EA	15.00	15.00	26-00	74970	001805
04	108-0903-001	BANANA JACK (BLK)				B	5	0000	EA	15.00	15.00	27-00	74970	001806
04	**47E387084-28	LENS, ENGRAVED				B		0000	EA	1.00	1.00	28-00		001807
04	PT07A-14-5P	RECEPTACLE, JAM NUT				B		0000	EA	1.00	1.00	29-00	77820	001808
04	DBM-25P	CONNECTOR				B	5	0000	EA	2.00	2.00	30-00	71785	001809
04	3341-1L	JACK SOCKET KIT				*		0000	EA	2.00	2.00	31-00	52760	001810
04	47A380052	ELECTRICAL FAB. STD				X	5	0000	EA	X		32-00		001811
04	47E387101	SCHEMATIC				X		0000	EA	X		33-00		001812
04	**47E387084-34	WIRE LIST				X		0000	EA	X		34-00		001813
04	SNGOWRMAP2	SOLDER / QQ-S-571				B	5	0000	LB	AR		35-00		001814
04	AWG-22-TYPE-S	BUS WIRE/QQ-W-343				B	5	0000	FT	AR		36-00		001815
04	44A0111-24-9	WIRE, AWG 24				B	5	0000	FT	AR		37-00	06090	001816
04	47A381045P5	CABLE CLAMP				B		0000	EA	3.00	3.00	38-00		001817
04	47A380071PAR	SLEEVING, SHRINK				*		0000	FT	AR		39-00		001818
04	47A381044PAR	SLEEVING,TEFLON				*		0000	FT	AR		40-00		001819
04	47A381037P1	LACING TAPE				*		0000	FT	AR		41-00		001820
04	NP-206417	NAMEPLATE				B	5	0000	EA	1.00	1.00	42-00		001821
04	47A380069P31	NAMEPLATE,IDENT (J1)				*		0000	EA	1.00	1.00	43-00		001822
04	47A380069P32	NAMEPLATE,IDENT (J2)				*		0000	EA	1.00	1.00	44-00		001823
04	47A380069P33	NAMEPLATE,IDENT (J3)				B		0000	EA	1.00	1.00	45-00		001824
04	47A380070P3	NPL, AN/REV STATUS				*		0000	EA	1.00	1.00	46-00		001825
04	AWG-20-TYPE-S	WIRE, BUS/QQ-W-343				B		0000	FT	AR		47-00		001826
04	AWG-16-TYPE-S	WIRE, BUS/QQ-W-343				B	5	0000	FT	AR		48-00		001827
04	570-3650-02-01-00	TERMINAL, INSULATED				B	5	0000	EA	8.00	8.00	49-00	71279	001828
04	**47E387084-50	LENS, ENGRAVED				B		0000	EA	1.00	1.00	50-00		001829
04	**47E387084-51	LENS, ENGRAVED				B		0000	EA	1.00	1.00	51-00		001830
04	**47E387084-52	LENS, ENGRAVED				B		0000	EA	2.00	2.00	52-00		001831

LVL	IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	U/M	PL-QTY	EXT/TOT QTY	ITEM/ REF DESG	FSCM	CROSS REF
04	N153P16007	SCREW, PAN HD				*		0000	EA	4.00	4.00	53-00		001832
04	N153P13005	SCREW, PAN HD				*		0000	EA	3.00	3.00	54-00		001833
04	N415P19	WASHER, LOCK, #10				*		0000	EA	4.00	4.00	55-00		001834
04	N226P16	NUT, HEX, #10-32				*		0000	EA	4.00	4.00	56-00		001835
04	N678P15008	SCREW, FLAT HD				B	5	0000	EA	2.00	2.00	57-00		001836
04	N153P15008	SCREW, PAN HD				B		0000	EA	4.00	4.00	58-00		001837
04	N415P16	WASHER, LOCK, #8				*		0000	EA	4.00	4.00	59-00		001838
04	N226P15	NUT, HEX, #8-32				B	5	0000	EA	2.00	2.00	60-00		001839
04	N153P13004	SCR, PH, #6-32				*		0000	EA	8.00	8.00	61-00		001840
04	N153P13006	SCREW, PAN HD				B		0000	EA	6.00	6.00	62-00		001841
04	N400P37	WASHER, FL. #6				*		0000	EA	8.00	8.00	63-00		001842
04	N415P13	WASHER, LOCK, #6				*		0000	EA	17.00	17.00	64-00		001843
04	N226P13	NUT,PLAIN HEX, #6-32				*		0000	EA	9.00	9.00	65-00		001844
04	**47E387084-66	LENS, ENGRAVED				B		0000	EA	1.00	1.00	66-00		001845
04	AML52-N10W	LENS				B		0000	EA	1.00	1.00	67-00	91929	001846
04	47A380102	FINISH				X		0000	PT	X		68-00		001847
03	**47E387112-6	COMM PANEL				M		0000	EA	1.00	1.00	6-00		001848
03	47A380030	SPEC,SYST DISP PNL				X		0000	EA	X		7-00		001849
03	**47E387112-8	BLOWER,130 CFM				B		0000	EA	1.00	1.00	8-00		001850
03	**47E387112-9	BLOWER				B		0000	EA	1.00	1.00	9-00		001851
03	**47E387112-10	ENCLOSURE,FRAME				M		0000	EA	1.00	1.00	10-00		001852
03	**47E387112-11	AIR EXHAUST UNIT L.H				B		0000	EA	1.00	1.00	11-00		001853
03	**47E387112-12	AIR EXHAUST UNIT R.H				B		0000	EA	1.00	1.00	12-00		001854
03	**47E387112-13	SCHEMATIC				X		0000	EA	X		13-00		001855
03	**47E387112-14	CABLE ASSY				X		0000	EA	X		14-00		001856
03	**47E387112-15	WIRE LIST				X		0000	EA	X		15-00		001857
02	**47E387081-19	C.D.S. OPR TERMINAL				M		0000	EA	1.00	1.00	19-00		001858
02	47E387018	POWER DISTBR SCHEM				X		0000	EA	X		20-00		001859
02	**47E387081-21	EYE WASH STATION				M		0000	EA	1.00	1.00	21-00		001860
02	**47E387081-22	EMER LIGHT UNIT				M		0000	EA	3.00	3.00	22-00		001861
02	**47E387081-23	FIRE EXT UNIT				M		0000	EA	5.00	5.00	23-00		001862
02	**47E387081-24	TEL & SITE INTERCOM				M		0000	EA	1.00	1.00	24-00		001863
02	47A380094	7500KVA VAR SP GEN				X		0000	EA	X		25-00		001864
01	47E387114	CONTROL SYSTEM SCHEM				X		0000	EA	X		10-00		001865
01	47A380023	POWER CABLING REQT				X		0000	EA	X		11-00		001866
01	47A380024	INSTL CABLING REQT				X		0000	EA	X		12-00		001867
01	47A380008	STEP-UP XFMR SPEC				X		0000	EA	X		13-00		001868
01	47A387005	I&C SIGNAL LIST				X		0000	EA	X		14-00		001869
01	47D382288	GENERAL SITE LCTN				X		0000	EA	X		15-00		001870
01	47D382298	SITE PLAN-1ST UNIT				X		0000	EA	X		16-00		001871
01	47E387014	SCHEM,NACELLE,GEN				X		0000	EA	X		17-00		001872
01	47D382000	TOWER GEOMETRY/DIAG				X		0000	EA	X		18-00		001873
01	47D382274	NACELLE GEOMETRY				X		0000	EA	X		19-00		001874

IDENTIFICATION NO.	NOMENCLATURE	ECN DWG INC	ECN DWG OUT	PL-LATE APPLY	P C	T Y	CYCLE TIME	FSCM	U/M	NEXT HIGHER ASSEMBLY	QTY	EXT/TOT-QTY	CROSS REF
300H1-15CG-04-K	PRESSURE TRANSDUCER				B		0000	89326	EA	47J382313G1	03.000	03.000	000103
3009-P-104	POTENTIOMETER, 100 K				B		0000	32997	EA	47D387113G1	02.000	02.000	001492
3009-P-503	POTENTIOMETER, 50K				B		0000	32997	EA	47D387113G1	02.000	02.000	001788
3009P-1-102	POTENTIOMETER, 1 K				B	7	0000	32997	EA	47E387037G1	01.000	02.000	000720
3009P-1-202	POTENTIOMETER, 2 K				B		0000	32997	EA	47E387037G1	02.000	04.000	000715
3009P-1-501	POTENTIOMTR 500 OHMS				B		0000	32997	EA	47E387037G1	04.000	08.000	000718
3043T18	"U" BOLT & NUTS				B	5	0000	39428	EA	47J382313G1	06.000	06.000	000080
3059J-1-102M	POTENTIOMETER				M		0000	32997	EA	47D387130G1	02.000	02.000	000894
326T-FRAME	MOTOR,TEFC				B		0000		EA	47E382579G1	01.000	01.000	000471
3302-37	CABLE 12" LG				*		0000	75037	EA	47D387087G1	01.000	07.000	000741
3341-1L	JACK SOCKET KIT				*		0000	52760	EA	47E387072G1	07.000	07.000	000742
3341-1L	JACK SOCKET KIT				*		0000	52760	EA	47E387084G1	02.000	02.000	001810
3341-1L	JACK SOCKET KIT				*		0000	52760	EA	47E387085G1	01.000	01.000	001652
3341-1L	JACK SOCKET KIT				*		0000	52760	EA	47E387091G1	02.000	02.000	001512
3341-1L	JACK SOCKET KIT				*		0000	52760	EA	47E387095G1	04.000	04.000	000623
												16.000	
3417-7040	CONNECTOR				B	5	0000	75037	EA	47D387087G1	01.000	07.000	000740
3432-4205	HEADER				*		0000	52760	EA	47D387083G1	10.000	10.000	000658
350-SERIES-3DC	PUMP				B		0000	59180	EA	47E382579G1	01.000	01.000	000470
3502-1000	CONNECTOR				*		0000	75037	EA	47D387087G1	01.000	07.000	000739
3596A-3	TERMINAL BOARD				*		0000	75382	EA	47E387072G1	01.000	01.000	000745
3596A-3	TERMINAL BOARD				*		0000	75382	EA	47E387095G1	01.000	01.000	000608
												02.000	
47A380008	STEP-UP XFMR SPEC				X		0000		EA	47E382304G1	X		001868
47A380009	DES. REQMTS,ROTOR BL				X		0000		EA	47E382400G1	X		001118
47A380009	DES. REQMTS,ROTOR BL				X		0000		EA	47E382590G1	X		001224
												00.000	
47A380014	STATION BATTERY SPEC				M		0000		EA	47E387081G1	01.000	01.000	001317
47A380023	POWER CABLING REQT				X		0000		EA	47E382304G1	X		001866

SPECIFICATION

FOR THE

EMERGENCY SHUTDOWN PANEL

FOR THE

MOD-5A WIND TURBINE GENERATOR

Responsible Engineer DATE: 11-30-83

Subsystems Engineer DATE: 1-12-84

Systems Engineering DATE: 1/31/84

Quality Assurance DATE: 1-18-84

WTG Integration DATE: 1-18-84

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SECTION 1.0

INTRODUCTION

1.1 SCOPE

This document describes the functional and performance requirements of the MOD-5A Emergency Shutdown Panel.

1.2 GENERAL DESCRIPTION

The Emergency Shutdown Panel receives inputs from the controller and several critical sensors to determine operation or the need for a shut down, and is independent of the controller with respect to the emergency shutdown function.

For normal operation all sensor input requirements must be satisfied (ESD Ready). The system controller will issue feather valve enable commands and with the ESD enable command (issued by the system controller) the Emergency Shutdown panel will energize the feather valves for aileron control and apply a control voltage to remove the rotor brake.

The Emergency Shutdown Panel will generate an emergency shutdown when it detects a fault on any one of its inputs by interrupting power to the feather valves, allowing the ailerons to be hydraulically driven to a feather position and removing the rotor brake control voltage.

SECTION 2.0

APPLICABLE DOCUMENTS

The following documents of the date of issue noted form a part of this specification to the extent specified herein. In the event of conflict between this specification and the documents referenced herein, the contents of this specification shall supersede.

2.1 GENERAL ELECTRIC DRAWINGS

47A380013 Control System Specification for MOD-5A WTG

47A380052 Electrical Fabrication and Workmanship Standard

47A380053 Electrical Systems Test Equipment Design, Fabrication and Test Specifications

47E387114 Control System Schematic

47E387064 Control Electronic Cabinet (CEC) Schematic

2.2 INDUSTRY

NEC - National Electrical Code

2.3 FEDERAL

FED-STD-595 Federal Standard Colors

SECTION 3.0

REQUIREMENTS

3.1 FUNCTIONAL REQUIREMENTS

Figure 1 is a logic diagram of the Emergency Shutdown Panel (ESD). The ESD monitors the parameters specified in Paragraph 3.1.1 for a fault condition. If all conditions are met, the ESD sends an "ESD Ready" Signal to the controller and allows the controller command of the feather valves. If a fault condition occurs on any parameter, the ESD senses this fault and removes power from the feather valves and controls power to engage the Rotor brakes. Both feather valves enable commands must be present to release the rotor brake command.

3.1.1 INPUTS

The Emergency Shutdown Panel will receive inputs from the following sensors or components:

Input No.	Function
1.	Ground Emergency Stop Switch
2.	Generator Overspeed
3.	Nacelle Emergency Stop Switch
4.	Spare
5.	Spare
6.	Spare
7.	Rotor Overspeed
8.	Watch Dog Timer
9.	ESD Enable
10.	Feather Valve A1 Enable
11.	Feather Valve A2 Enable

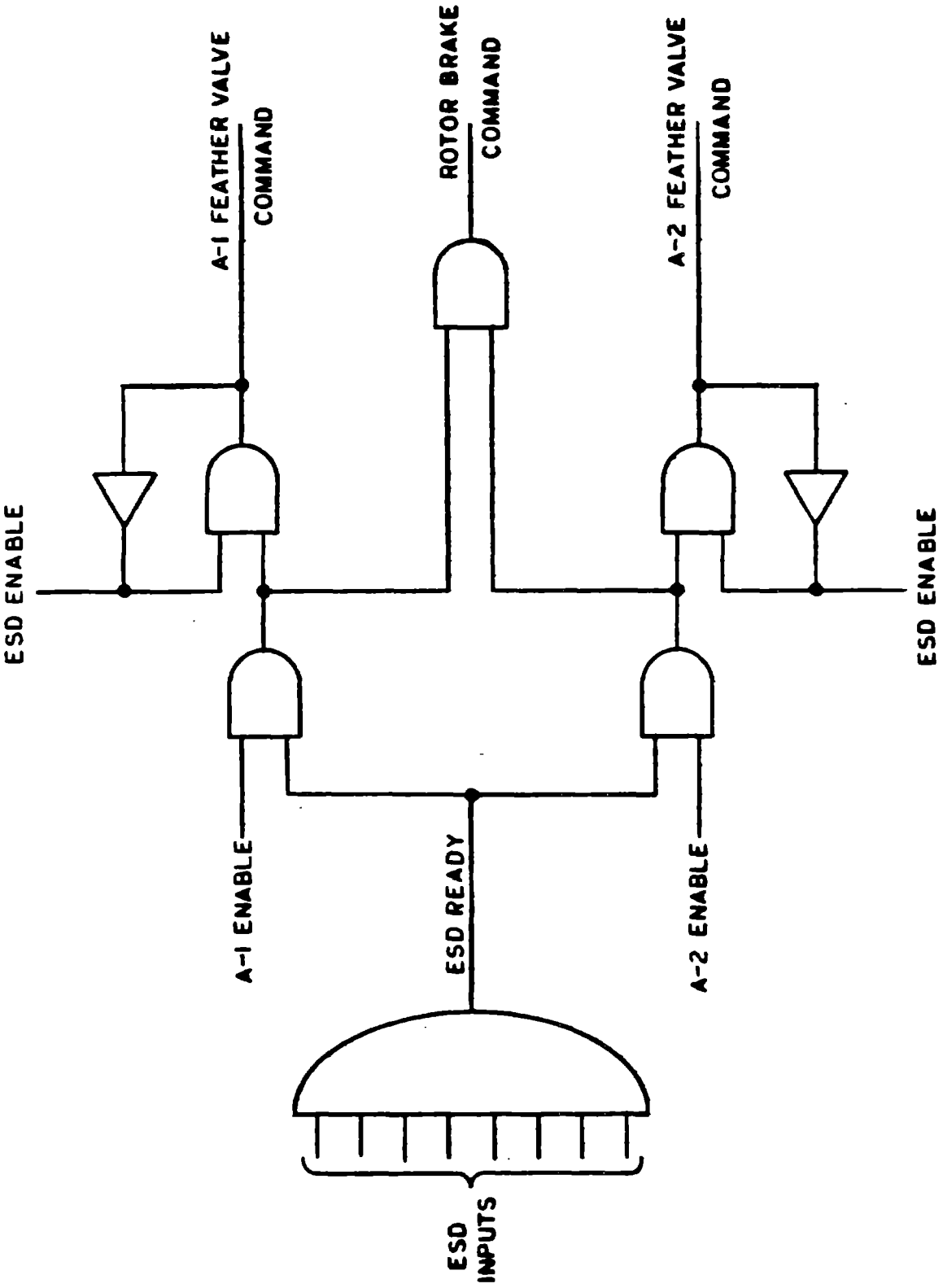

FIGURE 1 - LOGIC DIAGRAM - EMERGENCY SHUTDOWN PANEL (ESD)

3.1.2 OUTPUTS

The Emergency Shutdown Panel shall provide the following outputs:

1. Feather Valve (A1) Cmd
2. Feather Valve (A2) Cmd
3. ESD Ready signal
4. Feather Valve (A1) Status
5. Feather Valve (A2) Status
6. Rotor Brake Cmd

3.2 OPERATIONAL REQUIREMENTS

3.2.1 ESD READY SIGNAL

The ESD ready signal shall be issued when all inputs except for the feather valve (A1) and (A2) Enable commands are in their normal operational state. This indicates readiness to operate.

3.2.2 OUTPUT SIGNALS

The feather valve output signals will be issued when the ESD ready signal and the feather valve Enable signals are present and the ESD Enable Pulse has been received.

The rotor brake command shall be energized only when both feather valve enable commands are present.

3.2.3 STATUS SIGNALS

The feather valve status signals shall be issued when the feather valve commands are being issued.

3.2.4 ESD ENABLE

The ESD Enable is a 120 vac, 1 Ø 60 Hz Pulse, 100 milliseconds in duration.

The ESD Enable Pulse momentarily closes a set of relay contacts to energize the feather valve cmd relays which shall be configured to latch on. The feather valve commands shall be interlocked with the ESD Ready Signal and the individual feather valve enable signals. This provides for one-shot operation in the event of a momentary fault (greater than 10 milliseconds in durations) from any of the inputs.

3.3 PERFORMANCE REQUIREMENTS

3.3.1 INPUT CIRCUITS

3.3.1.1 DRY CONTACT INPUT

Input Number 1 through 7 listed in paragraph 3.1.1 are dry contact closures rated at 120 vac with a current carring capability of 1 Amp continuous and 5 Amps surge.

3.3.1.2 DC INPUT

Input Number 8 of paragraph 3.1.1 is a dry contact closure rated at 8 volt-Amps with a maximum current of .250 Amperes.

3.3.1.3 AC INPUT

Input numbers 9, 10, and 11 of Paragraph 3.1.1 are discrete 120 Vac, 60 Hz signals capable of supplying 3 amperes (RMS).

3.3.2 OUTPUT CIRCUITS

The output circuits listed in paragraph 3.1.2 shall be capable of supplying 120 VAC, 1Ø, 60 Hz with a continuous current rating of 3 Amps maximum.

3.4 MECHANICAL

3.4.1 SIZE

The Emergency Shutdown Panel design shall not exceed the envelope shown in Figure 2. The front panel size and mounting shall be as specified in Figure 2.

3.4.2 WEIGHT

The maximum weight of the Emergency Shutdown Panel shall not exceed 10 pounds.

3.5 ENVIRONMENT

3.5.1 TEMPERATURE

Operating:	0° to 50 °C.	Ambient air temperature
Non-Operating:	-40°C to 50°C	Ambient air temperature

3.5.2 HUMIDITY

10 to 90% RH (non-condensing).

3.5.3 ELEVATION

Sea level to 7000 feet.

3.6 VIBRATION

The operation of the Emergency Shutdown Panel shall not be affected when subjected to vibration levels of up to ±.25g in any direction.

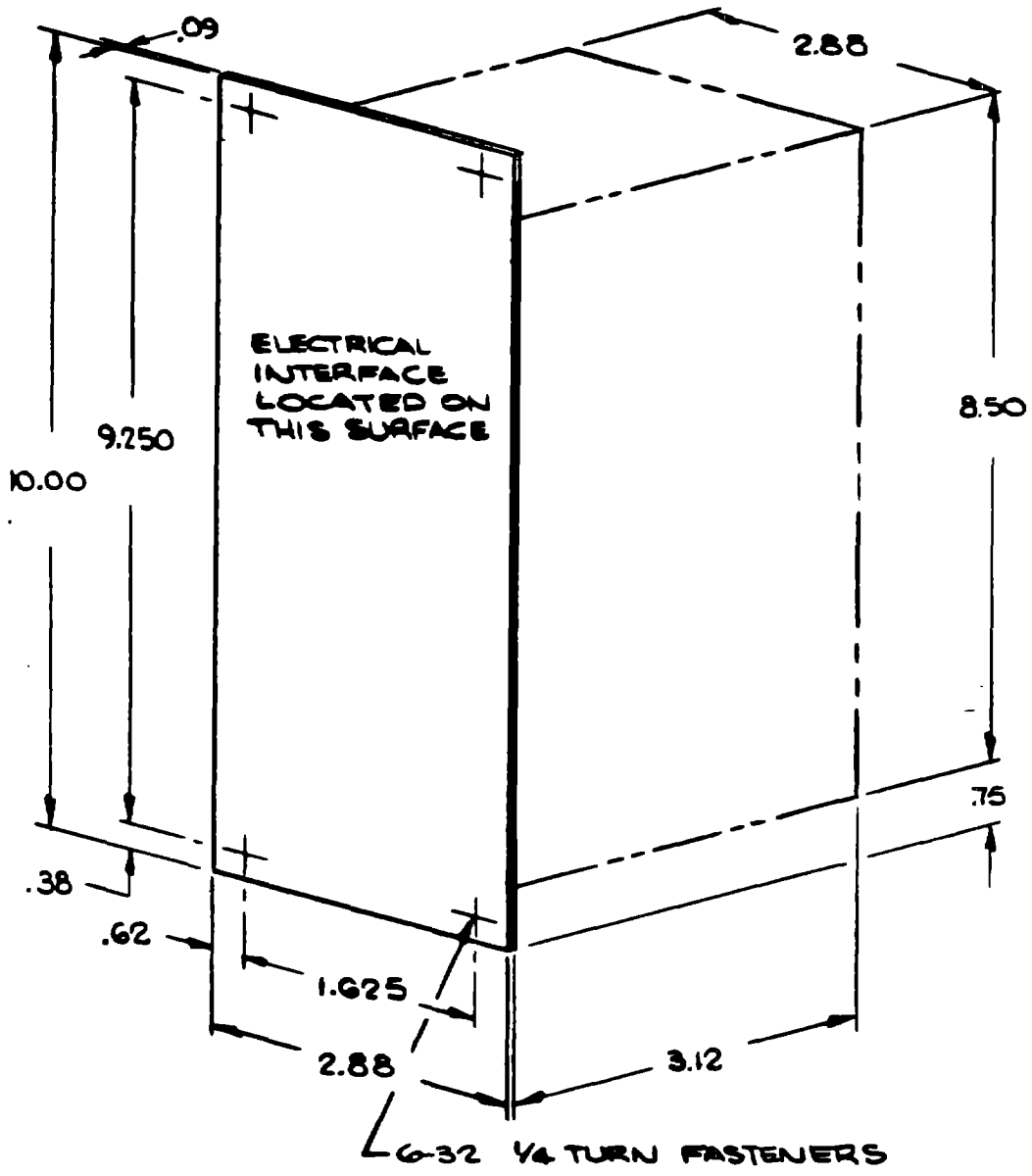

FIGURE 2 - ENVELOPE-EMERGENCY SHUTDOWN PANEL

3.7 SAFETY

All exposed wiring, terminals, etc. having a potential of greater than 48 volts shall be protected from accidental contact by service personnel in accordance with N E C.

3.8 MATERIALS

Material used in the ESD assembly shall be inherently corrosion resistant or protected from corrosion due to exposure to airborne moisture and salt in the operational environment. For corrosion analysis, assume 0.005 PPM maximum salt content in the environmental air after filtration for sea coast installation.

3.9 FINISH

All surfaces shall be chemically cleaned and treated to provide a bond between the primer paint and metal surfaces. The Emergency Shutdown Panel (ESD) shall be painted a semi-gloss blue (color conforming to FED-STD-595, color number 25550).

3.10 ELECTRICAL

3.10.1 WIRING INTERFACE

The ESD shall provide screw type or connector terminations for all interface wiring. The use of screw type terminations or connectors shall be consistant with the Controls Electronic Cabinet (CEC) schematic.

3.10.2 INTERNAL WIRING

Insulation for internal wiring shall have a rating of 600V and a minimum temperature rating of 105°C.

Internal wiring shall be supported as required to prevent damage from vibration levels specified in paragraph 3.6.

3.11 MAINTAINABILITY

MTTR = 4 hours (1 hour to identify, 2 hours to repair, 1 hour to restart)
The lowest level of repair shall be at the chassis level.

3.12 DESIGN AND FABRICATION

Equipment fabricated by or for AEPD shall conform to the fabrication and workmanship requirements specified in the following documents.

47A380052 Electrical Fabrication and Workmanship Standard

47A380053 Electrical System Test Equipment Design, Fabrication and Test Specification

3.13 LIFE

The expected lifetime of the Emergency Shutdown Panel assembly shall be thirty (30) years. All relays used in the Emergency Shutdown Panel design shall have a life expectancy of 100,000 operations minimum at rated load.

SECTION 4.0

VERIFICATION

4.1 GENERAL

The acceptance program for the Emergency Shutdown Panel (ESD) shall be implemented by analysis and test of a prime design unit. Development tests will also be performed in advance of prime design unit tests to support and confirm design and analytical tradeoffs. These tests are defined in this section.

4.1.1 RESPONSIBILITY FOR INSPECTION AND TESTS

GE/AEPD or its suppliers, at GE/AEPD direction, are responsible for conducting all tests and inspections to assure compliance with this specification and the domcuments referenced herein.

4.2 SPECIAL TESTS AND INSPECTIONS

4.2.1 ANALYSES

The following requirements of Section 3.0 shall be verified by review of analysis based on applicable specifications, applicable drawings, in-process test data, supplier component data, and operating experience with similar units.

Paragraph 3.3.2 Output Circuits

Paragraph 3.4.2	Weight
Paragraph 3.5.1	Environment
Paragraph 3.5.2	Humidity
Paragraph 3.6.	Vibration
Paragraph 3.7	Safety
Paragraph 3.8	Materials
Paragraph 3.10.2	Internal Wiring
Paragraph 3.11	Maintainability
Paragraph 3.13	Reliability

4.2.2 ACCEPTANCE INSPECTIONS

The following requirements of Section 3.0 shall be verified by inspection of the hardware or review of manufacturing in-process inspection data or component supplier data.

Paragraph 3.4.1	Size
Paragraph 3.9	Finish
Paragraph 3.10.1.	Wiring Interface
Paragraph 3.12	Design and Fabrication

4.3 ACCEPTANCE TESTS

4.3.1 WIRING

All wiring shall be checked for loose connections.

4.3.2 FUNCTIONAL TESTS

4.3.2.1 Thermal

The Emergency Shutdown Panel will be thermally tested while it is installed in the Control Electronics Cabinet as part of the Control Electronics Cabinet thermal test. The requirements of Paragraph 4.3.2.2 will be verified during this thermal test.

4.3.2.2 Logic

A functional logic test shall be performed prior to and during the thermal test specified in paragraph 4.3.2.1.

The outputs specified in paragraph 3.1.2 shall conform to paragraph 3.3.2 when the logic requirements of paragraphs 3.2.1, 3.2.2, 3.2.3 and 3.2.4 are met. The inputs shall be as specified in paragraphs 3.1.1, 3.3.1.1, 3.3.1.2 and 3.3.1.3.

4.4 TEST PROCEDURE

All tests shall be conducted using documented test procedures approved by quality assurance. All test procedures shall contain data sheets on which the results of the individual tests may be recorded.

4.5 TEST CONDITIONS

All tests shall be performed at room ambient conditions of temperature, humidity and atmospheric pressure unless otherwise specified.

4.6 APPROVAL

Review and approval of all test results by a General Electric Quality Assurance Representative is required prior to shipment of the Emergency Shutdown Panel assembly.

REV NO. A

47A380032
CONT ON SHEET 17 SH NO. 1

TITLE

FIRST MADE FOR

REVISIONS

A ISSUED REV. A PER AN-1 12/8/83

SPECIFICATION

FOR THE

MOD-5A WIND TURBINE GENERATOR SIMULATOR SOFTWARE

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Subsystems Engineer DATE: 9-23-82

Systems Engineering DATE: 9/27/82 10/14/82

Quality Assurance DATE: 9/28/82

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ISSUED 10/18/82

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	4	Table 1		
	5	Table 1		
	6	Table 2		
	7	Table 3		
	8	Table 4		
	9	Table 5		
	10	Table 6		
	11	Table 7		
	13	Add Paragraph 3.3.3 and Page 14		
	15	3.3.4		
	16	Figure 1		
	17	Figure 2		
	18	3.3.5, 3.3.5.1, 3.3.5.2, 3.3.6., 3.3.6.1, 3.3.6.2		
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SECTION 1.0

INTRODUCTION

1.1 SCOPE

This document describes the functional and performance requirements for the MOD-5A Simulator Software.

1.2 GENERAL DESCRIPTION

The basic function of the WTG simulator is to functionally test and check out the Controller. The WTG simulator will interface with the Controller to receive the Controller command outputs, simulate the WTG dynamic response to the Controller command output in accordance with operator selected external parameters, and provide the corresponding signals to the Controller sensor inputs.

The simulator is a component which will allow testing of the Controller simulating WTG operation. It will receive commands from the control system outputs and provide simulated sensor inputs to the control system so that functions and modes of operation of the Controller may be tested.

The simulator will provide the capability to check out and test the functional operation of both the system software and firmware during controller software development.

SECTION 2.0

APPLICABLE DOCUMENTS

The following documents as of the date of this issue or as noted below form a part of this specification to the extent specified herein. In the event of conflict between this specification and the documents referenced herein, the contents of this specification shall supersede.

2.1 GENERAL ELECTRIC DRAWINGS

47A380011	System Specification MOD-5A WTG
47A380013	Control System Specification for MOD-5A WTG
47A380033	WTG Simulator Hardware Specification
47A387005	Signal & Command List

SECTION 3.0

REQUIREMENTS

3.1 FUNCTIONAL REQUIREMENTS

The simulator processes inputs from the controller and the operator to provide responses to the controller which will exercise the controller in the manner it will experience during WTG operation.

The simulator signal outputs to the Controller are of 5 basic types. They are:

- Discrete signals that are independent of system operation, and are the result of a system anomaly or are generated external to the system. These signals would be generated by the operator during test operation and are listed in Table 1.
- Discrete signals that in normal operation would change state as a result of a Controller output command. The signals are listed in Table 2.
- Analog signals that represent dynamic response to Controller output commands and are listed in Table 3.
- Analog signals that represent external parameters. These signals would be operator controllable in accordance with the test operation and are listed in Table 4.
- Site and remote operator commands via serial data communications as listed in Table 7.

The simulator signal inputs from the Controller are of three basic types. They are:

- Discrete signals that are on/off commands issued by the Controller. These signals are listed in Table 5.
- Analog signals that are position commands issued by the Controller. These signals are listed in Table 6.
- All operating data via serial data communications.

TABLE 1

DISCRETE SIGNALS GENERATED EXTERNAL TO THE CONTROL SYSTEM

ID NUMBER	NAME
S1.3	Hi Temp Blade #1
S1.4	Hi Temp Blade #2
S1.5	Hi Strain Blade #1
S1.6	Hi Strain Blade #2
S2.3	Pitch Hydraulic Resv. Level
S2.4	Pitch Hydraulic Oil Filter
S2.5	Pitch Hydraulic Oil Temperature Status
S2.6	Pitch Pump Pressure
S2.16	Servo Valve Filter Status Blade #1
S2.17	Servo Valve Filter Status Blade #2
S3.3	Vibration #1 Rotor Vibration
S3.5	Hub Position
S4.2	Gearbox High Temperature
S4.11	Lube Resv. Level
S4.14	Lube Supply Filter Status
S4.23	Lube Supply Lo Pressure
S4.24	Lube Supply Lo Pressure
S4.25	Lube Supply Lo Pressure
S4.26	Lube Resv. Hi Temperature
S4.27	Lube Resv. Lo Temperature
S4.28	Lube Supply Temperature Hi
S4.29	Lube Supply Temperature HiHi
S4.30	Lube Pump Status, Shaft Driven
S5.1	Generator Winding Over Temperature
S5.2	Generator Lube Pressure Lo
S5.3	Vibration #2 (Generator)
S5.6	Generator Resv. Lube Level Lo
S5.7	Generator Resv. Lube Temperature Hi
S5.8	Generator Bearing Over Temperature
S6.3	Yaw Oil Level Low
S6.8	Yaw Filter Status
S6.9	Yaw Holding Brake Status
S6.10	Yaw Motive Brake Status
S6.11	Yaw Holding Brake Pressure Low
S6.12	Yaw Oil Temperature O.K.
S7.4	Emergency Shutdown System O.K.
S7.8	Nacelle Emergency Stop
S7.9	Ground Emergency Stop
S8.6	Utility Power Presence (Power Monitor)

TABLE 1

DISCRETE SIGNALS GENERATED EXTERNAL TO THE CONTROL SYSTEM

ID NUMBER	NAME
S9.1	Ground Intrusion
S9.2	EIS/OIS Ready
S9.3	Charger Malfunction
S9.8	Auto/Manual
S9.10	UPS Battery Status
S9.11	UPS Inverter Status
S9.12	Nacelle Fire Alarm
S9.13	CEC Heat Exchanger Alarm
S9.14	CEC Temperature Hi
S9.15	CEC Temperature HiHi
S9.16	Aircraft Strobe Status

TABLE 2

DISCRETE SIGNALS GENERATED INTERNAL TO THE CONTROL SYSTEM

ID NUMBER	NAME	FUNCTIONAL DESCRIPTION
S2.6	Charge Pump Pressure Low	C2.4 with delay
S2.7	Teeter Brake Accum Press Low (Low Force Brake)	C2.4 with delay
S2.8	Teeter Brake Accum Press Low (High Force Brake)	C2.4 with delay
S2.12	Teeter Brake Status High Force "ON"	
S2.13	Teeter High Force Brake Pressure	C2.11, C2.12
S2.19	Teeter Angle >±2.5°	
S2.20	Teeter Angle >±5°	
S2.30	Aileron Latch Status	C7.5, C7.6
S2.31	Accumulator Pressure Low	
S3.1	Rotor Brake Status	C3.1 + time delay
S3.11	Rotor Positioner Drive Status	C4.6
S4.23	Lube Supply Lo Pressure	C4.1 + time delay
S4.24	Lube Supply Lo Pressure	C4.1 + time delay
S4.25	Lube Supply Lo Pressure	C4.1 + time delay
S6.2	Yaw Oil Pressure	C6.1 + time delay
S6.4	Yaw Cyl #1 Full CW (L1 Limit SW)	C6.3, C6.4, C6.5
S6.5	Yaw Cyl #1 Full CCW (L2 Limit SW)	C6.2, C6.4, C6.5 See
S6.6	Yaw Cyl #2 Full CW (L3 Limit SW)	C6.3, C6.4, C6.5 Fig.
S6.7	Yaw Cyl #2 Retracted (L4 Limit SW)	C6.2, C6.4, C6.5 1 & 2
S7.2	Rotor Overspeed	S3.4
S7.3	Lube Supply Pressure	C4.1 + time delay
S7.4	Emergency Shutdown System Status	S7.1, S7.2, S7.3, S7.6
S7.6	"G" Switch #1	S3.4 C2.5, C2.7, C2.9
S7.7	"G" Switch #2	S3.4 C2.6, C2.8, C2.10
S7.10	Generator Overspeed	S3.4
S7.13	Feather Vlv A-1 Status	FSE C7.5 + time delay
S7.14	Feather Vlv A-2 Status	FSE C7.5 + time delay
S8.1	Lockout Relay Tripped	
S8.3	Stator Tie Status	C5.4
S8.4	Stator Short Contactor Status	C5.3
S8.5	Cycloconverter Tie Status	C5.8, C5.9
S8.2	Converter Ready	C5.2
S1.1	Ice Detected Blade #1	C1.1
S1.2	Ice Detected Blade #2	C1.2

TABLE 3

INTERNAL ANALOG SIGNALS

ID NUMBER	NAME	FUNCTIONAL DESCRIPTION
S2.21	Aileron 1, 1 Position	
S2.22	Aileron 1, 2 Position	
S2.23	Aileron 1, 3 Position	
S2.24	Aileron 1, 4 Position	
S2.25	Aileron 2, 1 Position	
S2.26	Aileron 2, 2 Position	
S2.27	Aileron 2, 3 Position	
S2.28	Aileron 2, 4 Position	
S3.4	Rotor Speed	S9.4, S9.6, S2.1, S2.2
S3.10	Rotor Position	S9.4, S9.6, S2.1, S2.2, S3.4
S5.4	Generator RPM	S3.4,
S5.5	Generator Output Power	S9.4, S9.6, S2.1, S2.2
S5.10	Generator Output VARS	

TABLE 4

EXTERNAL ANALOG SIGNALS

ID NUMBER	NAME	FUNCTIONAL DESCRIPTION
S2.18	Teeter Angle	
S9.4	Wind Speed #1	
S9.5	Wind Direction #1	C6.2, C6.3
S9.6	Wind Speed #2	
S9.7	Wind Direction #2	C6.2, C6.3

TABLE 5

DISCRETE COMMANDS

ID NUMBER	NAME
C1.1	Ice Detector Test Blade #1
C1.2	Ice Detector Test Blade #2
C2.4	Pitch Hydraulic Pump On/ CMD
C2.5	"G" Switch Full Test Blade #1
C2.6	"G" Switch Full Test Blade #2
C2.7	"G" Switch Half Test Blade #1
C2.8	"G" Switch Half Test Blade #2
C2.9	"G" Switch Reset Blade #1
C2.10	"G" Switch Reset Blade #2
C2.11	Teeter Brake AC Power on CMD
C2.12	Teeter Brake HF Brakes "Off" CMD
C3.1	Rotor Brake Release CMD
C4.1	Gearbox Lube System on CMD
C4.6	Rotor Positioner Drive CMD
C5.2	Turbine Ready CMD
C5.3	Start/Motor CMD
C5.4	Synchronize/Generate CMD
C5.7	Lockout Relay CMD
C5.8	Cycloconverter Tie Close CMD
C5.9	Cycloconverter Tie Trip CMD
C6.1	Yaw Solenoid Valve (S1) CMD
C6.2	Yaw Solenoid Valve (S2) CMD
C6.3	Yaw Solenoid Valve (S3) CMD
C6.4	Yaw Solenoid Valve (S4) CMD
C6.5	Yaw Hydraulic Pump On CMD
C7.1	Emergency Accum. Act. CMD
C7.2	Emergency Accum. Inhibit CMD
C7.3	Feather Valve A-1 CMD
C7.4	Feather Valve A-2 CMD
C7.5	Enable Feather Valve A-1
C7.6	Enable Feather Valve A-2
C9.1	Enable ESD CMD

TABLE 6

ANALOG CONTROL COMMANDS

ID NUMBER	NAME
C2.21	Aileron #1 Servo CMD
C2.22	Aileron #2 Servo CMD
C2.23	Aileron #3 Servo CMD
C2.24	Aileron #4 Servo CMD
C5.5	Torque Reference (Stator Power Reference)
C5.6	VAR/VOLT Reference

TABLE 7

REMOTE OPERATOR TERMINAL COMMANDS TO CONTROLLER

- Standby Enable
- Power Set Point
- VAR Set Point
- Normal Shutdown
- Request Remote Terminal Control
- Enable Site Terminal Control

SITE OPERATOR TERMINAL COMMANDS TO CONTROLLER

- Standby Enable
- Rotor Speed Set Point
- Generator Speed Set Point
- Power Set Point
- VAR Set Point
- Normal Shutdown
- Emergency Shutdown
- Request Site Terminal Control
- Enable Remote Terminal Control
- Manual Control Commands
  - Data Output - Dump Archive
  - Rotor Brake Control
  - Rotor Position Control
  - Individual Hydraulic Pump Controls
  - Yaw Brake Control
  - Yaw Position Control
  - Individual Aileron Pair Motion

3.2 OPERATIONAL REQUIREMENTS

3.2.1 OPERATOR SELECTABLE BI-LEVEL OUTPUTS

The simulator shall provide the means to select the state of any of the bi-level outputs. There shall be a method of changing the state of any bi-level output at any time during a simulation.

3.2.2 SIMULATOR CONTROLLED BI-LEVEL OUTPUTS

The simulator shall provide the means to select the state of any of the bi-level outputs which shall be functions of other simulator outputs or controller outputs. The functions shall include time delays, level comparisons, sum, products, differences, quotients, integrals and differentials of other simulator and controller outputs.

3.3 PERFORMANCE REQUIREMENTS

3.3.1 BI-LEVEL SIGNAL DELAY

The simulator shall be capable of providing delays to the discrete signals generated by the simulator (Table 2) which are individually selectable in 100 m sec increments from 0 to 120 seconds.

3.3.2 WIND SIMULATION

The simulator shall provide an output for the wind speed signal. The model shall allow the operator to select a steady wind of from 0 to 150 mph. The model shall provide for the simulation of a wind gust in the form of an inverted raised cosine pulse with the peak to peak amplitude selectable from 0 to 20 mph and with the period selectable from 0 to 10 seconds.

The wind direction signal shall be relative to the nacelle and as such it will indicate yaw error. The operator shall be able to select an initial yaw error of 0 to ±180 degrees.

3.3.3 AERODYNAMIC TORQUE CALCULATION

The simulator shall calculate the rotor torque as a function of the rotor RPM, the wind velocity, and control angle. The equations for the torque calculations will be of the form:

$$\tau = 2\, C_q\, V_w^2 \quad (29882.8)$$

where τ = rotor torque in ft-lbs

V_w = wind speed in feet/sec

C_q = torque coefficient calculated as follows:

```
INPUT B1,L
REM B1=THE CONTROL ANGLE(DEGREES)
REM L= LAMBDA= L1/L2
REM WHERE L1=14.28*ROTOR RATE(RPM)
REM AND L2=WIND VELOCITY(MI/HR)
C0=-15.377
C1=-4.6884
C2=0.77052
C3=-0.031635
C4=3.9301E-4
D0=19.254
D1=1.4571
D2=-0.32222
D3=0.014065
D4=-1.7809E-4
E0=-1.3128
E1=-0.15073
E2=0.029725
E3=-0.0013601
E4=1.7194E-5
B2=B1*B1
B3=B2*B1
B4=B3*B1
A0=C0+C1*B1+C2*B2+C3*B3+C4*B4
A1=D0+D1*B1+D2*B2+D3*B3+D4*B4
A2=E0+E1*B1+E2*B2+E3*B3+E4*B4
X=A0+A1*L+A2*L*L
REM TORQUE COEFFICIENT= X/10000
END
```

3.3.4 YAW

Given the followng yaw commands:

C6.1	Yaw hydraulic pump ON
C6.2	Yaw solenoid valve S1 (CW)
C6.3	Yaw solenoid valve S2 (CCW)
C6.4	Yaw solenoid valve S3 (gripper)
C6.5	Yaw solenoid valve S4 (holding brake)

The simulator shall activate the followng signals:

S6.4	Yaw cylinder set #1 Full CW
S6.5	Yaw cylinder set #1 Full CCW
S6.6	Yaw cylinder set #2 Full CW
S6.7	Yaw cylinder set #2 Full CCW

Signals S6.4, S6.5, S6.6, S6.7, S9.5, S9.7 shall respond to commands C6.1, C6.2, C6.3, C6.4 and C6.5 in a timed sequence as shown in Figures 1 and 2.

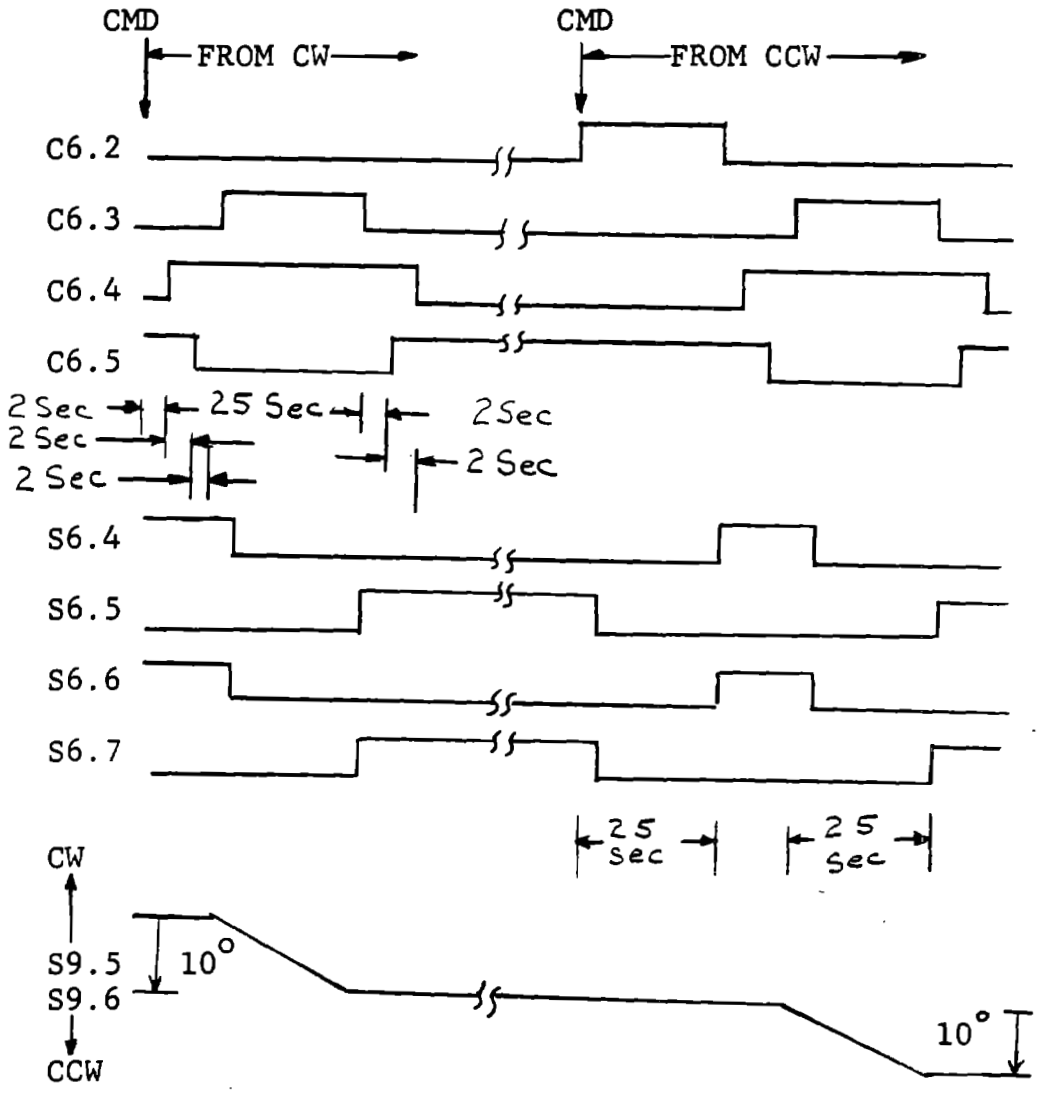

FIGURE 1 YAW CONTROL SEQUENCE - CW

3.3.5 LOGIC FUNCTIONS

3.3.5.1 Externally Generated Discrete Signal (See Table 1)

The default status for the externally generated discrete signals shall be the acceptable value. A malfunction error signal shall be generated by operator command.

3.3.5.2 Internally Generated Discrete Signals (See Table 2)

The internally generated discrete signal shall be generated in normal operation in response to controller command signal as indicated in Table 2. A malfunction condition error signal generated via operator command shall override the nominally generated signal to the controller.

3.3.6 ANALOG SIGNALS

3.3.6.1 Internally Generated Analog Signals

The internally generated analog signal shall be generated in accordance with the algorithm of paragraph 3.3.4.2. The operator shall have the capability to command a malfunction signal condition for each of the signals and which shall override the nominal internally generated signal to the controller.

3.3.6.2 Externally Generated Analog Signals

External analog signals shall be generated in accordance with paragraph 3.3.2.

SECTION 4.0

VERIFICATION

4.1 GENERAL

Verification of the conformance of the simulator with the requirements of Section 3 of this document shall be accomplished by utilizing a special program in the controller.

This program will be written to:

1) Exercise each simulator input
2) Verify all expected simulator outputs
3) Provide a printed record of each function tested

The program shall prompt the operator to exercise the simulator outputs which are independent (such as those listed in Table 1). It will then verify the appropriate response and provide a printed record of the verification.

TITLE

FIRST MADE FOR

REVISIONS
A ISSUED REV "A" PER AN-1
B ISSUED REV-B

WTG SIMULATOR HARDWARE SPECIFICATION

FOR THE

MOD-5A WIND TURBINE GENERATOR

SEPTEMBER 1982

REV. B
OCT. 1983

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REVISION LOG

This log identifies those portions of this document which have been revised since original issue. Revised portions of each page, for the current revision only, are identified by marginal striping.

Revision	Page No.	Paragraph Number(s) Affected	Rev. Date	Approval
A	3	3.1.1, 3.1.4	07/13/83	
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	4	3.1.7		AN-2
	6	Figures		

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SECTION 1

INTRODUCTION

1.1 SCOPE

This document describes the functional and performance requirements for the MOD-5A Simulator hardware.

1.2 GENERAL DESCRIPTION

The basic function of the WTG simulator is to functionally test and evaluate the control electronics. The WTG simulator will interface with the control electronics to receive the control electronics command outputs, simulate the WTG dynamic response to the control electronics command output in accordance with operator selected external parameters, and provide corresponding signals to the control electronics sensor inputs.

The simulator is a component which will allow testing of the control electronics by simulating WTG operation. It will receive commands from the control system outputs and provide simulated sensor inputs to the control system so that functions and modes of operation of the control electronics may be tested.

The simulator will provide the capability to evaluate the performance of the controller, to check out basic operation and to test the operation of both the system software and firmware during controller software development.

SECTION 2

APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflict between this specification and the documents referenced herein, the contents of this specification shall supersede.

2.1 GENERAL ELECTRIC DRAWINGS

47A380011	System Specification MOD-5A WTG
47A380013	Control System Specification for MOD-5A WTG
47A210105	Electrical AGE Fabrication and Workmanship Standard
47A210106	Electrical AGE and Systems Test Equipment Design, Fabrication and Test Specifications

SECTION 3

REQUIREMENTS

3.1 FUNCTIONAL REQUIREMENTS

The Simulator:

1. Accepts analog control inputs from controller
2. Accepts digital control inputs from controller
3. Performs analog computation to simulate the WTG rotational dynamics and power generation
4. Produces analog sensor outputs
5. Produces digital sensor outputs
6. Produces serial data outputs to peripheral terminals
7. Receives serial data from controller
8. Transmits operator commands to the controller

3.1.1 ANALOG CONTROL INPUT

The simulator shall have an analog input capacity for at least sixteen (16) channels.

3.1.2 DIGITAL CONTROL INPUT

The simulator shall have a digital input capacity for at least twenty (20) channels.

3.1.3 MEMORY

The simulator shall have a memory capacity of at least 64K-byte (8-bits/bytes).

3.1.4 ANALOG SENSOR OUTPUT

The simulator shall have at least twelve (12) channels of analog output.

3.1.5 DIGITAL SENSOR OUTPUT

The simulator shall have at least sixty (60) channels of digital output.

3.1.6 SERIAL DATA

The simulator shall have a capacity for at least three (3) serial data ports.

3.1.7 SIMULATION COMPUTATIONS

3.1.7.1 Actuator Characteristics

The actuator control simulation shall have the following characteristic:

$$\beta_a = \beta_c\left(\frac{1}{1+\tau s}\right)$$

where β_a = Actual Angle (in degrees)

β_c = Controller Drive Signal (in degrees)

τ = Actuator Time Constant (in seconds)
= 50 to 300 milliseconds

The simulator shall also provide a rate limit on the angle. Figure 1 shows the block diagram for the Actuator Simulator. The value of the rate limit shall be 5 to 20 degrees/second.

3.1.7.2 Rotating Dynamics Calculations

The simulator shall have the ability for analog computation which will be used to simulate rotational dynamics and power generation. A diagram of the analog simulation for the rotor dynamics and electrical power generation is shown in Figure 2. The equation for the dynamics simulation are:

$$\ddot{\Theta}_R = \frac{\tau_R}{J_R} + \frac{C}{J_R}(\dot{\Theta}_R - \dot{\Theta}_G) + \frac{K}{J_R}(\Theta_G - \Theta_R)$$

$$\ddot{\Theta}_G = \frac{\tau_E}{J_G} + \frac{C}{J_G}(\dot{\Theta}_G - \dot{\Theta}_R) + \frac{K}{J_G}(\Theta_R - \Theta_G)$$

where Θ_R, $\dot{\Theta}_R$, and $\ddot{\Theta}_R$ are the rotor position, velocity, and acceleration respectively, (RADIANS) Θ_G, $\dot{\Theta}_G$, and $\ddot{\Theta}_G$ are the generator position velocity and acceleration respectively (in radians and as reflected to the rotor side of the gearbox).

T_R is the rotor torque in ft-lbs

J_R is the rotor inertia in ft-lbs sec^2/rad

C is the damping factor in ft-lb sec/rad

K is the spring constant in ft-lb/rad

τ_E is the equivalent electrical torque in ft-lbs.

3.1.7.3 Electrical Power Calculation

The electrical power generated will be calculated by the following equation:

$$P_e = \tau_e \times \dot{\Theta}_G \times K_{eq}$$

where T_e is the electrical torque equivalent in ft-lbs.

$\dot{\Theta}_G$ is the generator speed in RPM

$K_{eq} = 0.142\ w/_{ft\text{-}lb}\ RPM$

and τ_e and $\dot{\Theta}_G$ are expressed as reflected to the rotor side of the gearbox

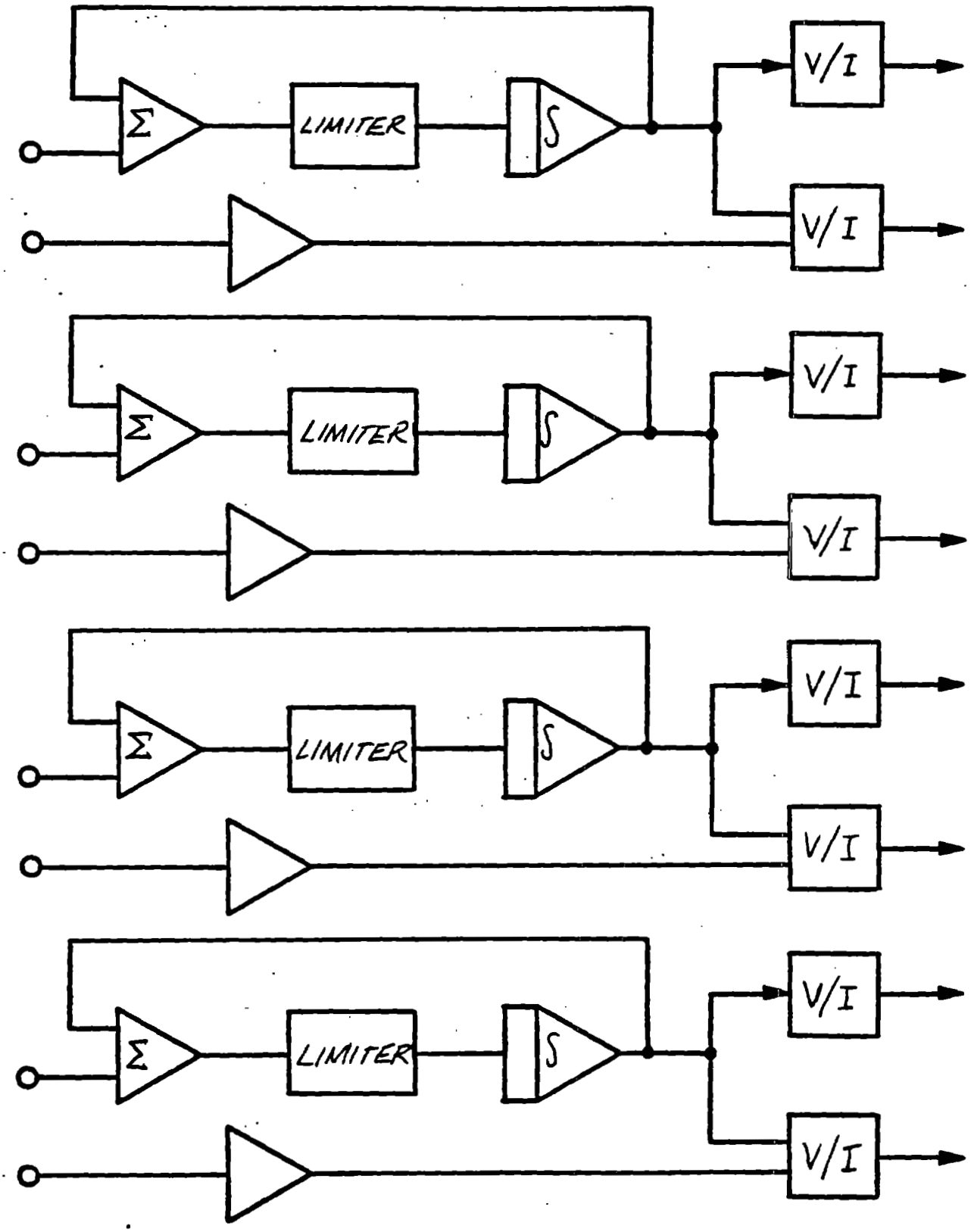

FIGURE 1 - ACTUATOR SIMULATOR BLOCK DIAGRAM

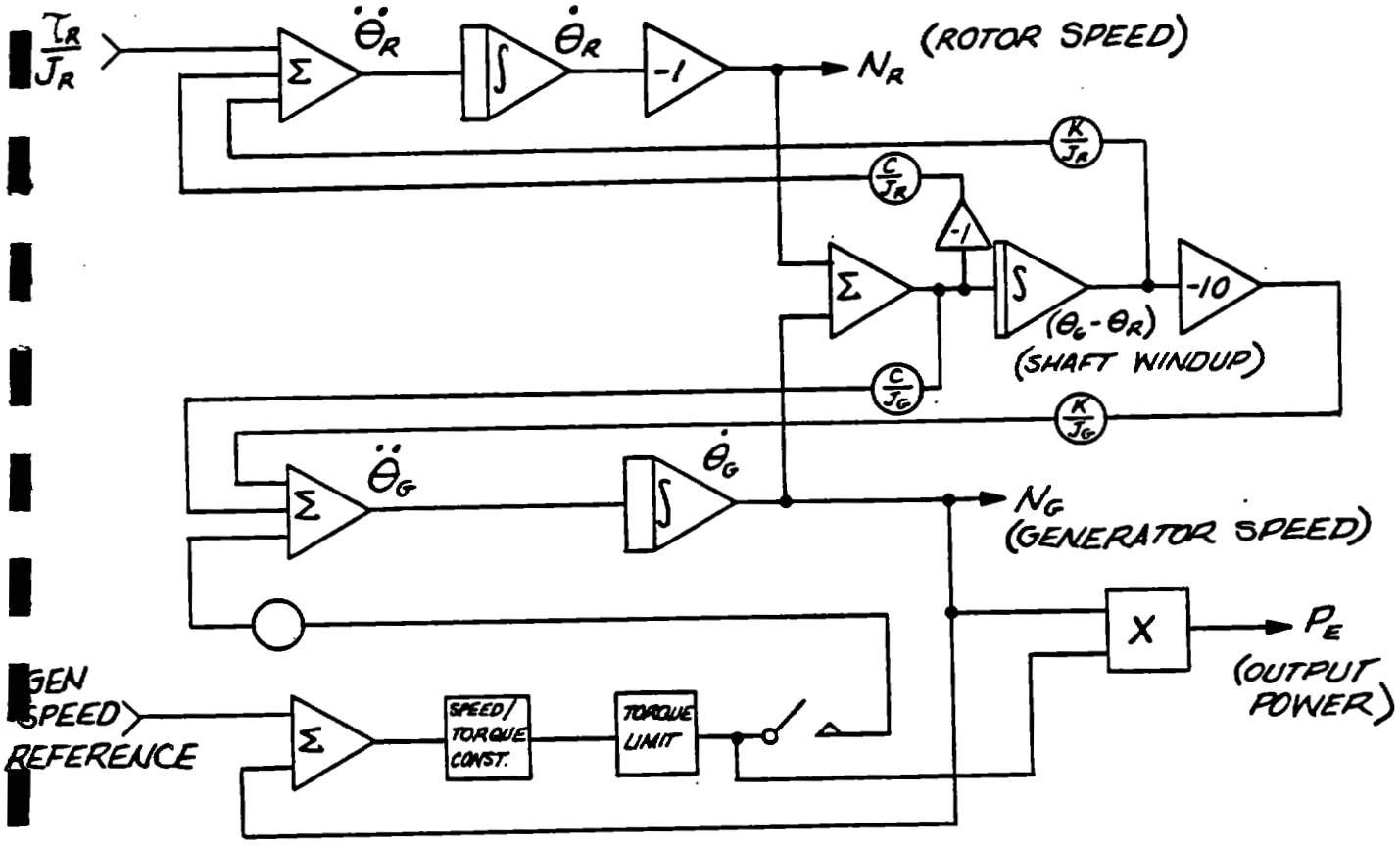

FIGURE 2 - DYNAMICS SIMULATOR BLOCK DIAGRAM

3.2 OPERATIONAL REQUIREMENTS

3.2.1 OPERATOR SELECTABLE BI-LEVEL OUTPUTS

The simulator shall provide the means to select the state of any of the bi-level outputs. There shall be a method of changing the state of any bi-level output at any point in time during a simulation.

3.2.2 SIMULATOR CONTROLLED BI-LEVEL OUTPUTS

The simulator shall provide the means to select the state of any of the bi-level outputs which shall be functions of other simulator outputs or controller outputs. The functions shall include time delays, level comparisons, sum, products, differences, quotients, integrals and differentials of other simulator and controller outputs.

3.3 PERFORMANCE REQUIREMENTS

3.3.1 CLOCK

The simulator shall have an internal real time clock that can be used in providing delays to the discrete signals generated by the simulator. The clock resolution shall be at least one 60 Hz cycle (16.7 msec).

3.3.2 ANALOG INPUTS

The simulator shall accept 4-20 ma current inputs. There shall also be a 12-bit resolution on the analog to digital converter.

3.3.3 DIGITAL INPUTS

The simulator shall accept a 90 VAC to 140 VAC signal and load the circuit to a rated value of 10 ma.

3.3.4 ANALOG OUTPUTS

Analog outputs generated by the simulator shall be 4 to 20 ma current loop signal. The simulator shall be capable of driving up to a 475 ohm load.

3.3.5 DIGITAL OUTPUTS

The simulator shall provide digital outputs on the form of a 12 VAC to 140 VAC signal with a 3 amp current steady state and a 20 amp surge capability.

3.3.6 SERIAL DATA PORTS

The simulator shall provide serial data ports that are RS232C or 20ma compatible. The Baud rate shall be selectable from 300 to 9600 Baud.

3.3.7 CYCLE TIME

The simulator shall have a cycle time of less than 1.0 second for the complete simulation of the WTG.

3.3.8 SOFTWARE PROGRAM

The simulator shall have a higher level software programming language to make the programming easier and to lessen the amount of time for programming.

3.4 ELECTRICAL

3.4.1 POWER REQUIREMENTS

The simulator shall be powered from a 120 VAC, 60 Hz, 1 phase circuit at 5 Amp maximum.

3.5 MECHANICAL

The simulator shall be relatively portable and there should be a minimum of assembly and disassembly when changing the location. The simulator shall also accommodate analog computations.

3.6 ENVIRONMENT

Operating

The simulator shall function in an environment of 5° to 40°C with up to 90% relative humidity.

Non-Operating

-20° to +50°C, 0-100% relative humidity, non-condensing

3.7 MAINTAINABILITY

The lowest level of repair is at the plug-in card level.

SECTION 4

VERIFICATION

4.1 GENERAL

The verification of the hardware of the simulator shall be achieved with software provided in accordance with vendor's instructions. There shall be verification of the memory, CPU, and System I/O. A vendor supplied program shall test the memory by writing and reading back data. The CPU shall be tested by a vendor supplied program that will exercise the arithmetic and logical instructions of the CPU. A System I/O test will be run by a vendor supplied program to test various system functions which includes front panel controls and indicators, the real time clocks, and the power failure monitor.

4.2 THE ANALOG BOARD

The analog board shall be verified with a bench test on the card by itself. The inputs will be simulated with power supplies or function generators and the outputs and test points will be monitored with meters and oscilliscopes to verify stage gains and potentiometer settings.

SITE OPERATOR TERMINAL REQUIREMENTS

FOR THE

MOD-5A WIND TURBINE GENERATOR

OCTOBER 1982

Responsible Engineer — DATE: 10/19/82

Subsystems Engineer — DATE: 10/19/82

Systems Engineering — DATE: 10/19/82

Quality Assurance — DATE: 11-1-82

WTG Integration — DATE: 10/20/82

TOTAL NUMBER OF PAGES 15

WTG 516

PRINTS

REVISION LOG

This log identifies those portions of this document which have been revised since original issue. Revised portions of each page, for the current revision only, are identified by marginal striping.

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SECTION 1

1.0 INTRODUCTION

1.1 SCOPE

This document describes the functional and performance requirements for the Site Operator Terminal for use on the MOD-5A Wind Turbine generator.

1.2 GENERAL DESCRIPTION

The Site Operators Terminal (SOT) is located in the Ground Control Enclosure (GCE) and interfaces with the control system Controller located in the nacelle via asynchronous serial communications. Operator commands are entered through a keyboard, coded, and transmitted to the Controller. Controller operating data is received by the site terminal and processed in real time to provide the following functions:

- o Generate a magnetic tape record of the data
- o Selectively display the data on a CRT
- o Selectively display the analog data on a strip chart recorder
- o Compute summary data for printout on a line printer
- o Print an alarm status on the line printer and display the alarm status on the CRT
- o Print operator commands on the line printer

SECTION 2

2.0 APPLICABLE DOCUMENTS

The following documents as of the date of this issue or as noted below form a part of this specification to the extent specified herein. In the event of conflict between this specification and the documents referenced herein, the contents of this specification shall be considered a superseding document.

2.1 GENERAL ELECTRIC DRAWINGS

47A380011	System Specification MOD-5A WTG
47A380013	Control System Specification for MOD-5A WTG
	Electrical AGE Fabrication and Workmanship Standard
47A380052	Electrical AGE and Systems Test Equipment Design, Fabrication and Test Specifications
TBD	Lightning Protection Requirements for MOD-5A WTG

SECTION 3

3.0 REQUIREMENTS

3.1 FUNCTIONAL REQUIREMENTS

A block diagram is shown in Figure 1. The SOT will be located in the Ground Control Enclosure (GCE) and shall provide asynchronous serial communications with the WTG Controller located in the Nacelle.

Operator commands entered via a keyboard, provide the following commands to the Controller:

OPERATIONAL COMMANDS

- o Request site terminal control
- o Enable remote terminal control
- o Standby enable
- o Normal shutdown
- o Rapid shutdown
- o Speed setpoint
- o Power setpoint
- o Data archive dump request
- o Gear select

MANUAL COMMANDS

- o Yaw CW
- o Yaw CCW
- o Yaw hydraulics pump motor ON/OFF
- o PSC hydraulics pump motor ON/OFF

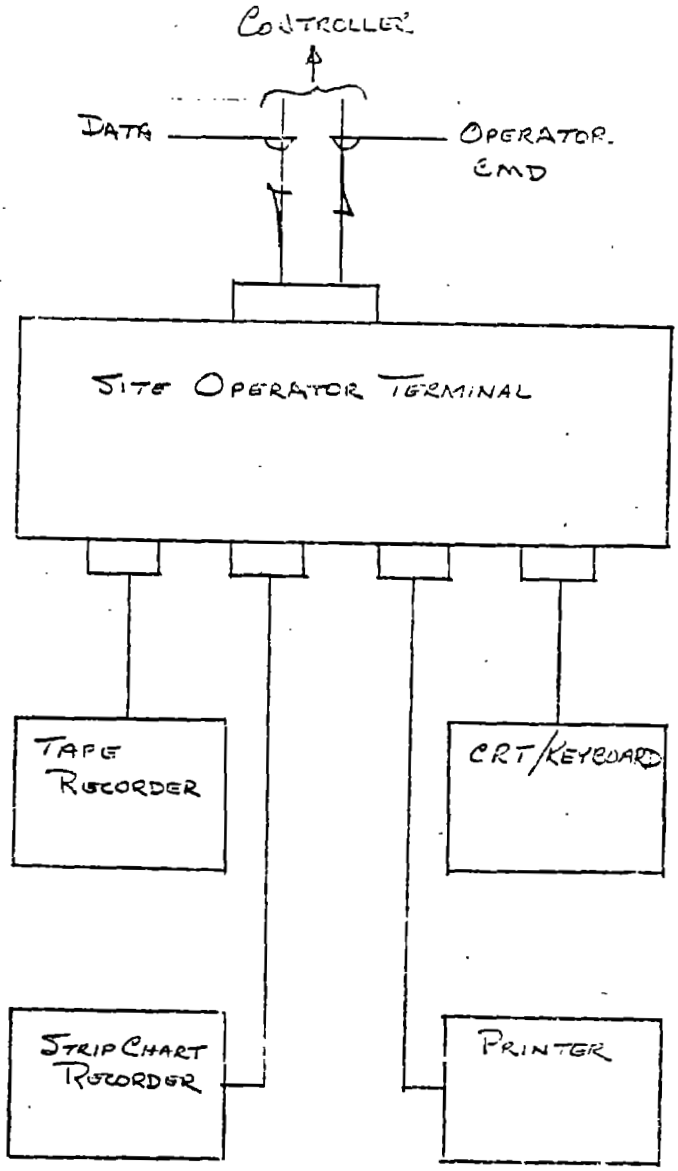

FIGURE 1 - SITE OPERATOR TERMINAL BLOCK DIAGRAM

3.1 FUNCTIONAL REQUIREMENTS (cont'd)

MANUAL COMMANDS (cont'd)

- o Gearbox lube pump ON/OFF
- o Generator lube pump ON/OFF
- o Tip #1 to power
- o Tip #1 to feather
- o Tip #2 to power
- o Tip #2 to feather
- o Teeter brakes high press
- o Teeter brakes low press
- o Rotor parking brake ON/OFF
- o Gear Select
- o Turning gear engage
- o Turning gear drive
- o Yaw brakes ON/OFF

The data received from the Controller will be processed for recording and display. Analog data will be converted for output to strip chart recorders. Operating status and alarms data will be displayed on the CRT in alphanumeric form. Summary data will be generated for output to the printer.

Alarm status will be displayed on the CRT and on the printer. The data will be retransmitted to the tape recorder.

3.1.1 CONTROLLER INTERFACE, RECEIVE

The site terminal shall provide a 20 mA serial interface for receiving data from the Controller. The data rate shall be selectable between 300 and 9600 baud. The expected data rate is 1200 baud. The data stream from the Controller shall consist of 50 - 8 bit words (nominal). This message will be updated and transmitted at a minimum rate of 1 message per second. A continuous data stream, if present, shall be processed at a rate of one data set per second.

3.1.2 CONTROLLER INTERFACE, TRANSMIT

The site terminal shall provide a 20 mA serial data interface for transmitting commands to the Controller. The data rate shall be 1200 baud.

3.1.3 CRT DISPLAY

The site terminal shall provide a cathode ray tube display. It shall have capabilities of at least 12 lines with at least 40 characters/lines. The CRT display shall be masked (protected field) screen fixed format alphanumeric presentation of the data. A minimum of 10 pages of data presentation shall be selectable for display with the data updated at a 1/sec. rate.

3.1.4 TAPE RECORDER

The site terminal shall provide an interface for a magnetic tape recorder. The data format shall be parallel ASCII. The tape recorder shall utilize 1/2 inch magnetic tape. It shall record the ASCII data in a 9 track 1600 bpi PE (phase encoded) format.

3.1.5 STRIP CHART

The site terminal shall provide an interface to strip chart recorder. It shall provide 8 analog output channels. Each channel shall be a 0 to 5 volt (0 to 10 volt) output. The output channels shall provide 12 bit resolution.

3.1.6 KEYBOARD

The site terminal shall provide an ASCII Keyboard with a minimum of 8 user defined function keys.

3.1.7 PRINTER INTERFACE

The site terminal shall provide an RS232C port for data output to the printer.

3.2 PERFORMANCE REQUIREMENTS

3.2.1 TAPE RECORDER

The site terminal shall buffer the data received from the Controller and retransmit it to the magnetic tape recorder at the specified baud rate. The site terminal shall generate the tape transport control signals.

3.2.2 STRIP CHART RECORDER

The site terminal shall drive the strip chart with data from the Controller. The site terminal shall perform any conversions required to produce the strip chart signal from the data stream from the Controller. The site terminal shall provide individual selection of the analog functions to be displayed on the strip chart, up to eight signals at a time.

3.2.3 PRINTER FUNCTIONS

The printer shall provide an operating log by recording change of Controller mode alarm detected by the Controller and also by operator command to the Controller. The printer shall record operator selected data displays and summaries. Each event shall include a time record. At periodic intervals, i.e. 1 hour, or upon operator request via the keyboard, an operating summary shall be printed.

3.2.4 CRT DISPLAY FUNCTION

The terminal shall extract the appropriate data from the data input and, in real time perform scaling and conversion to engineering units for display. The display shall be fixed format with multi-page capability. The terminal shall provide capacity for at least 10 pages of display. The format for the display shall be preprogrammed and stored in memory. The terminal shall have the capability such that the operator can change individual parameters for display. The basic format for each page will consist of three basic sections. They are a selectable dynamic display, alarms, and operator input.

The dynamic display will consist of preprogrammed (or operator preselected) parameters. The parameter title will be continuously displayed and the operating parameter data will be updated at the 1/sec data rate. There shall be provision for at least 10 parameters per page.

A separate area of the CRT display shall display alarm functions. The alarm code received from the Controller and its alphanumeric description (stored in SOT memory) shall be displayed.

A third area on the CRT shall be set aside to display the operator input commands as entered through the keyboard and for operator messages from the remote terminal.

3.2.4 CRT DISPLAY FUNCTION (cont'd)

For the display page selected, the site terminal will extract the appropriate data from the Controller data stream on a real time basis, convert and scale the data, and display the results on the CRT.

An illustrative example of a page of CRT display is shown in Table 1.

TABLE 1

PERFORMANCE SUMMARY

Power Generated (MW)		xx.x
Power Setpoint (MW)		xx.x
Energy Produced Today (MWHR)		xxx
Energy Produced Yesterday (MWHR)		xxx
Current Operating Mode	-	Normal Shutdown
Operator Control	-	Site

ALARMS

PSC HYD PRESS LOW xxx

REQUEST REMOTE CONTROL: ENABLE*

* Request is received in data stream and displayed, ENABLE is site operator keyboard input

3.2.5 PROCESSING

The analog data shall be converted from 12 bit binary to engineering units for output to the CRT and printer. Using the input data for WTG power output and wind velocity, the site terminal shall calculate the following:

- o energy produced = power generated * time
- o energy available = energy produced + energy avail. but not operating + energy avail. but not produced by operating at power setpoint below rated
- o energy availability = $\frac{\text{energy produced}}{\text{energy avail.}}$
- o time availability = $\frac{\text{operating time}}{\text{total time of operating wind velocity}}$

Discrete data shall be displayed on the CRT and printer in alphanumeric form where the descriptive information is stored in memory. For example, operating mode would be displayed as:

STANDBY ENABLE

STANDBY DISABLE

START UP

RAMP/SYNC.

POWER GEN

SHUTDOWN

LOCKOUT

etc.

Alarms shall be displayed as:

PSC PRESS LOW

HUB SPEED HIGH

etc.

3.3 ELECTRICAL REQUIREMENTS

3.3.1 POWER

117 VAC 60 Hz 1Ø @ TBD watts max. and TBD amp max.

3.3.2 SERIAL DATA - 20 ma

3.3.3 PARALLEL DATA

3.3.4 ANALOG SIGNAL

Analog Signal Output To Strip Chart Recorder - 0 to 5 or 0 to 10V with 12 bit resolution

3.4 MECHANICAL

Size - (Later)

Weight - (Later)

3.5 ENVIRONMENT

Temperature:	60°F to 90°F operating -40°F to +122°F non-operating
Humidity:	0 to 95% RH non-condensing
Altitude:	Sea Level to 7000 ft.

SECTION 4

4.0 VERIFICATION

(Later)

4.1 HARDWARE VERIFICATION

Verification for instrumentation such as the strip chart, printer, and tape recorder shall be done by normal calibration procedures.

Verification of processing equipment shall be done using vendor supplied checkout.

4.2. SOFTWARE VERIFICATION

Verification of software functions shall be done during system integration and checkout.

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TITLE

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CONT ON SHEET ii SH NO. i

FIRST MADE FOR

REVISIONS

CONTROLS DATA SYSTEM REQUIREMENTS

FOR THE

MOD-5A WIND TURBINE GENERATOR

JULY 1983

G P Schanzenbach — Responsible Engineer — DATE: 7-22-83

W C Lucas — Engineering Manager — DATE: 7/22/83

[signature] — Systems Engineering — DATE: 7/22/83

[signature] — Chief Engineer — DATE: 7/25/83

A. Cheddar — Quality Assurance — DATE: 7/22/83

L [signature] — WTG Integration — DATE: 7/22/83

TOTAL NUMBER OF PAGES 17

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SECTION 1

1.0 INTRODUCTION

1.1 SCOPE

This document describes the functional and performance requirements for the CDS (Controls Data System) for use on the MOD-5A Wind Turbine generator.

1.2 GENERAL DESCRIPTION

The CDS is located on the ground near the base of the tower and interfaces with the control system Controller located in the nacelle via asynchronous serial communications. Controller operating data is received by the CDS and processed in real time to provide the following functions:

- o Generate a magnetic tape record of the data
- o Selectively display the data on a CRT
- o Selectively display the analog data on a strip chart recorder
- o Compute summary data for print out on a line printer

SECTION 2

2.0 APPLICABLE DOCUMENTS

The following documents as of the date of this issue or as noted below form a part of this specification to the extent specified herein. In the event of conflict between this specification and the documents referenced herein, the contents of this specification supersede.

SECTION 3

3.0 REQUIREMENTS

3.1 FUNCTIONAL REQUIREMENTS

A block diagram is shown in Figure 1. The CDS shall provide asynchronous serial communications with the WTG Controller.

The data received from the Controller will be processed for recording and display. Analog data will be converted for output to strip chart recorders. Operating status and alarms data will be displayed on the CRT in alphanumeric form. Summary data will be generated for output to the printer.

3.1.1 CONTROLLER INTERFACE, RECEIVE

The CDS shall provide a 20 mA serial interface for receiving data from the Controller. The data rate shall be selectable between 300 and 9600 baud. The expected data rate is 1200 baud. The data stream from the Controller shall consist of 50 - 8 bit words (nominal). This message will be updated and transmitted at a minimum rate of 1 message per second.

3.1.2 CONTROLLER INTERFACE, TRANSMIT

The CDS shall provide a 20 mA serial data interface for transmitting commands to the Controller. The data rate shall be 1200 baud.

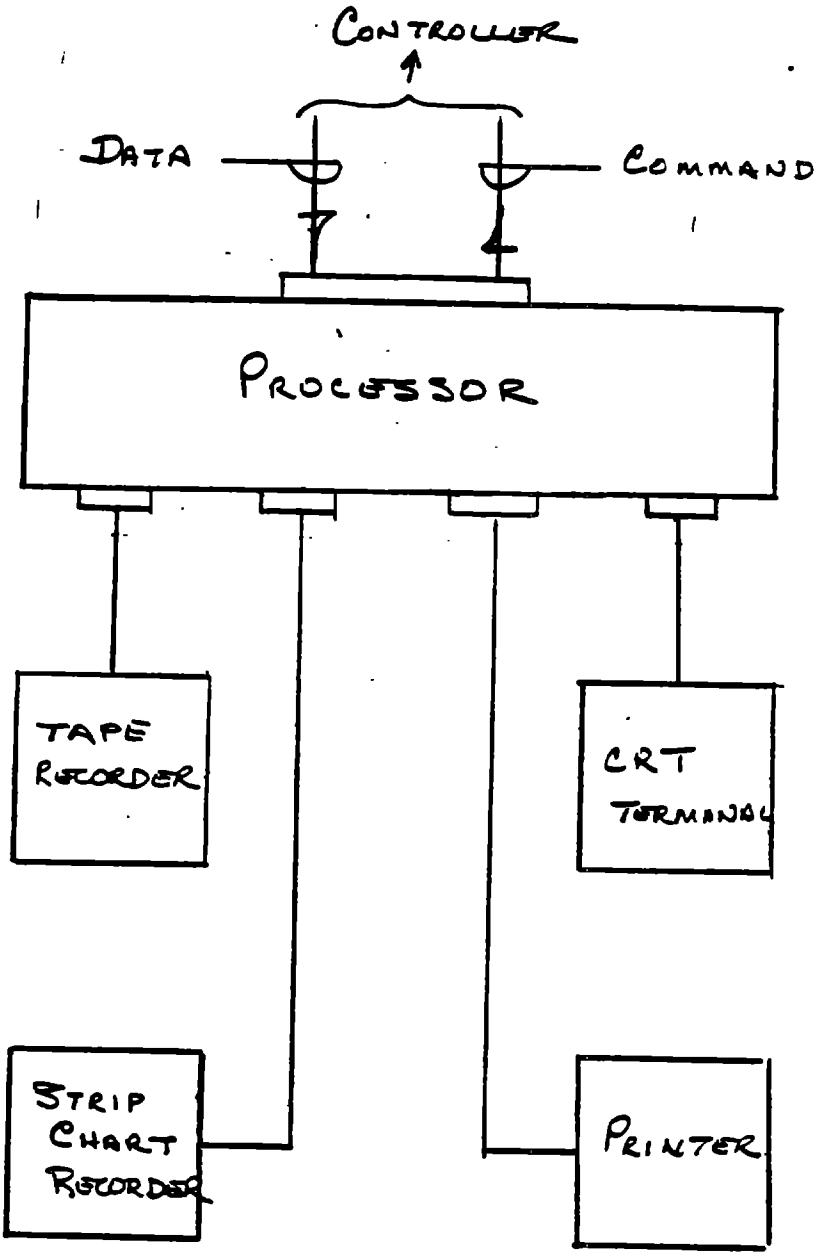


FIGURE 1 - CDS BLOCK DIAGRAM

3.1.3 CRT DISPLAY

The CDS shall provide a cathode ray tube display. It shall have capabilities of at least 24 lines with at least 80 characters/line. The CRT display shall be masked (protected field) screen fixed format alphanumeric presentation of the data. A minimum of 10 pages of data presentation shall be selectable for display with the data updated at a 1/sec. rate.

3.1.4 TAPE RECORDER

The CDS shall provide an interface for a magnetic tape recorder. The data format shall be parallel ASCII. The tape recorder shall utilize 1/2 inch magnetic tape. It shall record the ASCII data in a 9 track 1600 bpi PE (phase encoded) format.

3.1.5 STRIP CHART

The CDS shall provide an interface to a strip chart recorder. It shall provide 8 analog output channels. Each channel shall be a 0 to 10 volt output. The output channels shall provide 12 bit resolution.

3.1.6 KEYBOARD

The CDS shall provide an ASCII Keyboard with a minimum of 8 user defined function keys.

3.1.7 PRINTER INTERFACE

The CDS shall provide a port for data output to the printer.

3.1.8 EXECUTION RATE

The processor shall have an execution rate to enable completion of the following required functions within 1 second.

- o receive serial data
- o buffer the data for tape recording
- o transfer contents of buffer to the tape recorder
- o D/A conversion of analog data and output to strip chart recorder
- o calculate summary data for printer output
- o prepare alarm output to printer
- o convert and format data for CRT display
- o accept operator input commands via the keyboard, format the command and transmit the command to the controller -- a command will consist of a leader, 1 to 4 word message, and a checksum.

An optional additional requirement is the capability to input up to 16 analog signals at a sampling rate of 6K hz (nominal). That is, sample each of 16 analog signals at a rate of 400 samples per second (nom).

3.1.9 MEMORY CAPACITY

Memory capacity shall be 64K bytes or words minimum based on the following allocation:

- o tape recorder data buffer - 15K
  (5 minutes of 50 words per second
- o CRT display - 19K
  (10 pages @ 24 x 80 characters)
- o alarm message - 20K
  (255 alarms @ 80 characters)
- o program and scratch - 10K

3.1.10 PROGRAM LANGUAGE

The processor shall utilize a higher level program language i.e. Fortran, Compiled Basic, to minimize the user program development time. However the use of a higher level language shall be subordinate to the execution speed. Assembly language programming is acceptable as a trade-off to execution speed and reduced memory requirements.

3.2 PERFORMANCE REQUIREMENTS

3.2.1 TAPE RECORDER

The CDS shall buffer the data received from the Controller and retransmit it to the magnetic tape recorder at the specified baud rate. The CDS processor shall generate the tape transport control signals.

3.2.2 STRIP CHART RECORDER

The CDS shall drive the strip chart with data from the Controller. The CDS shall perform any conversions required to produce the analog strip chart signal from the data stream from the Controller. The CDS shall provide individual selection of the analog functions to be displayed on the strip chart, up to eight signals at a time.

3.2.3 PRINTER FUNCTIONS

The printer shall provide an operating log by recording change of Controller mode and alarms detected by the Controller and also by operator command to the Controller. The printer shall record operator selected data displays and summaries. Each event shall include a time record. At periodic intervals, i.e. 15 minutes, or upon operator request via the keyboard, an operating summary shall be printed. Figure 2 is an example of a typical printout.

0.00 14.32.34 MOD 5A SUMMARY DATA UNIT SN 001

CONTROL SITE	MWH PRODUCED YESTER .0	CUMM .00	FROM 0.00	TA% 97.7	SET POINTS MW 7.2	RPM 17.8

TIME	ALRM	MPH	MW	MWH	MODE
14.34.14	0	39.8	7.37	58.2	PWR
14.49.14	0	46.7	6.61	60.0	PWR
15.04.14	0	46.4	7.24	61.8	PWR
15.19.14	0	39.4	7.25	63.6	PWR
15.34.14	0	25.2	1.72	64.9	PWR
15.49.14	0	10.9	.02	65.0	PWR
15.54.21	0	5.3	.02	65.0	NSD
15.55.59	0	3.9	.01	65.0	SBE
16.10.59	0	15.5	.02	65.0	SBE
16.14.19	0	20.1	.02	65.0	SU
16.15.29	0	19.9	.02	65.0	RMP
16.17.31	0	22.2	.44	65.0	PWR
16.32.31	0	36.9	7.44	66.0	PWR
16.47.31	0	46.4	7.48	67.8	PWR
17.02.31	0	47.2	7.29	69.6	PWR
17.17.31	0	42.2	6.88	71.4	PWR
17.32.32	0	26.9	2.34	72.8	PWR
17.47.32	0	11.4	.02	73.0	PWR
17.53.04	16	6.1	.00	73.0	NSD
17.53.08	0				
17.54.43	0	4.4	.00	73.0	LO
17.55.08	0	4.9	.00	73.0	SBI
11			17.55.17		
17.55.19	0	5.2	.00	73.0	SBE
18.10.19	0	15.5	.00	73.0	SBE
18.14.19	0	19.4	.00	73.0	SU
18.15.29	0	20.6	.00	73.0	RMP
18.17.31	0	23.0	.57	73.0	PWR

FIGURE 2

ILLUSTRATIVE EXAMPLE OF PRINTER OUTPUT

3.2.4 CRT DISPLAY FUNCTION

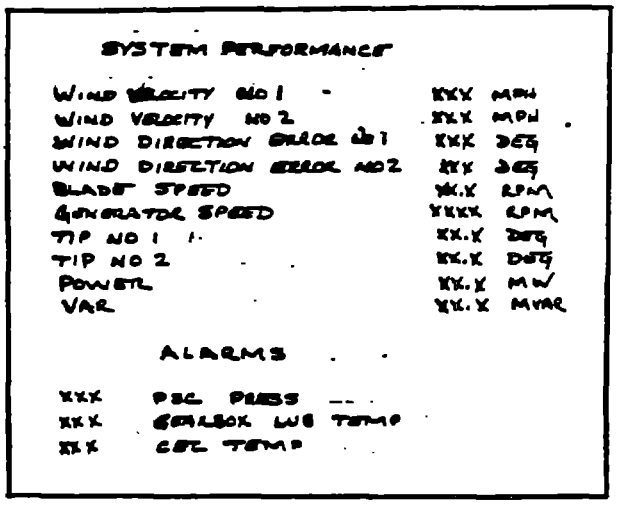
The processor shall extract the appropriate data from the data input and, in real time,perform scaling and conversion to engineering units for display. The display shall be fixed format with multi-page capability. The processor shall provide capacity for at least 10 pages of display. The format for the display shall be preprogrammed and stored in memory. The processor shall have the capability such that the operator can change individual parameters for display. The basic format for each page will consist of two basic sections. They are a selectable dynamic display and alarms.

The dynamic display will consist of preprogrammed (or operator preselected) parameters. The parameter title will be continuously displayed and the operating parameter data will be updated at the 1/sec data rate. There shall be provision for at least 10 parameters per page.

A separate area of the CRT display shall display alarm functions. The alarm code received from the Controller and its alphanumeric description (stored in CDS memory) shall be displayed.

For the display page selected, the CDS will extract the appropriate data from the Controller data stream on a real time basis, convert and scale the data, and display the results on the CRT.

Illustrative examples of the CRT display are shown in Figure 3.



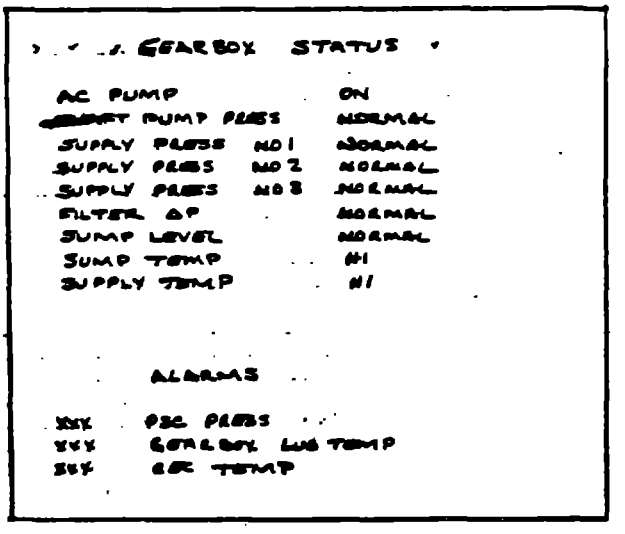


FIGURE 3

ILLUSTRATIONS OF CRT DISPLAYS

3.2.5 PROCESSING

The analog data shall be converted from 12 bit binary to engineering units for output to the CRT and the printer.

The processor shall be capable of arithmetic computation which, as a minimum, shall include addition, subtraction, multiplication and division.

Discrete data shall be displayed by the CRT and printer in alphanumeric form where the text information is stored in memory. For example, operation mode would be displayed as one of the following:

STANDBY ENABLE

STANDBY DISABLE

START UP

RAMP/SYNC.

POWER GEN

SHUTDOWN

LOCKOUT

Alarms message test shall be stored in memory and displayed by the CRT in alphanumeric form as the alarm number and the message. A typical alarm display would be as follows:

123	PSC PRESS LOW
231	HUB SPEED HIGH

The alarm function for printer output shall consist of the alarm number and the time of the alarm occurrence. The alarm message printout shall indicate when an alarm function is restored to the normal operating condition. An illustrative example of the alarm printout is shown in Figure 4.

```
0.00    0.00.00    MOD 5A SUMMARY DATA  UNIT SN 001

                    MWH PRODUCED                    SET POINTS
 CONTROL  YESTER    CUMM    FROM     TA%      MW        RPM
   SITE      .0      .00    0.00      .0       .0        .0

    TIME     ALRM    MPH     MW     MWH    MODE
    ----     ----    ---     --     ---    ----
  0.00.14       0   17.8    .00      .0     LO
  0.00.20       0   17.5    .00      .0     SBI
5@@@@@@@@@@
1:                            0.00:33
  0.00.35       0   17.8    .00      .0     SBE
  0.03.46       0   17.5    .00      .0      SU
  0.04.55       0   17.3    .00      .0     RMP
  0.08.45       0   22.4    .30      .0     PWR
  0.14.16      16   17.9   1.06      .0     NSD
  0.14.20       0
  0.15.55       0   19.6    .00      .0     LO
```

Alarm (#16)→

Alarm Condition Restored →

FIGURE 4

ILLUSTRATIVE EXAMPLE OF PRINTER OUTPUT OF ALARM

3.3 ELECTRICAL REQUIREMENTS

3.3.1 POWER

117 VAC 60 Hz 1Ø @ 1000 watts ~~max.~~ NOM. and 15 amp max.

3.3.2 SERIAL DATA - 20 ma - 1200 Baud/1000 ft cable

3.3.3 PARALLEL DATA - TTL/25 ft cable

3.3.4 ANALOG SIGNAL

Analog Signal Output To Strip Chart Recorder - 0 to 10V with 12 bit resolution

3.4 MECHANICAL

Size - Suitable for installation in a single 19" rack.

3.5 ENVIRONMENT

Temperature:	60°F to 90°F operating -40°F to +122°F non-operating
Humidity:	0 to 95% RH non-condensing
Altitude:	Sea Level to 7000 ft.

SECTION 4

4.0 VERIFICATION

4.1 HARDWARE VERIFICATION

Verification for instrumentation such as the strip chart, printer, and tape recorder shall be done by normal calibration procedures.

Verification of processing equipment shall be done using vendor supplied checkout.

4.2. SOFTWARE VERIFICATION

Verification of software functions shall be done during system integration and checkout.

MOD-5A SOFTWARE PROJECT

MANAGEMENT PLAN

MAY 1982

G P Schaugenbach
Responsible Engineer DATE: 6/2/82

R.K. Barton
Systems Engineering DATE: 2 JUN '82

W C Luccar
Engineering Manager DATE: 6/3/82

G Drenker for A. Kellar
Quality Assurance DATE: 6/4/82

L Terry
Program Office DATE: 6/4/82

TOTAL NUMBER OF PAGES 19

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SECTION 1

1.0 INTRODUCTION

1.1 SCOPE

This Software Project Management plan delineates the methods and procedures to be followed during the development of the software targeted for the MOD-5A Wind Turbine Generator. The key elements provided by this plan are:

1. Definition of the MOD-5A software
2. A description of the software development process to be employed in developing the software for the MOD-5A.
3. Software test program
4. Software quality program
5. The software engineering methodology to be employed.
6. Software configuration management plan
7. Project planning, organization and control
8. Required documentation.

All software developed for the MOD-5A Wind Turbine Generator shall be developed according to this plan; deviations shall be allowed only where they will result in significant benefit to the MOD-5A program and software development and have no adverse effect upon the software reliability or maintainability.

1.2 OBJECTIVES

The objective of this document is to define a methodology for the development of the MOD-5A software that will provide software that will operate sucessfully and be easy to maintain.

1.3 APPLICABLE DOCUMENTS

1.3.1 GENERAL ELECTRIC COMPANY DOCUMENTS

1. MOD-5A Wind Turbine Generator Conceptual Design Review Data package.
2. GE Space Systems Division Policy 8.1(SEAM) February 1979
3. Specifications for the MOD-5A Simulator Software, Document No. 47A380032
4. Specifications for the MOD-5A Controller Software, Document No. 47A380029
5. Standardization of Drawings, Specifications, Program Plans and Procedures for the MOD-5A WTG, PD 7430-MOD-5A-039

1.4 ABBREVIATIONS

CDS - Control Data System

CPDS - Computer Program Design Specification

CDR - Conceptual Design Review

ECL - EPTAK Control Language

EDS - Engineering Data System

EPROM - Erasable Programmable ROM

EPTAK - A Controller Hardware Product of Eagle Signal Company

FDR - Final Design Review

GEN - Generator

PDL - Program Design Language

PDR - Preliminary Design Review

PROM - Programmable ROM

PSC - Partial Span Control

PWR - Power

RAM - Random Access Memory

ROM - Read Only Memory

SEAM - Software Engineering and Management

TBD - To be determined

TBS - To be specified

WTG - Wind Turbine Generator

SECTION 2

2.0 SOFTWARE PRODUCT IDENTIFICATION

The MOD-5A Wind Turbine Generator (WTG) Software provides for the on-line, real-time operation and control of the MOD-5A Wind Turbine Generator using the Eagle Signal EPTAK 700 micro-processor based controller. The MOD-5A software shall consist of four major subsystems: the Operational Program, the WTG Simulator, the Data Handling subsystem and the Remote and Local Terminal Interface package. Descriptions of each of these subsystems is given in the following sections.

2.1 OPERATIONAL PROGRAM DESCRIPTION

The Operational Program shall consist of the Eagle Signal Executive (SL 708-0011-M) and the GE developed MOD-5A Controller Software.

2.1.1. EXECUTIVE

The Eagle Signal Executive (SL 708-0011-M) shall reside in the EPTAK 700 controller. The Executive shall process all system interrupts.

2.1.2. MOD-5A WTG CONTROLLER SOFTWARE

The MOD-5A Controller Software (in deliverable form) shall reside in the EPTAK 700 controller erasable programmable read-only memory (EPROM) as part of the controller hardware and shall perform all the functions necessary to provide real time closed loop control of the MOD-5A WTG. The controller software shall provide the following functions as described in the MOD-5A Controller Software Specification.

1. Mode Control
2. Communications
3. Data Archive
4. Data Processing
5. Lockout Mode Processing
6. Standby Mode Processing
7. Startup Mode Processing
8. Generating Mode Processing
9. Normal Shutdown Mode Processing
10. Emergency Shutdown Mode Processing
11. Manual Mode Processing
12. Yaw Position Control
13. Pitch Tip Angle Control

2.2 REMOTE AND LOCAL TERMINAL INTERFACE SOFTWARE

The remote and local terminal interface software shall reside in intelligent CRT terminals and provide keyboard entry to the controller and alphanumeric display of output data and operating status from the controller.

2.3 DATA HANDLING SUBSYSTEM

TBD

2.4 WTG SIMULATOR

The WTG Simulator shall reside in the MACSYM-2 measurement and control computer. The Simulator shall simulate the wind turbine generator sensor and actuator interface. The Simulator shall provide dynamic interraction between the signal input (controller command output) and signal output(controller signal output) that is representative of the WTG. Nominal and anomalous WTG performance is selectable by operator input.

SECTION 3

3.0 SOFTWARE DEVELOPMENT PROCESS

The software development process for the MOD-5A software shall consist of six sequential development phases. These phases are:

1. Requirements and debug
2. Preliminary design
3. Detailed design
4. Code and debug
5. Unit test
6. Integration test

The activity of each of the sequential development phases shall culminate with a review and an item that is baseline. Each baseline shall serve as the point of departure for the activities of the next sequential phase. It is expected that each phase shall be completed before the activities constituting the next phase are started; however, if starting a subsequent phase prior to completion of a given phase will have a favorable impact on the software development effort, a phase will be started prior to the completion of the preceeding phase or phases.

3.1 BASELINES, DESIGN REVIEWS AND TEST PHASES

Baselines, design reviews and test phases are central in the overall management of the software development process. The attainment of predefined baselines shall serve to establish milestones which provide software management and customer visibility into the progress of the software development effort. A review shall be associated with the establishing of each baseline to afford the opportunity for all relevant parties to develop mutual understanding of the requirements, design and status of the software development process. A description of the baselines and reviews planned for the MOD-5A software development is given below.

3.2 SOFTWARE DEVELOPMENT BASELINES

A baseline is defined to be the attainment of a predefined state in the software development process. At the conclusion of each sequential phase of the software development process, a review shall be conducted to review the item being baselined. Following the resolution of any action items arising as a result of the review, a baseline shall be established. The establishment of a baseline will signify that all parties are in concurrence with the baselined item and shall be implicit approval to proceed to the next phase in the software development process.

The establishment of a baseline shall also signify a change in the level of configuration control of the items which constitute the baseline. After a baseline is established, any proposed change to the baselined item shall be processed in accordance with the configuration control procedure i.e. Program Directive 7430-MOD-5A-039. The following baselines and reviews shall be used in the MOD-5A software development. Reviews shall include all affected functions.

BASELINES	ITEM
1. Software Requirements	Software Requirements Specification
2. Preliminary Design	Preliminary Software Design Specification
3. Code and Unit Test	Component Source Code
4. Development	Integrated Subsystems
5. Operational Final Design	MOD-5A SYSTEM

REVIEWS	
1. Software Requirements	Formal
2. Preliminary Design	Formal
3. Final Design	Formal
4. Code	Informal
5. Unit Test Readiness	Informal
6. Unit Test Results	Informal
7. Integration Test Readiness	Informal
8. Integration Test Results	Formal

3.2.1 SOFTWARE REQUIREMENTS BASELINE

The first phase of the MOD-5A software development cycle shall be concerned with identification of the software functional and interface requirements. All software functions shall be identified. The inputs required, the processing required and the outputs required from each function shall be identified and documented in a software requirements specification. The control and sequencing requirements for each function shall also be in this specification. The software requirements specification shall provide a description of the external interfaces to the MOD-5A WTG software.

The software requirements baseline shall consist of the software requirements specification.

3.2.2 PRELIMINARY DESIGN BASELINE

The second phase of the software development process, the preliminary design phase shall be concerned with selecting a detailed design and implementation approach. In this phase each of the software functions specified in the software requirements will be expanded and the algorithms chosen to implement the function will be defined.

The documentation of the design and implementation approach will be in the form of a preliminary version of a Computer Program Design specification. The design description that will be developed during this phase will consist of the overall structure and functions of the software for each of the subsystems in each of the various modes of operation. Preliminary design description shall include a definition of all relevant interfaces and interrelationships between the software functions.

In addition, a preliminary Software Test Plan which outlines test philosophy and verification methods shall also be developed during the preliminary design phase.

3.2.3 CODE AND UNIT TEST BASELINE

The Code and Debug phase shall be started following the detailed design. In this phase, code will be written for each component defined in the Computer Design Specification and error free assemblies or compilations obtained.

As the code for each component is completed, the code for the component shall be subject to an informal peer review to detect errors or inadequacies in the code.

The unit test shall be started at the completion of the informal peer review. Prior to the start of unit test an informal internal "unit test readiness" review shall be neld to review test input data and the test procedures and to insure the adequacy for the unit test data. Each component shall undergo rigorous unit tests that will exercise all logic paths in the component using various combinations of input data.

The unit test results will be subject to informal peer review to insure the adequacy of the test techniques and to insure thoroughness of test coverage. At the completion of the peer review, the unit test baseline will be established and the source shall be placed under formal configuration control.

3.2.4 DEVELOPMENT BASELINE

At the conclusion of the code and unit test phase, the integration test phase shall be entered. In this phase the components of each subsystem shall be linked together to form the operational subsystem. The software shall be executed using simulated data to insure that the components interface correctly and execute as a subsystem to satisfy the subsystem function.

After satisfactory integration test the development baseline shall be established. The development baseline shall serve to establish a point in the software development process where each software subsystem has been successfully executed.

3.2.5 OPERATIONAL FINAL DESIGN BASELINE

After the completion of the integration testing and the establishment of the development baseline, the entire system shall be tested in operational configuration to verify MOD-5A System operation.

The successful verification of the entire system shall constitute the Operational Final Design or "product" baseline.

3.3 REVIEW OF SOFTWARE BASELINES

3.3.1 PURPOSE

Each software review shall be a critical and independent audit of the current level of the software development effort. Each review will have technical and management objectives.

Technical Objectives

1. To provide an independent evaluation and concurrence of design.
2. To assure compatible interfaces between the software, hardware and personnel.

Management Objectives

1. To establish software development baselines that can serve as milestones against which progress can be measured and against which cost and schedule can be evaluated.
2. To provide a means for monitoring progress of the task activity and the early detection and recognition of potential cost or schedule impacts.
3. Resolution of action items and "follow up" of design adjustments and modifications.

3.3.2 IDENTIFICATION AND DEFINITION OF REVIEWS

Three formal reviews will be used for the MOD-5A software development to establish the requirements baseline, the preliminary design baseline and the final design baseline.

3.3.2.1 Software Requirements Review

The purpose of the software requirements review is to review the software requirements specification and to develop mutual understanding of the software requirements between the customer and the software development staff. Particular emphasis will be given to the following:

1. Insure that the proposed system has been carefully evaluated.
2. Insure that all software functions and external interfaces have been correctly identified.
3. Detect inconsistencies, redundancies or omissions in the software requirements, and insure hardware/software compatibility.
4. Identify any design constraints.
5. Identify any potential problem areas that could affect the subsequent design and implementation.
6. Establish a format for subsequent formal reviews.

3.3.2.2 Preliminary Design Review

The purpose of the preliminary design review shall be to insure the adequacy of the software design and implementation approach. The preliminary version of the Computer Program Design Specification and a preliminary Software Test Plan shall be reviewed. Particular emphasis will be given to:

1. Top level design of the software.

2. Design traceability to the software requirements specification.

3. Test concepts, philosophy and verification methods.

3.3.2.3 Final Design Review

The purpose of the final design review is to provide a structured walk through of each component in the selected design. The material to be reviewed will include the final version of the Computer Program Design Specification and Software Test Plan. Particular emphasis will be given to:

1. The adequacy of the detailed design. Insure that all software requirements are addressed.

2. All hardware/software and man/machine interfaces are completely defined.

3. Verify the adequacy of the Software Test Plan to adequately test the software.

3.3.3 DESIGN REVIEW PROCEDURE

For each formal design review, the software development staff shall prepare an audio-visual presentation that highlights all important elements of the item under review. Technically knowledgeable representatives from the customer and other internal organization units shall be invited to attend the review. The review material will be distributed in sufficient time, prior to the review, to allow careful consideration of the material and to allow for a written critique to identify topics and/or questions that need to be addressed during the review meeting.

The design reviews will be held at GE's Valley Forge facility. Prior to terminating the review meeting, action items will be reviewed and a schedule established for their resolution. The members of the review team will also be asked to verbally specify whether the review was a success and if not, what further review is needed. Within five working days of the meeting, the meeting minutes, (including an action item list) will be distributed.

SECTION 4

4.0 SOFTWARE TEST PROGRAM

The software testing for the MOD-5A WTG software shall be documented in a Software Test Plan. The Software Test Plan shall define a test hierachy beginning with unit test and culminating with integration test. Each level of test employed shall be documented as to test philosophy, test approach and test schedule. Written test specifications shall be employed that define test requirements, outline test methods, and define resources required to perform the testing. Each test specification shall define the required input data for the test and explain how test results are to be evaluated. The software test plan shall outline methods for software modification and retest when errors are uncovered during software test. A traceability matrix shall be incorporated into the software test plan to insure that all software requirements are tested.

SECTION 5

5.0 SOFTWARE QUALITY ASSURANCE

The Software Quality Assurance shall provide for: configuration management procedures, testing practices, corrective action for discrepancies, library controls, requirements traceability, computer program design practices, software documentation, and standards for the employment of support tools, techniques and methodologies. The Software Quality Requirements listed above shall be incorporated into the software requirements and specification documents.

SECTION 6

6.0 SOFTWARE ENGINEERING METHODOLOGY

The objective of the software engineering methodology that has been selected for use in the MOD-5A WTG software development process is to develop high quality software that executes correctly and efficiently fulfills all identified software requirements. It is intended that the software be easy to understand, easy to maintain and highly reliable. The software engineering methodology shall employ state-of-the-art software engineering techniques that provide for the orderly and rapid development of the WTG software both on time and within the budgeted cost. The following software methodologies shall be used:

1. Written requirements specification
2. Written design description
3. Programming practices and convention standards
4. Top-Down design and development
5. Program modularity
6. Structured programming
7. Descriptive commenting of source code
8. Higher level programming language
9. Unit development folders
10. Structured walk-throughs
11. Programming support library
12. Automated development tools

SECTION 7

7.0 SOFTWARE CONFIGURATION MANAGEMENT PLAN

In order to maintain the integrity of the MOD-5A software and the associated documentation formal software configuration management shall be employed as a part of the MOD-5A software development process, by following the provisions of PD 7430-MOD-5A-039. The primary provisions of Configuration Control shall be to:

1. Provide identification of each baselined item that is placed under formal configuration control.

2. Provide accurate tracking and controlled access to completed documents and programs.

3. Provide evaluation and recording of all changes to the software configuration.

4. To insure that changes made to the software are necessary and that thorough consideration is given to all affected interfaces and to the impact on cost and schedule.

SECTION 8

8.0 PROJECT PLANNING, ORGANIZATION AND CONTROL

The responsibility for the MOD-5A Software development shall reside with the project engineer. The responsibilities shall include:

1. Preparation of development plans.
2. Analysis of design requirements and development of software subsystem specifications.
3. Software design, code, test and integration.
4. Preparation of software development schedules.
5. Reporting of progress milestone accomplishments and test results.
6. Maintenance of software configuration control procedures.
7. Monitoring the performance of the software development staff.
8. Planning, cost assessment, tracking and control shall follow the existing MOD-5A Program Directives on these subjects.

8.1 SOFTWARE DEVELOPMENT FACILITY

8.1.1 MOD-5A CONTROLLER SOFTWARE DEVELOPMENT FACILITY

The MOD-5A Controller software development facility shall be the Datapoint 1800 with Computer and dual drive diskettes. The Datapoint Disk Operating System shall be used. This system provides the EPTAK Control Language (ECL), EPTAK Assembly Language (EAL), EPTAK Universal Controller/Loader Interactive Debugger Program (EUCLID) and a program to produce PROM (PGROM). PROM burning is provided by the EPTAK hardware.

8.1.2 MOD-5A SIMULATOR SOFTWARE DEVELOPMENT FACILITY

The Software development facility for the MOD-5A simulator shall be the MACSYM-2 computer. A MACSYM-2 version of BASIC shall be used to write the programs.

8.1.3 DATA HANDLING SOFTWARE DEVELOPMENT FACILITY

TBD

8.1.4 REMOTE AND LOCAL TERMINAL INTERFACE SOFTWARE

TBD

SECTION 9

9.0 REQUIRED DOCUMENTATION

The following documents shall be published to document the MOD-5A software:

9.1 SPECIFICATIONS

1. MOD-5A Controller Software Requirements Specification.
2. MOD-5A Simulator Software Requirements Specification.
3. MOD-5A Control Data System Software Requirements Specification.
4. MOD-5A Remote and Local Interface Terminal Software Requirements Specification.

9.2 DESIGN DOCUMENTATION

1. MOD-5A Controller Application Program Design.
2. MOD-5A Simulator Computer Design
3. MOD-5A Controls Data System Computer Design.
4. MOD-5A Remote and Local Terminal Interface Software Design.

9.3 TEST AND OPERATIONS SUPPORT DOCUMENTS

1. MOD-5A Software Test Plan.
2. MOD-5A Operational User Manual (TBD)

REVISION

ISSUED REV "A" PER AW-1 5/23/83

ELASTOMERIC

TEETER BEARING REQUIREMENTS SPECIFICATION

REV. "A" 5/23/83

FOR THE

MOD-5A WIND TURBINE GENERATOR

R A Knight
Responsible Engineer DATE: 24 Sep 82

Subsystem Engineer DATE: 24 Sep 82.

Systems Engineering DATE: 9/25/82

Quality Assurance DATE: 9-27-82

WTG Integration DATE: 9/27/82

TOTAL NUMBER OF PAGES 29

WTG 500

PRINTS T

REVISION LOG

This log identifies those portions of this document which have been revised since original issue. Revised portions of each page, for the current revision only, are identified by marginal striping or text notes.

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	3	3.1.1		
	7	Figure 3		AN-1
	8	3.1.2.1, 3.1.2.3		
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	10	3.2.1, 3.2.2		
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SECTION 1.0

INTRODUCTION

This specification provides the requirements for two sets of bearings which are used to provide a teetering motion of the rotor of the MOD-5A Wind Turbine Generator (WTG). The bearings are to be elastomeric material molded with metal support structure so that rotor loads can be transmitted while allowing oscillations and deflections with no sliding contact motion. Each bearing set will consist of a radial bearing and a thrust bearing. The sets on both ends of the teeter shaft shall be identical. In the event of conflict of requirements between this specification and higher level documents, the higher level document shall have precedence.

This specification is to be the technical basis for procurement of the two sets of bearings which are hereinafter referred to as the teeter bearings.

SECTION 2.0

APPLICABLE DOCUMENTS

General Electric Drawings

47D381057	Teeter Radial Bearing Source Control Drawing
47D381058	Teeter Thrust Bearing Source Control Drawing
47E382300	Teeter Bearing Installation Drawing
47A380048	Specification For Material Finishes

SECTION 3.0

REQUIREMENTS

3.1 FUNCTIONAL REQUIREMENTS

The teeter bearings are to provide an axis of limited oscillation for the rotor of a wind turbine generator without sliding or rolling contact motion. The axis of rotation of the bearings is in a direction perpendicular to the primary axis of rotor rotation. The primary axis of rotor rotation is tilted up 7° from horizontal.

3.1.1 ROTATION

The teeter bearings shall rotate with an oscillating motion through a maximum ±3.5 degrees of arc during normal operation of the WTG. During start-up, shut-down and some other occasional conditions the teeter bearings will oscillate up to an additional 5.5 degrees for a total maximum travel of ±9.0 degrees of arc. One oscillation from one position through a maximum angle and minimum angle and back to the original position will take place during one rotation of the rotor which is rotating at either 16.8 or 13.75 revolutions per minute. The probability of oscillation range is shown in Figure 1 for each speed.

3.1.2 MECHANICAL INTERFACES

The teeter bearing will be located in the yoke of the rotor as illustrated in Figure 2. As shown in Figure 3 the teeter bearing set shall consist of one thrust bearing and one radial bearing. The thrust bearing shall be capable of transmitting loads in a direction parallel to its axis of rotation. Each thrust bearing will be preloaded against the rotor shaft. The radial bearing shall be capable of transmitting loads in a direction radial to its axis of rotation. The bore of each bearing shall engage the rotor shaft of diameter noted in Section 3.1.2.3.

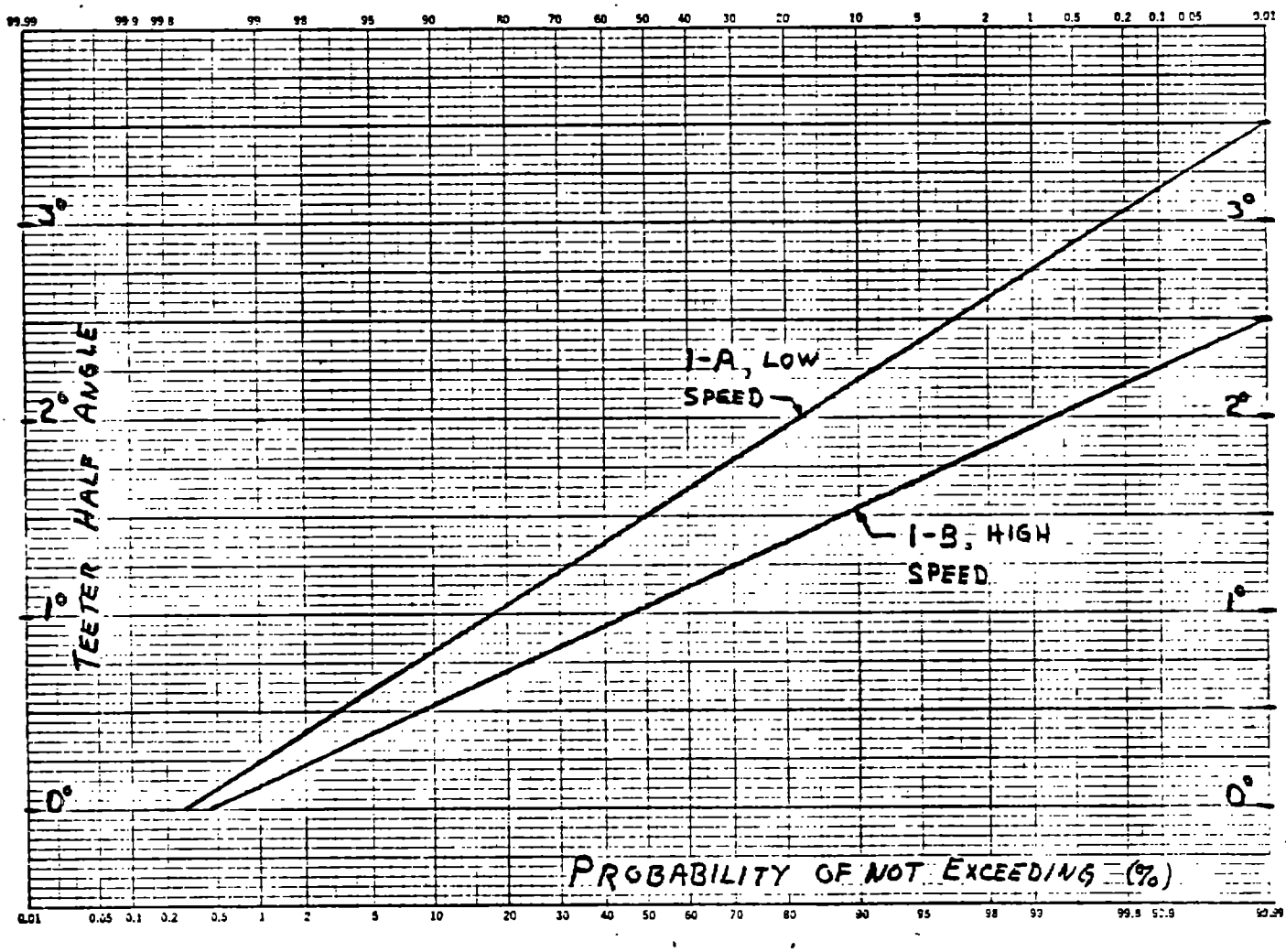

Figure 1

Probability of Oscillation Range

REV. A

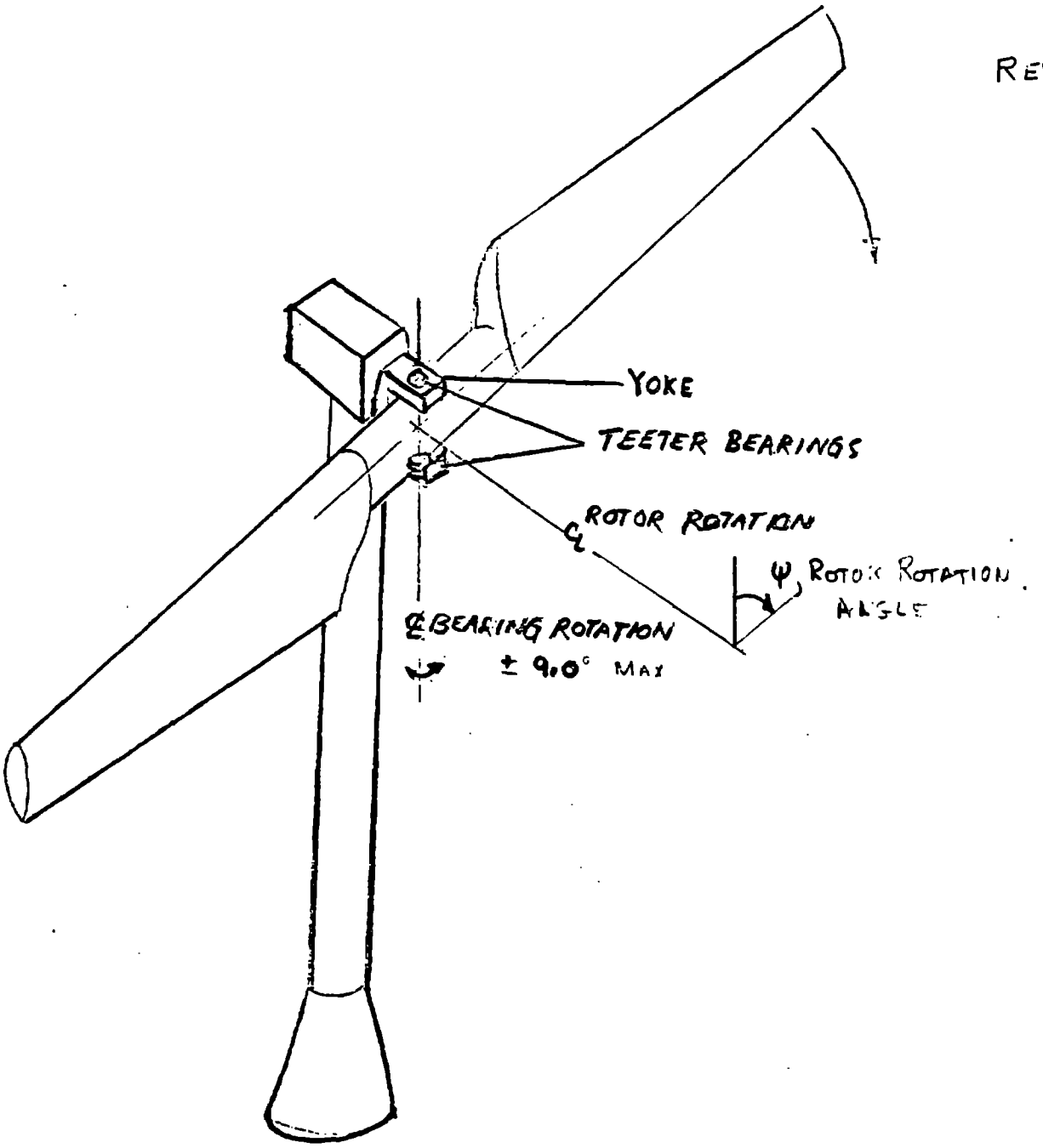

Figure 2

Teeter Bearing Location in WTG

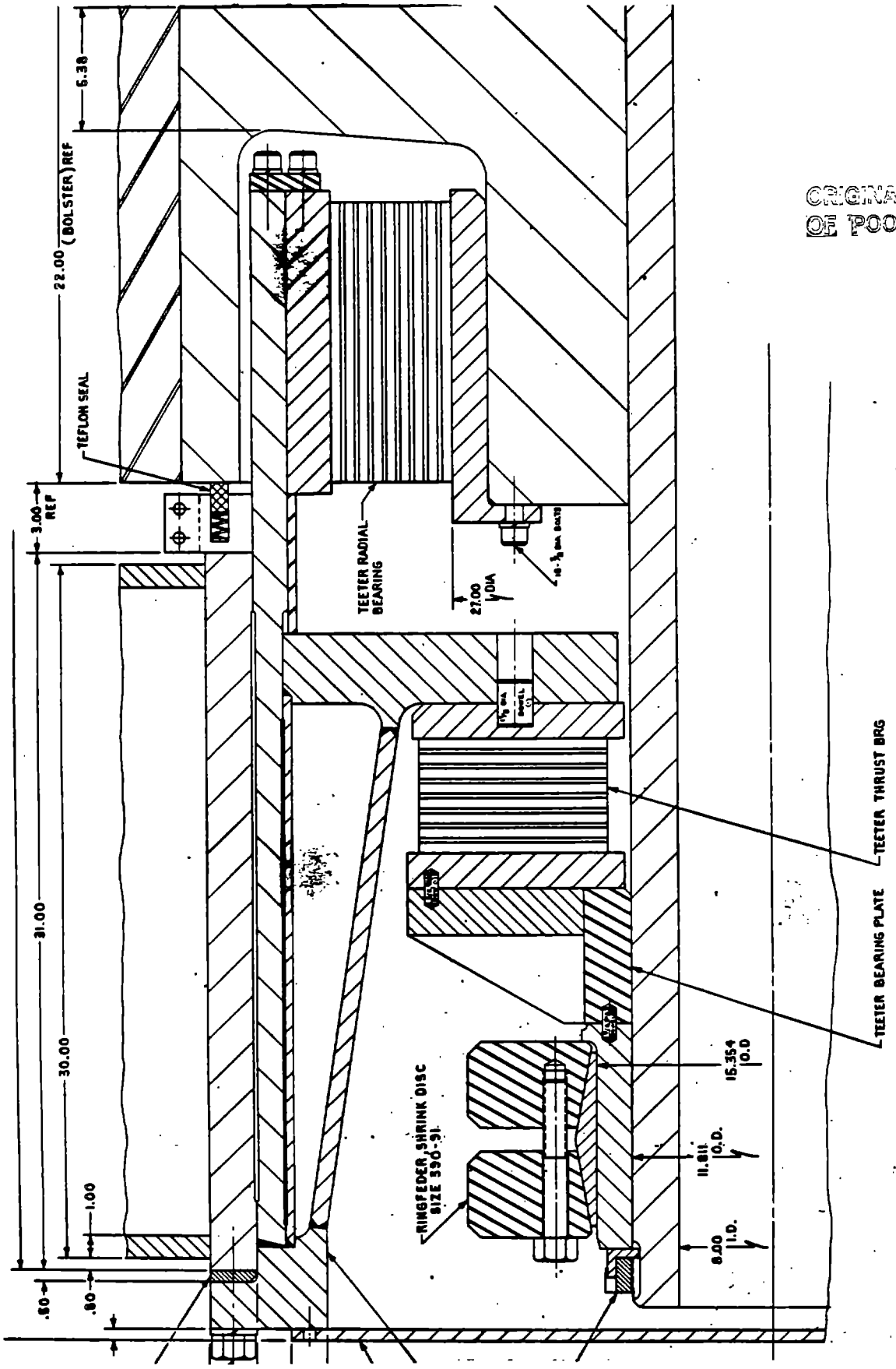

Figure 3

Teeter Bearing Arrangement

3.1.2.1 Axial Displacement

To account for relative deflections of the rotor shaft due to the thrust bearing compliance, thermal and blade moisture growth expansions and assembly tolerances, the radial bearing shall be designed to deflect axially up to 0.25 inch parallel to its axis of rotation.

3.1.2.2 Angular Axis Misalignment

The bearings will be subjected to angular axial misalignment between the inner and outer races of up to ten minutes of arc during operation under loads specified in paragraph 3.2

3.1.2.3 Space Envelope

The space envelopes for the teeter bearings are:

	Inner Dia.	Outer Dia.	Width
Thrust Bearing	14 in (TBR)	30 in (TBR)	8 in (TBR)
Radial Bearing	24 in (TBR)	41 in (TBR)	12 in (TBR)

The final dimension shall be controlled by GE Drawings 47D381057 and 47D381058.

3.2 LOADING CONDITIONS

The teeter bearings shall be capable of withstanding the loading conditions defined herein. The basic loads that are transmitted from the rotor shaft to the yoke structure (Figure 4) are the aerodynamic thrust (A), the rotor torque, the rotor weight (W) and any differential aerodynamic forces between the rotor blades. The rotor torque is reacted through the moment couple created by the spacing between the bearings and produces a radial load (T) on each bearing in the x-x direction. The aerodynamic thrust (A) and the rotor twist are reacted by the radial bearings in the z-z direction. The differential aerodynamic forces are variable and are included in with the rotor weight force as a W' force in the ψ = 90 degrees or as a W/2 force in the ψ = 0 degrees (Figures 5 and 6). The W' force acts on the thrust bearings in the y-y direction and W/2 acts on the radial bearings in the x-x direction. The thrust bearings shall be preloaded against each other to 300 kips (TBR) so that these bearings will always remain in compression. The loads presented herein include a contingency factor to account for the maturity of the design and analyses. The bearing supplier shall also apply to these loads whatever additional factors of safety and operational factors that are appropriate based on the supplier's design and experience in order to properly size the bearing and analyze their capabilities.

3.2.1 NON-OPERATING LOADS (1510 hours per year)

When the WTG is not operating the rotor will be locked in a horizontal orientation (3-9 o'clock). As shown in Figure 4, the thrust bearing will be subjected to only the weight load (W') of 330 kips (multiplied by cos 7^0). Since the orientation of the bearings will be random in this condition, 50% of the time the load with respect to bearings will be +330 kips and 50% of the time it will be -330 kips.

3.2.2 NORMAL OPERATION LOADS

During normal operation of the WTG the bearings will be subjected to radial loads T and A/2 plus the weight load. With the rotor in the horizontal orientation as shown in Figure 4 the weight plus aerodynamic load (W') is transmitted through the bottom and top thrust bearing as a thrust load. The magnitude of the W' load varies sinusoidally as the rotor rotates. With the rotor in a vertical orientation (6-12 o'clock) the weight load is equally shared as radial forces (W/2) on each of the two bearings as shown in Figure 5. Also shown on Figure 5 are the T and A/2 loads. The sinusoidal variation of the W' and W/2 loads with rotor rotation is shown in Figure 6 in a phasing sense only. Each load varies in each rotor cycle and from cycle to cycle. By combining different operational conditions the loads can be conservatively approximated as given in Table I. Also given is the number of cycles in each equivalent load bin. Figures 7 and 8 give the distribution of teeter angles for the equivalent load in histogram form.

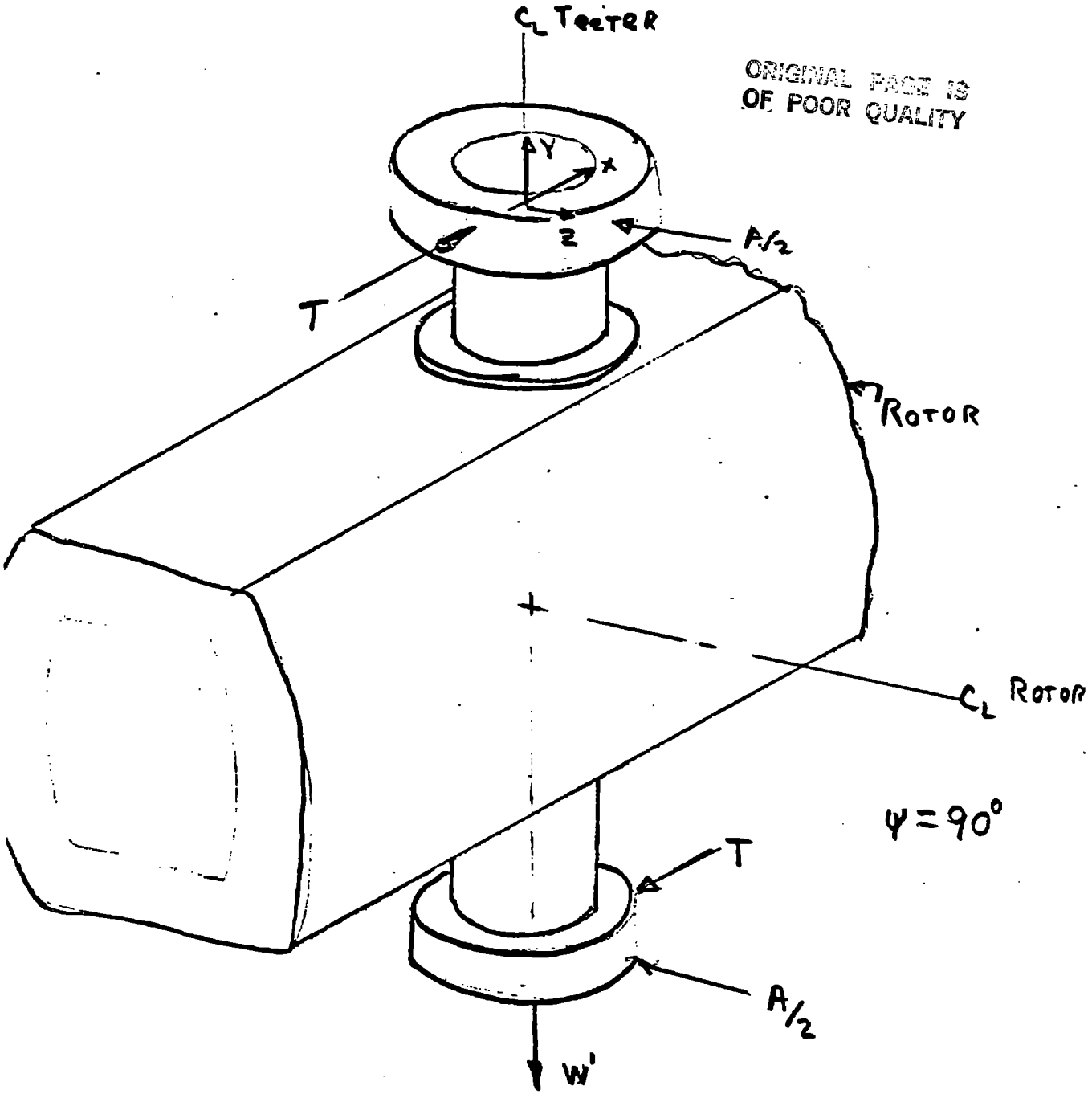

Figure 4

Rotor Horizontal

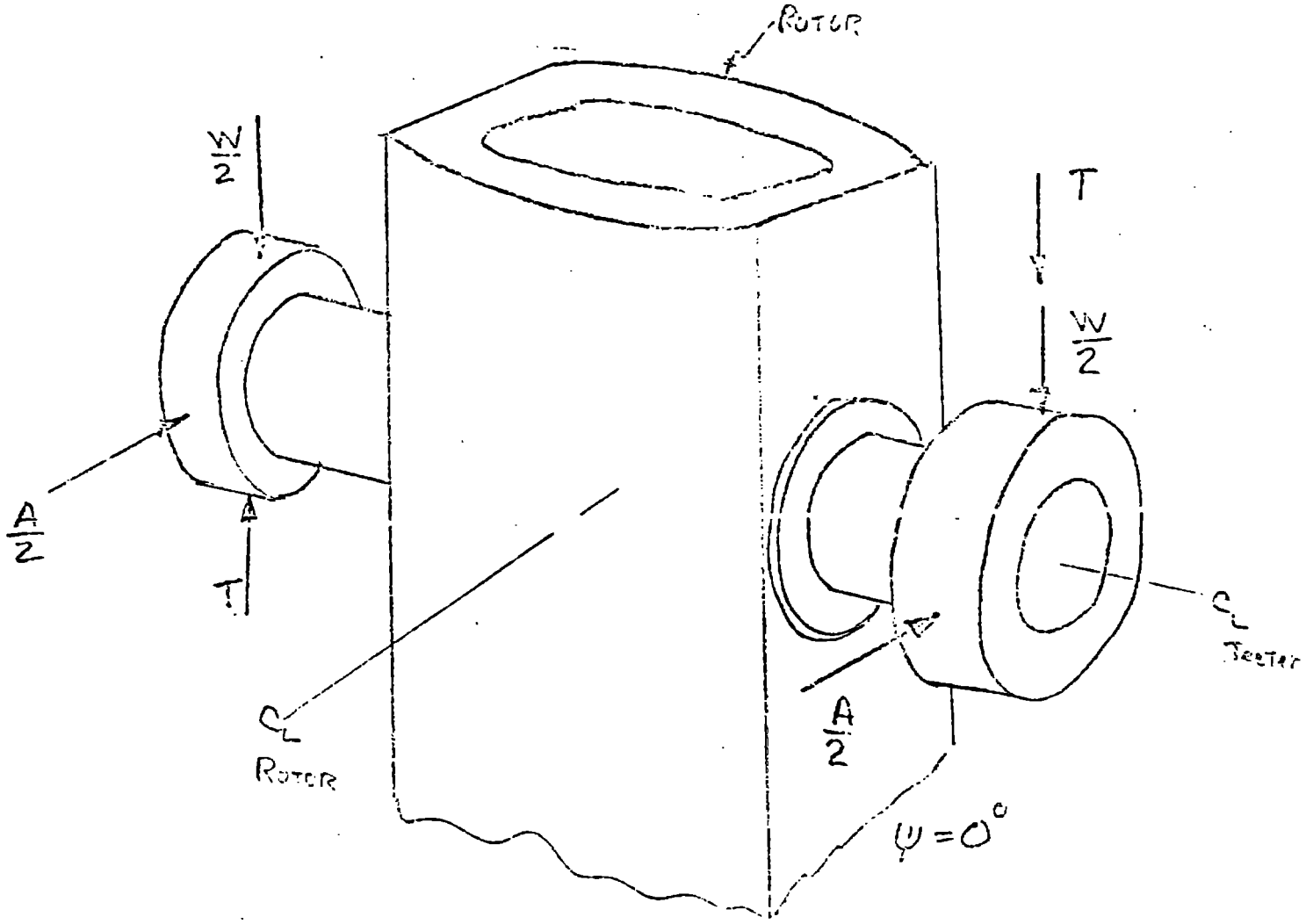

Figure 5

Rotor Vertical

ORIGINAL PAGE IS
OF POOR QUALITY

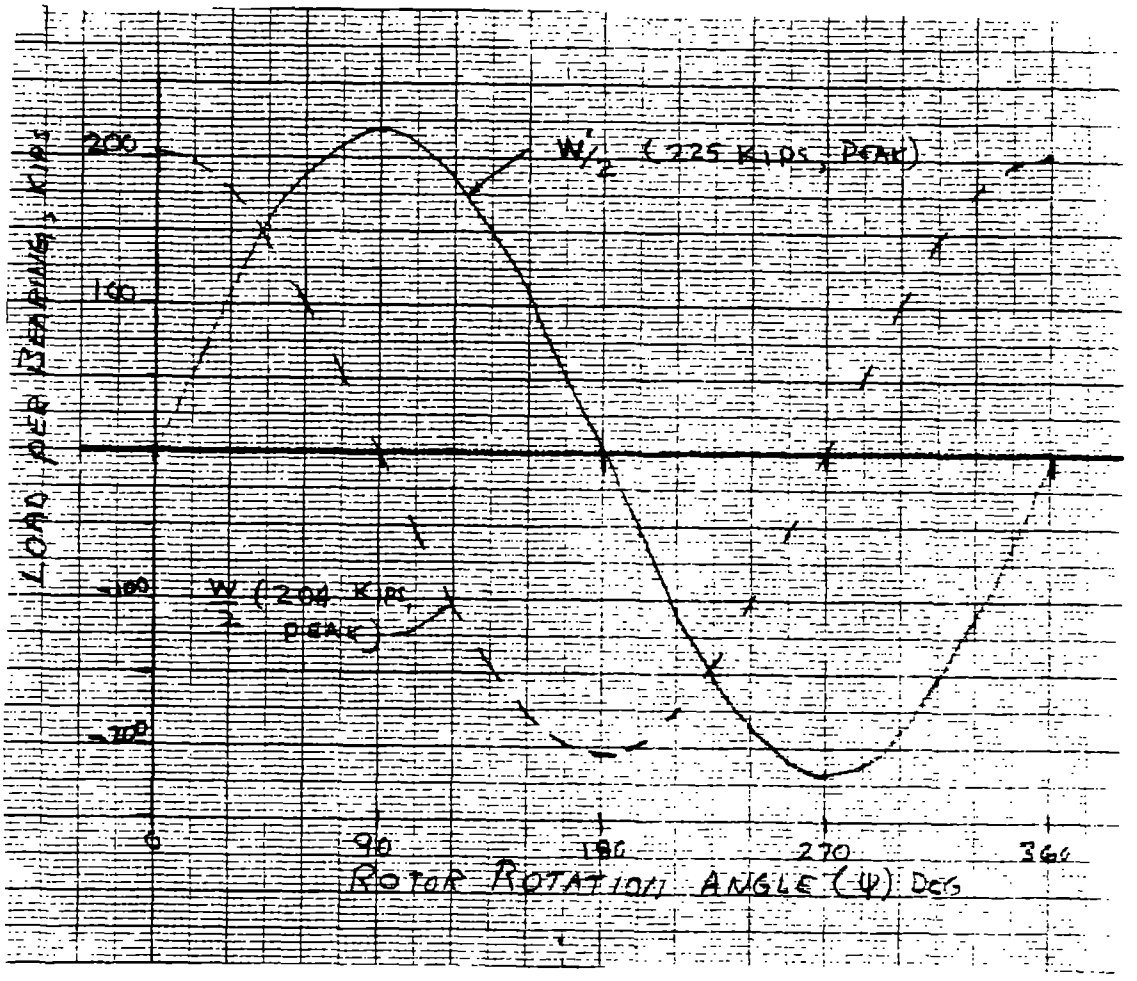

Figure 6

Teeter Bearing Operational Loads

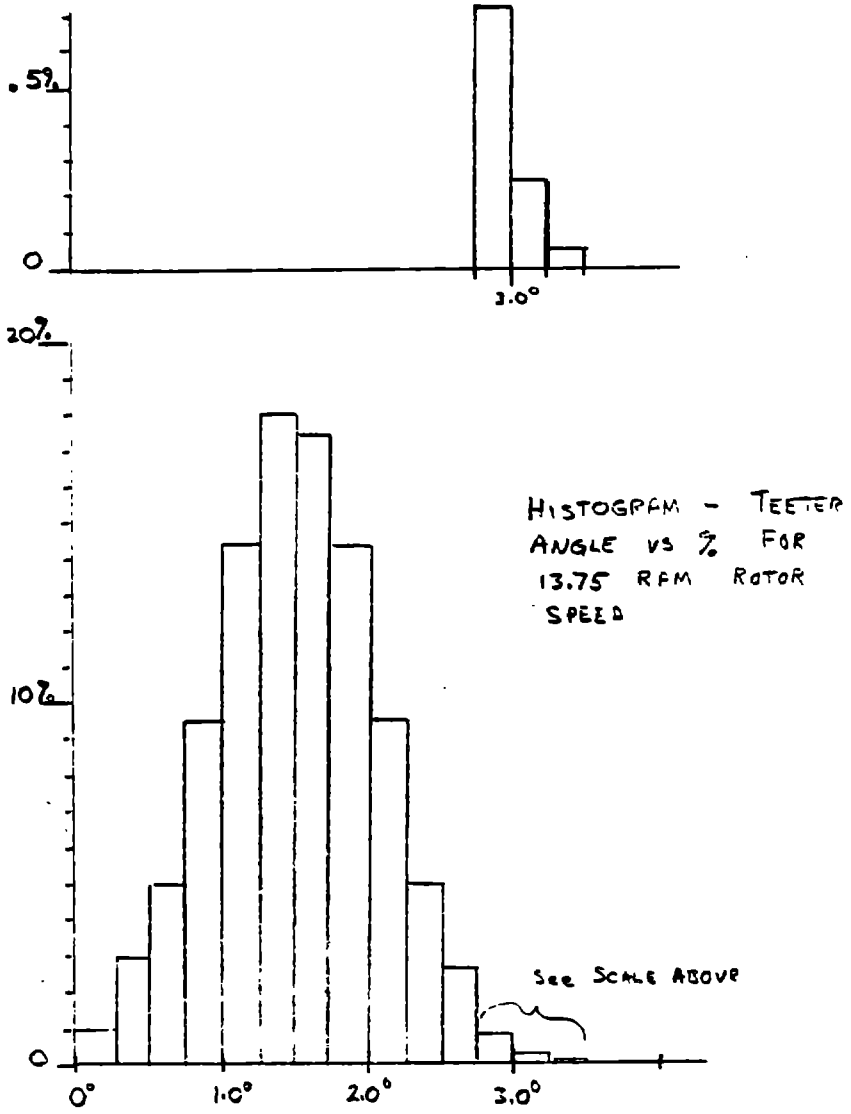

Figure 7

Low Speed Teeter Angle Histogram

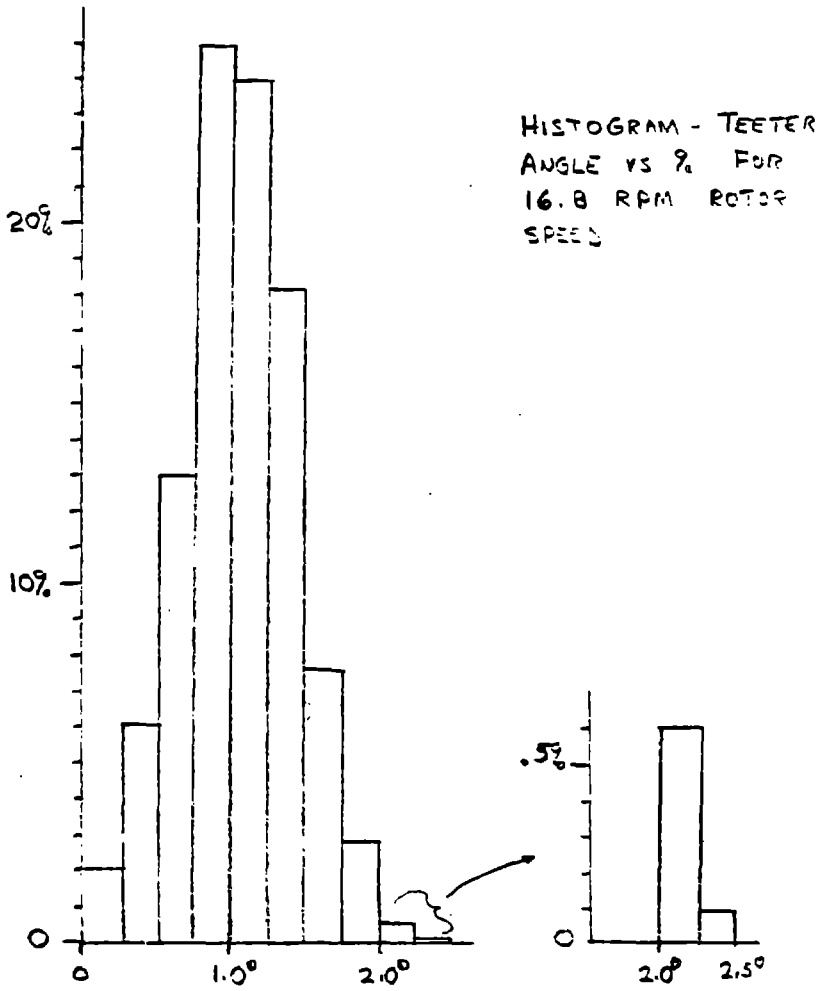

Figure 8

High Speed Teeter Angle Histogram

TABLE I

WIND BIN DATA FOR TEETER BEARING NORMAL OPERATING LOADS (KIPS)

Normal Operating Loads (Kips)

BIN	NO. OF CYCLES	SPECTRUM (Degrees)	RADIAL BEARING x-x	RADIAL BEARING z-z	THRUST BEARING y-y
A	56 E6	Fig 1-A & 7	140 ±336	139 ±92	225(1)
B	135 E6	Fig 1-B & 8	140 ±336	139 ±92	225(1)
C	Deleted				
SUM	191 E6				

Abnormal Operating Loads (Kips)

BIN	NO. OF CYCLES	SPECTRUM (Degrees)	RADIAL BEARING x-x	RADIAL BEARING z-z	THRUST BEARING y-y
D	500	±2.0°	343 ±277	324 ±0	225(1)

(1) 225 K is the peak value - the minimum is 189 K (dead weight).

3.2.3 ABNORMAL OPERATION LOADS

A few times during the life of the WTG certain conditions will cause the teeter bearings to be subjected to aerodynamic thrust and rotor torque loads that are higher than normal. These loads are referred to as limit loads. During these conditions the bearings should be capable of withstanding the loads given in Table I as Abnormal Loads.

3.2.4 START-UP & SHUT-DOWN LOADS (35,000 events each)

3.2.4.1 Normal Start-up and Shut-down Loads

During normal start-up and shut-down the teeter bearings will be subject to the loads in Table II.

3.2.4.2 Abnormal Start-up and Shut-down Loads

With the present design of the rotor system, should the blade hit the teeter soft bumper stops (between 7^0 and 9^0) an increased load would be transmitted through the teeter bearings in the z-z direction as shown in Table II.

3.3 AMBIENT ENVIRONMENTAL CONDITIONS

The bearings are to be used in an outdoor environment. However, with the yoke mounting, the teeter bearings will normally be shielded from direct exposure to solar radiation, rain, hail, snow, sand, dust, ozone, fungus and insects.

3.3.1 ALTITUDE

The bearing shall be exposed to ambient pressure at altitudes anywhere between sea level and 7,000 feet.

TABLE II

Normal Start-up and Shutdown Loads (Kips)

	BIN	NO. OF CYCLES	SPECTRUM (Degrees)	RADIAL BEARING x-x	RADIAL BEARING z-z	THRUST BEARING y-y
Normal						
Start	E1	315,000	< ±2.5°	0 ±204	75(1)	225
Up	E2	420,000	±2.5 to 3.5°	0 ±204	75	↓
	E3	210,000	±3.5 to 4.5°	0 ±204	75	↓
	E4	84,000	±4.5 to 5.5°	0 ±204	75	↓
	E5	18,900	±5.5 to 7°	0 ±204	75	↓
Shut	F1	84,000	< ±2.5°	0 ±204	160(2)	↓
Down	F2	126,000	±2.5 to 3.5°	0 ±204	160	↓
	F3	126,000	±3.5 to 4.5°	0 ±204	160	↓
	F4	67,200	±4.5 to 5.5°	0 ±204	160	↓
	F5	13,500	±5.5 to 7°	0 ±204	160	225
Abnormal						
	E6	2,100	±7° to 9°	0 ±204	250	225
	F6	600	±7° to 9°	0 ±204	330	225

(1) This is the maximum rotor thrust expected on start-up. Load will vary from zero at 0 rpm to peak shown with an average value of 35 KIPS.

(2) This is the maximum rotor thrust expected on shutdown. Load can reverse to a peak negative value of 25 K. The overall shutdown average value will be +40 K.

3.3.2 TEMPERATURE RANGE

The bearings shall be subjected to and survive a temperature range of +140 degrees F to -40 degrees F. The upper range includes an allowance for local surrounding structure temperature increase from solar radiation. The WTG, however, will only operate in the ambient temperature range of -22°F to 104°F.

3.3.3 SPECIAL PRECAUTIONS

During conditions of assembly and maintenance of the teeter bearings the bearings could be subjected to the environments identified in paragraph 3.3. To prevent damage and contamination of the bearings the following special precautions shall be taken:

1) Exposure of the elastomer to grease, oil or solvent spills shall be minimized (i.e. wiped off with a clean rag as soon as possible).
2) Mounting shall be carried out per requirements of GE Drawing 47E382300

3.4 LIFE

The bearings shall operate for 30 years within the limits of the requirements of this specification without major overhaul or replacement.

3.4.1 OSCILLATION CYCLES

The bearings shall be subjected to the range and total number of oscillation cycles as specified in paragraphs 3.2.2 and 3.2.4, respectively.

3.4.2 PLANNED MAINTENANCE

Planned maintenance of the bearings shall consist of inspection every three years per vendor directions, procedures, and guidelines as provided in the vendor's operations and maintenance manual.

3.5 WEIGHT

The weights of the bearings shall not exceed:

Thrust Bearing	TBD lbs.
Radial Bearing	TBD lbs.

3.6 STIFFNESS

The axial and radial spring rates of the individual bearings shall be in the range specified below at 75°F ±15°F.

Bearing	Axial Spring Rate (lbs/inch)	Radial Spring Rate (lbs/inch)	Torsional Spring Rate (in lbs/degree)
Radial	Not applicable	$>2x10^6$ (TBR)	$<4x10^5$ (TBR)
Thrust	$>4x10^6$ (TBR)	N/A	$<10^5$ (TBR)

3.7 WORKMANSHIP

The bearing shall be constructed in a thorough workmanlike manner. All parts shall be free of burrs, sharp edges and other damage or defects that could make the unit unsatisfactory for the intended use.

3.8 GENERAL

Identification markings shall be in accordance with standard commercial practice and shall include the following:

a) GE part number TBD.
b) Vendor's name, symbol, or code identification.
c) Vendor's part number, lot number and serial number.

3.9 EXTERNAL FINISH

No external finish is required for the elastomer beyond that normally provided to protect the elastomer from ozone. Non-corrosion resistant steel parts shall be painted per 47A380048 for interior surfaces.

SECTION 4.0

QUALITY ASSURANCE PROVISIONS

The Bearing vendor shall be responsible for the performance of all inspections and tests specified herein. The vendor shall utilize his own facilities or any commercial laboratory acceptable to GE. GE reserves the right to perform any of the inspections and tests set forth in this specification where such inspections and tests are deemed necessary to assure that supplies and services conform to prescribed requirements. Final acceptance shall be contingent upon successful completion of any such tests by GE.

4.1 PREPARATION OF TEST PROCEDURE

The procedure and methods for performing all tests specified herein shall be prepared by the bearing vendor. These procedures and methods shall be approved by GE prior to their implementation.

4.1.1 CLASSIFICATION OF TESTS

Tests shall be classified as Acceptance Tests (see Paragraph 4.2)

4.1.2 TEST CONDITIONS AND TOLERANCES

All static and dynamic tests shall be performed at ambient room temperature.

4.1.3 MEASUREMENTS

All measurements and dimensional checks shall be made with instruments that have been calibrated against certified standards. Calibration of the certified standards shall be traceable to the National Bureau of Standards. Standard gages shall be used for checking all radii and chamfers. Critical dimensional data shall be recorded and shall be available for review by GE prior to shipment of the bearings.

4.1.4 QUALITY CONFORMANCE INSPECTION

Each bearing shall be examined and acceptance tested per paragraph 4.2.

4.1.5 TEST SUCCESS CRITERIA

Any deviation from the performance parameters specified herein, or any physical/mechanical out-of-tolerance condition that is noted during or after the performance of the tests specified herein, shall constitute a failure of the bearing.

4.2 ACCEPTANCE TESTS (TBD)

Each bearing shall be subjected to and shall have passed the following tests prior to acceptance by GE:

Examination of Product	4.2.1
Identification	4.2.2
Weight	4.2.3
Workmanship	4.2.4
Spring Rates	4.2.5

4.2.1 EXAMINATION OF PRODUCT

Examine each bearing for strict conformance to paragraphs 3.1.2.3, and 3.9.

4.2.2 IDENTIFICATION

Examine each bearing and check for conformance to the requirements of paragraph 3.8.

4.2.3 WEIGHT

Examine each bearing for conformance to paragraph 3.5.

4.2.4 WORKMANSHIP

Examine each bearing to verify conformance to paragraph 3.7.

4.2.5 SPRING RATES

Each bearing shall be subjected to spring rate tests at room temperature to verify that the bearings conform to paragraph 3.6. Test data based on sample tests for spring rate versus temperature shall be supplied.

4.3 QUALITY ASSURANCE DATA

Certification of conformance to the requirements of this specification and GE Drawings 47D381057 and 47D381058 is required. Engineering analysis supporting bearing conformance to life requirements under loading and operation specified herein shall also be provided. Results of dimensional checks and test results shall be available for GE review prior to approval for shipment.

SECTION 5.0

PREPARATION FOR DELIVERY

The bearings shall be prepared for delivery in accordance with good commercial practices and the carrier rules and regulations applicable to the selected mode of transportation. The bearings shall be afforded adequate protection against corrosion, deterioration, contamination, and physical damage to ensure delivery in a condition capable of meeting the requirements of this drawing.

SPECIFICATION

FOR THE

CONTROLS ELECTRONICS CABINET

JULY 1983

Responsible Engineer — DATE: 8-15-83

Subsystem Engineer — DATE: 8-15-83

Systems Engineering — DATE: 8/17/83

Quality Assurance — DATE: 8-17-83

WTG Test — DATE: 8/19/83

Number of Pages 14

WTG 5L2
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REVISION LOG

This log identifies those portions of this document which have been revised since original issue. Revised portions of each page, for the current revision only, are identified by marginal striping.

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SECTION 1.0

INTRODUCTION

1.1 SCOPE

This specification establishes the requirements for a Controls Electronics Cabinet (CEC) for use with a seven (7) megawatt variable speed wind turbine generator system. The CEC will provide housing for the equipment required for electrical control of the wind turbine generator system. The CEC will provide the proper operating environment for the electrical components as well as a convenient interface for the electrical control systems.

SECTION 2.0

APPLICABLE DOCUMENTS

The following documents of the date of issue noted form a part of this specification to the extent specified herein. In the event of conflict between this specification and the documents referenced herein, the contents of this specification shall supersede.

2.1 GENERAL ELECTRIC DOCUMENTS

47A38011	System Specification MOD-5A WTG
(LATER)	ESD Electronics Assembly
(LATER),	Schematic, Control System (Rotor & Blades)
(LATER)	Schematic, Control System (Nacelle & Ground)
47A387005	Controls Sensor List
(LATER)	I&C Signal Conditioner Panel Assembly
47A380013	Control System Specification for MOD-5A WTG
(LATER)	Microprocessor Assembly
(LATER)	I/O Track
(LATER)	Meterological Signal Conditioner Assembly
47A380053	Electrical and Systems Test Equipment Design, Fabrication and Test Specification
(LATER)	Servo Valve Control Electronics Assembly
(LATER)	Assembly, Controls Electronic Cabinet
(LATER)	Schematic, Controls Electronic Cabinet
TBD	Lightning Protection Requirements for MOD-5A WTG
47E387080	One Line Diagram
47A380052	Electrical Fabrication and Workmanship Standard

SECTION 3.0

REQUIREMENTS

3.1 ENVIRONMENTAL

3.1.1 CEC EXTERNAL ENVIRONMENT

OPERATING TEMPERATURE: -20° C to +40° C
Humidity: 5% to 100% Condensing

Non-Operating Temperature: -40° C to +50° C
Humidity: 5% to 100% Condensing

3.2 ENCLOSURE

The enclosure for the CEC shall be designed to the NEMA standard for type 12 enclosures. Enclosure shall be designed for industrial use - dusttight and driptight. Door seals shall be used to protect the enclosed equipment against fibers, lint, dust, dirt and splashing liquids. Material used for enclosures shall not be affected by splashing Hydraulic fluids.

3.3 MAJOR COMPONENTS

The major components to be mounted in the CEC are as specified below:

- Microprocessor assembly
- I/O Tracks (8 tracks required)
- ESD electronics assembly
- I&C signal conditioner assembly
- Meterological signal conditioner assembly
- Control system interface
- Servo valve control electronics (assembly required)
- Misc. items required to complete the system control package.

3.4 THERMAL

The Control Electronics Cabinet (CEC) shall maintain an interior temperature while operating of 0° C to +50° C and a relative humidity of 10-90% non-condensing with an external environment as specified in Paragraph 3.1.

3.4.1 CIRCULATION

Forced air circulation shall be used within the CEC to equalize temperature and increase heat transfer from the electronics assemblies.

3.4.2 DISSIPATION

The maximum thermal dissipation within the Control Electronics Cabinet shall not exceed 1000 Watts (3413 BTU/H) while operating.

3.5 MECHANICAL

3.5.1 CEC MOUNTING

The CEC shall provide a minimum of six (6) reinforced half inch (1/2) attachment holes in the base to secure the CEC to the bed plate.

3.5.2 SIZE

The maximum size of the Control Electronics Cabinet (CEC) shall not exceed 48 inches in width, 34 inches in depth and 120 inches in height including externally mounted equipment.

3.5.3 INTERFACE PENETRATIONS

Interfaces for oil tight lay in wire way shall be provided in the CEC. Size and location of penetrations shall be consistent with the bed plate design and system wiring.

3.5.4 COMPONENT MOUNTING

Vertical mounting rails conforming to EIA Standard RS-310 shall be supplied within the CEC for mounting standard 19 inch panels. The maximum depth of any panel shall not exceed 11.5 inches. A minimum of 59.50 inches of vertical mounting space shall be provided.

Sub panels within the CEC shall be used to mount the remaining components.

Components shall be mounted such that they are replaceable without removing other components.

3.5.5 VIBRATION

The operation of the Controls Electronic Cabinet shall not be affected when subjected to vibration levels of up to ±.25g in any direction.

3.6 ELECTRICAL

3.6.1 WIRING INTERFACE

The CEC shall provide screw type terminations for all interface wiring. All interface terminations shall be accessible while standing on the bed plate with the CEC doors fully open. Wiring personnel shall not be required to position themselves within the CEC to terminate interface wiring.

3.6.2 INTERNAL WIRING

Insulation for internal wiring shall have a rating of 600V and a minimum temperature rating of 105°C.

Signal control and power wiring shall be routed separately when practical to minimize the effect of power line transients on the signals.

Internal wiring shall be supported as required to prevent damage from vibration levels specified in paragraph 3.5.5.

3.6.3 POWER INPUT

The CEC shall provide for 120VAC, 60Hz power input not to exceed 25 amperes.

3.6.4 SAFETY

All exposed wiring, terminals, etc. having a potential of greater than 48 volts shall be protected from accidental contact by service personnel in accordance with N E C.

3.7 WEIGHT

The maximum weight of the Controls Electronic Cabinet (CEC) shall not exceed 2500 pounds.

3.8 MATERIALS

Materials used in the CEC assembly shall be inherently corrosion resistant or protected from corrosion due to exposure to airborne moisture and salt in the operational environment. For corrosion analysis, assume 0.005 PPM maximum salt content in the environmental air after filtration for sea coast installation.

3.9 FINISH

All surfaces shall be chemically cleaned and treated to provide a bond between the primer paint and metal surfaces. The Control Electronics Cabinet (CEC) interior shall be painted a flat black (color conforming to FED-STD-595, color number 37038) with the exterior surfaces painted a semigloss white (color conforming to FED-STD-595, color number 27875).

3.10 MAINTAINABILITY

The Controls Electronic Cabinet assembly shall require routine maintenance no more frequently than once per year.

The lowest level of repair shall be at the circuit card level, with the assumption that properly trained personnel, replacement components and circuit cards are available. The mean time to repair shall be less than four (4) hours as follows: 1 hour to identify, 2 hours to repair, and 1 hour to restart.

SECTION 4.0

VERIFICATION

4.1 GENERAL

The acceptance program for the Control Electronic Cabinet (CEC) shall be implemented by analysis and test of a prime design unit. Development tests will also be performed in advance of prime design unit tests to support and confirm design and analytical tradeoffs. These tests are defined in this section.

4.1.1 RESPONSIBILITY FOR INSPECTION AND TESTS

GE/AEPD or its suppliers, at GE/AEPD direction, are responsible for conducting all tests and inspections to assure compliance with this specification and the documents referenced herein.

4.2 SPECIAL TESTS AND INSPECTIONS

4.2.1 ANALYSES

The following requirements of Section 3.0 shall be verified by review of analysis based on applicable specifications, applicable drawings, in-process test data, supplier component data, and operating experience with similar units.

Paragraph 3.1	Environmental
Paragraph 3.2	Enclosure
Paragraph 3.4.1	Circulation
Paragraph 3.4.2	Dissipation
Paragraph 3.5.5	Vibration
Paragraph 3.6.2	Internal Wiring
Paragraph 3.6.4	Safety
Paragraph 3.7	Weight
Paragraph 3.8	Materials
Paragraph 3.10	Maintainability

4.2.2 ACCEPTANCE INSPECTIONS

The following requirements of Section 3.0 shall be verified by inspection of the hardware or review of manufacturing in-process inspection data or component supplier data.

Paragraph 3.5.1	CEC Mounting
Paragraph 3.5.2	Size
Paragraph 3.5.3	Interface Penetration
Paragraph 3.5.4	Component Mounting
Paragraph 3.6.1	Wiring Interface
Paragraph 3.9	Finish

4.3 ACCEPTANCE TESTS

4.3.1 WIRING

All wiring shall be checked for loose connections.

4.3.2 FUNCTIONAL TESTS

4.3.2.1 Thermal

The requirements of paragraph 3.4 shall be verified under actual operating conditions as specified in this document including the environmental conditions specified in paragraph 3.1.

4.4 TEST PROCEDURE

All tests shall be conducted using documented test procedures approved by quality assurance. All test procedures shall contain data sheets on which the results of the individual tests may be recorded.

4.5 TEST CONDITIONS

All tests shall be performed at room ambient conditions of temperature, humidity and atmospheric pressure unless otherwise specified.

4.6 APPROVAL

Review and approval of all test results by a General Electric Quality Assurance Representative is required prior to shipment of the Control Electronics Cabinet assembly.

SECTION 5.0

PREPARATION FOR DELIVERY

The Controls Electronic Cabinet shall be prepared for shipment in accordance with GE Drawing (LATER). Storage of the CEC shall be consistent with the requirements of paragraph 3.1 of this document and GE Drawing (LATER).

TITLE
SPECIFICATION FOR BOLT PRETENSIONING

FIRST MADE FOR MOD-5A WTG

REVISIONS

REV "A" MAY 1984

SPECIFICATION FOR

BOLT PRETENSIONING

R Bedelscombe — Responsible Engineer — DATE: July 21/82

John M Medaglia — Stress Engineer — DATE: 27 July 82

B Boston — Systems Engineering — DATE: 26 JULY 1982

A. Chesbro — Quality Assurance — DATE: July 22, 1982

H. Drenker — WTG Integration — DATE: Aug. 5, 1982

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Revision	Page No.	Paragraph Number(s) Affected	Rev. Date	Approval
Rev A	2 3 4 7 8 TABLE 1	Revised sections pertinent to adding new hardware.	May 1984	5/8/84 AW-1

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  - 3.1.3 Recommended Bolts
  - 3.1.4 Hardened Washers
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SECTION 1

1.0 SCOPE

This specification defines the general technical requirements for pretensioning of all mechanical fasteners used throughout the MOD-5A Wind Turbine Generator construction. It defines pretensioning methods and some related tightening parameters for approved fasteners of a size chosen by analysis. The selection of a particular fastener size and type, is determined by suitable analysis methods including VDI 2230, the AISC Manual of Steel Construction, and the MOD-5A Structural Design Criteria Spec No. 47A380002. Prying action, preload benefits, interaction of tensile and shear stress in the fastener, and fatigue capability of the fastener material, must all have been considered in the fastener sizing analysis.

SECTION 2

2.0 APPLICABLE DOCUMENTS

The following documents form part of this specification to the extent specified herein.

American Society For Testing Materials

ASTM 325	High Strength Bolts For Structural Steel Joints

VDI Verlag GMBH

VDI 2230	Systematic Calculation of High Duty Bolted Joint

GE Specification

47A380002	MOD-5A Structural Design Criteria
*EMPIS	Engineering Materials and Processes Information Service
47A380121	Alloy Steel Twelve Point Head Bolt, 140 KSI UTS

American Institute of Steel Construction

AISC	Manual of Steel Construction

NOTE: * The EMPIS System is an authoritative materials information system developed and maintained by Materials Information Services of the General Electric Company for use in selecting, specifying, purchasing and controlling materials and processes used in manufacturing operations.

SECTION 3

3.0 REQUIREMENTS

Requirements for pretensioning all mechanical fasteners unless otherwise noted on the appropriate installation and assembly drawing are as specified herein.

Prying forces and interaction of tensile shear stresses must be considered in sizing all fasteners. Suitability for fatigue applications must be determined by appropriate analysis, and specification allowable strength values.

3.1 MATERIALS

3.1.1 JOINTS AND FASTENERS

Standard bolted joints and fasteners shall comply in this and all other respects to the American Society For Testing Material Specifications.

ASTM 325 (Grade 5 Bolts)

GE Specification 47A380121

3.1.2 BOLT GRADES

All primary structurally bolted joints throughout the WTG structural area shall use bolts equivalent to:

Grade 5 Minimum Ultimate Tensile Strength of 120 KSI

Grade 8 Minimum Ultimate Tensile Strength of 140 KSI

3.1.3 RECOMMENDED BOLTS

The following recommended bolts are to be used wherever possible:

Grade 5 --- EMPIS Part No. N727 P--

Grade 8 --- EMPIS Part No. N14 P--

Where access to bolt and/or nut is limited and for all major interfaces with bolt diameters 1.0 inch over 12 point heads should be used.

The following 12 point head bolts are recommended:

Grade 8 --- 47C381036P--

Grade 8 --- EMPIS Part No. 733 P--

No bolts other than those listed above will be used without the approval of the Engineering Manager.

No field assembled structural joint shall use bolts less than 3/4" diameter without the approval of the Engineering Manager.

3.1.4 HARDENED WASHERS

All Grade 8 and stronger bolted applications, must use hardened steel washers under nut and head of bolt, if pre-load is applied to head of bolt. See paragraphs 3.1.5 and 3.3.1. For all major interfaces with bolt diameters 1.0 inch over the following washer is recommended hardened steel washer---47C381088.

3.1.5 RECOMMENDED NUT AND WASHER

The following nuts and washers are recommended:

Grade 5 Nut (Plain Hex)	---	EMPIS N214P--
Nut (Lock)	---	EMPIS N265 P--
Grade 8 Nut (Lock)	---	EMPIS N266 P--
Standard Washers	---	EMPIS N402 P--
12 Point Nut (Lock)	---	EMPIS N271 P--

For all major interfaces with bolt diameters 1.0 inch or over use the following nuts:

Grade 8 (Plain)	---	47C381087P--
Grade 8 (Lock)	---	47C381087P--

3.1.6 FINISH

All hardware shall be finished with .0002 mil zinc coating, unless otherwise noted.

3.2 TORQUE REQUIREMENTS

3.2.1 TORQUE AND/OR TENSION REQUIREMENTS

Torque and/or tension requirements are as shown in Table 1. Drawings may call for level of torque required or leave as a general statement.

Example: Torque Bolt(s) to GE Specification 47A380047 (Line 5)

Line 5 would indicate a 1/2-13 UNC bolt (See Table 1).

3.3 LOADING

3.3.1 APPLICATION OF TORQUE

All torquing should wherever possible be applied to the nut side of fastener. If torque applied to head of bolt all torque values should be increased by 10% over those of Table 1. Values are to compensate for bolt head surface friction loss.

3.3.2 LUBRICATION OF FASTENERS

Unless otherwise stated in drawing, manufacturing may determine whether threads are torqued dry or lubricated. Use appropriate column in Table 1.

SECTION 4

4.0 GENERAL NOTES

The following set of notes are for clarification and general use of Table 1

4.1 NOTES FOR TABLE 1

4.1.1 RECOMMENDED GRADE BOLT

Recommended Grade Bolt, see Section 3.1.3

4.1.2 CLAMP LOAD

Clamp load, also known as preload or initial load in tension on bolt is calculated by assuming usable bolt strength is 75% of bolt proof load (psi) times tensile stress area (sq ins) of threaded section. Actual clamp load may vary ±25% from assumed values due to variation in friction with torque method.

4.1.3 TORQUE METHOD

Applied torque values are calculated on the formula T = KDP

where T = tightening torque (lb ins)

K = torque-friction coefficient

D = nominal bolt diameter (ins)

P = bolt clamping load developed by tightening (lbs)

NOTE:* "K" for threads dry = 0.20

"K" for thread lubricated = 0.15

* In critical joints actual "K" values should be determined by test.

4.1.4 STUD TENSIONING METHOD

The tension method of bolt loading can only be accomplished through the use of hydraulic tensioning devices (e.g: SKF, Biach Industries Inc.). This method should not be used for bolts or studs where the effective tensioning length is less than six (6) times the bolt or stud diameter (See Figure 1). Residual loads are based on 75% of bolt yield strength or clamp load given in Table 1. Higher residual loads are obtainable with greater than 6 to 1 length to diameter ratios.

Residual load is the minimum load left after relaxation of the bolt or stud. The greater the joint length, the more the relaxation is distributed or proportioned over that length, resulting in lower unit relaxation to be compensated for and hence a greater residual fastener load.

To determine the tensioning load applied to bolt or stud, use the following formula:

Tensioning Load = Required Residual Load X Joint Factor

The joint factor is found by dividing the effective joint length by the fastener diameter and reading "factor" from Figure 2.

NOTE: (a) At no time should tensioning load exceed the tensile yield strength of fastener.

(b) Hydraulic tensioning devices cannot be used with lock nuts - use plain nuts when using this method.

4.1.5 TURN-OF-NUT METHOD

Turn-Of-The-Nut/Bolt is approved for bolt tensioning.

When Turn-Of-Nut method is used to provide bolt tension, there must first be enough bolts brought to a "snug tight" condition to insure that the parts of the joint are brought into good contact with each other. During this operation there shall be no rotation permitted of the part of fastener not turned by the wrench. Verification of final tension should be checked by at least one calibrated fastener per joint.

Hydraulic torquing devices (e.g.) are recommended for all bolt sizes 1.0 inch and over.

4.1.6 YIELD SENSING METHOD

The yield sensing method of preload control using electronic torque wrenches tightens fastener to ~100% of combined yield (tensile and torsional).* Such systems (as SPS Joint Control System®) must be considered on an individual joint basis and as such are not controlled by this document at this time.

4.1.7 IMPACT METHOD

Impact wrenches if used, shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of the individual bolt in approximately 10 seconds.

* Residual load or clamp load is dependent on fastener friction coefficients, but to a lesser extent than the torque method, thus permitting higher effective clamp loads.

SECTION 5

5.0 INSPECTION AND TEST

5.1 INSPECTION

5.1.1 INSPECTORS

Inspectors shall observe the installation and torque/tensioning of all major structural interfaces to determine that the selected procedure is properly used, and shall determine that all bolts are tightened.

5.1.2 CALIBRATION

All manual torque wrenches, hydraulic tensioning devices and electronic torque wrenches shall carry current certified calibration inspection tags.

5.1.3 TIGHTENING PROCEDURE

Circular bolt patterns, and large flat area bolt patterns shall be diametrically tightened with at least two (2) passes per bolt to achieve the correct tensioning.

5.1.4 TORQUE STRIPING

After verification of correct torque/tensioning, all fasteners shall be torque striped. Torque stripes must be applied as follows:

Tapped Fasteners -	From head of fastener to adjacent material
Stud Fasteners -	From stud thread to nut and nut to adjacent material
Nut and Bolt Fasteners -	From bolt thread to nut and nut to adjacent material or from head of bolt to adjacent material

5.2 TEST

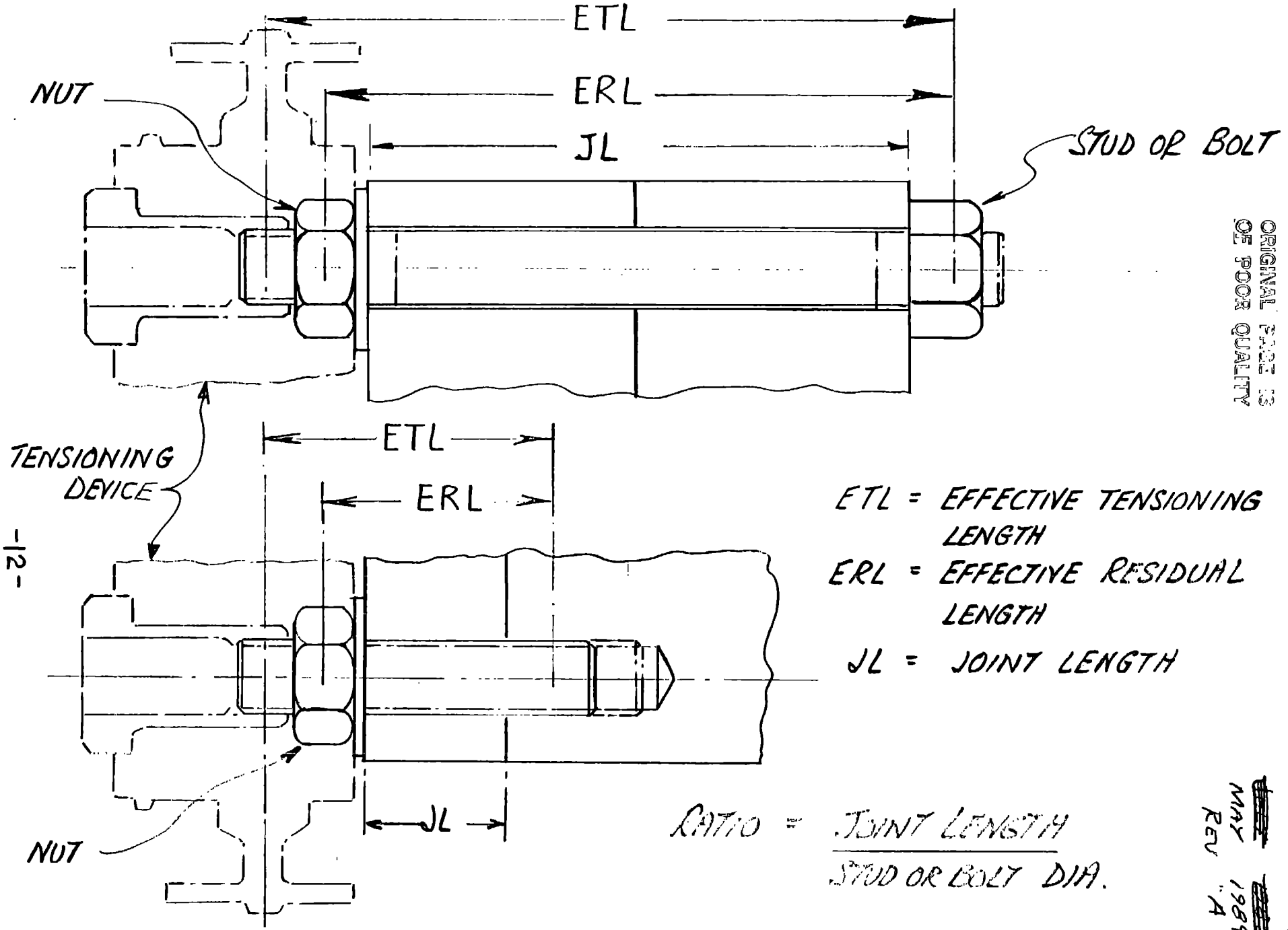
To verify the correct bolt tensioning it may be necessary to use an instrumented bolt at major interface locations.

Instrumented bolts may be of the strain gaged (hollow drilled) bolt, ultrasonic type bolt or drilled shank depth gage type.

Interface joint locations that require instrumented bolts will be so noted on the assembly drawings.

TABLE 1 - TORQUE/TENSION REQUIREMENTS

Torque Type	Bolt Size	SAE Grade (4.1.1)	Tensile Strength (min psi)	Tension (Clamp) Load (lbs) (4.1.2)	APPLIED TORQUE (NUT) Threads Dry (lbs ft) (4.1.3)	APPLIED TORQUE (NUT) Threads Lubed (lbs ft) (4.1.3)	RESIDUAL TENSION (Hyd. Ten. Device) (4.1.4)
1	1/4 - 20 UNC	--	74,000	1320	3 - 5	2 - 4	--
2	1/4 - 28 UNF	--		1500	4 - 6	3 - 5	--
3	3/8 - 16 UNC	--		3200	9 - 12	6 - 9	--
4	3/8 - 24 UNF	--	74,000	3620	17 - 20	12 - 20	--
5	1/2 - 13 UNC	5	120,000	9050	70 - 75	50 - 55	--
6	1/2 - 20 UNF			10,700	85 - 90	60 - 65	--
7	5/8 - 11 UNC			14,400	140 - 150	100 - 110	--
8	5/8 - 18 UNF			16,300	160 - 170	120 - 130	--
9	3/4 - 10 UNC			21,300	245 - 260	185 - 200	--
10	3/4 - 16 UNF			23,800	285 - 300	205 - 220	--
11	7/8 - 9 UNC			29,400	410 - 430	300 - 320	--
12	7/8 - 14 UNF			32,400	450 - 470	330 - 350	--
13	1 - 8 UNC			38,600	615 - 640	455 - 480	Load Required
14	1 - 12 UNF	5	120,000	42,200	675 - 700	505 - 530	
15	1 - 8 UNC	8	150,000	54,500	870 - 900	650 - 680	Per Individual
16	1 - 12 UNF	8	150,000	59,700	970 - 1000	710 - 740	
17	1-1/4 - 7 UNC	5	105,000	53,800	1080 - 1120	800 - 840	Application
18	1-1/4 - 12 UNF	5	105,000	59,600	1200 - 1240	880 - 920	
19	1-1/4 - 7 UNC	8	150,000	87,200	1780 - 1820	1320 - 1360	See Drawing
20	1-1/4 - 12 UNF	8	150,000	96,600	1960 - 2000	1460 - 1500	Callout
21	1-1/2 - 6 UNC	5	105,000	78,000	1890 - 1940	1410 - 1460	
22	1-1/2 - 12 UNF	5	105,000	87,700	2150 - 2200	1590 - 1640	
23	1-1/2 - 6 UNC	8	150,000	126,500	3110 - 3160	2330 - 2380	
24	1-1/2 - 12 UNF	8	150,000	132,200	3510 - 3560	2600 - 2650	
25	1-3/4 - UN	8	140,000	165,000	4800 - 4850	3600 - 3650	
26	2 - 8 UN	8	140,000	210,000	6,975 - 7025	5230 - 5280	
27	2-1/4 - 8 UN	8	140,000	292,000	10925 - 10975	8190 - 8240	



ETL = EFFECTIVE TENSIONING LENGTH

ERL = EFFECTIVE RESIDUAL LENGTH

JL = JOINT LENGTH

$$\text{RATIO} = \frac{\text{JOINT LENGTH}}{\text{STUD OR BOLT DIA.}}$$

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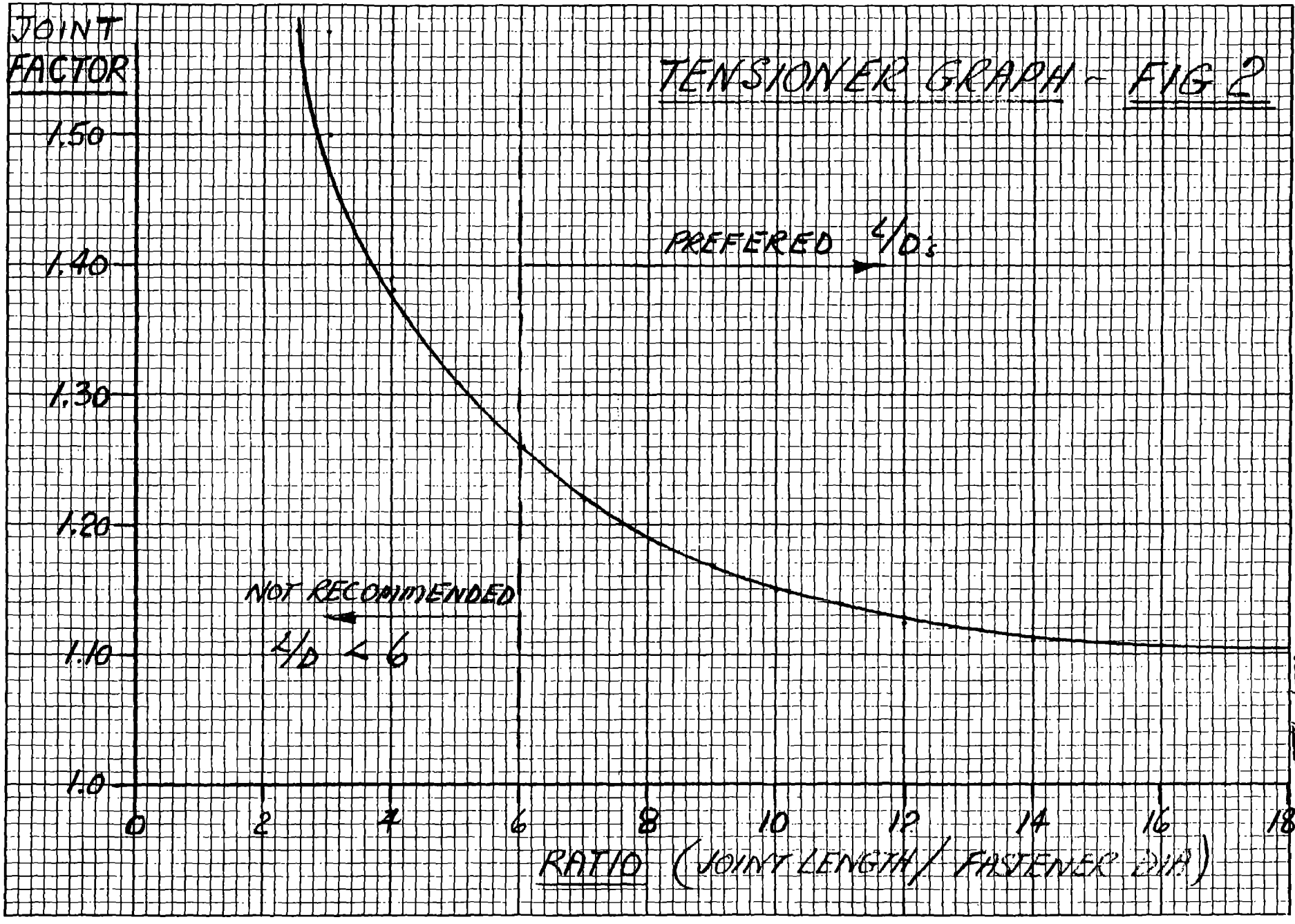
JOINT CONFIGURATION - FIG. 1



REV. "A"
MAY 1983

REVISION

ISSUED REV "A" PER AN-1 5/24/83

SPECIFICATION FOR
MATERIAL FINISHES
MOD-5A STRUCTURE
NOVEMBER 1982

Responsible Engineer — DATE: Nov 15/82

Systems Engineer — DATE: 15 Nov '82

Engineering Manager — DATE: 11/15/82

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PRINTS

REVISION LOG

This log identifies those portions of this document which have been revised since original issue. Revised portions of each page, for the current revision only, are identified by marginal striping.

Revision	Page No.	Paragraph Number(s) Affected	Rev. Date	Approval
A		General Revision and Update to Latest Requirements	05/09/83	RB/WCR AN-1

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SECTION 1

1.0 SCOPE

This specification defines the material finish requirements for all structural assemblies and details to be used on the MOD-5A Wind Turbine Generator.

The specification covers, but is not limited to, finish preparation and painting of all surfaces not previously finished by otners. It also includes cleaning and touch-up of factory primed and factory finished coated items, in the field.

All work performed under this specification shall conform to requirements stated herein. The responsible contractor shall furnish all labor, material, tools and equipment required, and provide competent supervision necessary to complete all operations in accordance with procedures established by this specification.

SECTION 2

2.0 APPLICABLE DOCUMENTS

All work specified herein shall be performed in accordance with applicable portions of the following codes, standard and regulations.

2.1 INDUSTRY STANDARDS

ANSI American National Standards Institute

ASTM American Society For Testing And Materials

F.S. Federal Standard No. 595A

SSPC Steel Structures Painting Council (SSPC), "Steel Structures Painting Manual, Vol. 2, Systems and Specifications", Third Edition

2.2 GENERAL ELECTRIC DRAWINGS

EMPIS - Engineering Materials and Processes Information

SECTION 3

3.0 GENERAL

3.1 REQUIREMENTS

Requirements for all finishing of detail and assembled parts shall be, unless otherwise noted on the appropriate detail and assembly drawings, as specified herein. See Table 3-1 for Paint System call-outs, and the approved coatings. Equivalent paint systems may be substituted with GE approval.

All necessary precautions shall be taken to protect personnel and property as itemized in SSPC-PA3.

All shop, field, and maintenance painting shall be in accordance with SSPC-PA1 except when modified by requirements stated herein.

3.2 SURFACE PREPARATION

All surfaces to be painted or otherwise finished shall be thoroughly cleaned and prepared as required in Table 3-1. Any condition detrimental to the proper completion of the finish required shall be noted and recorded.

3.3 BURRS

Prior to mechanical cleaning, all burrs and weld spatter shall be removed and all sharp edges and corners removed by filing or grinding.

3.4 CONTAMINANTS

Mill scale, oil, grease, dirt, and other foreign substances shall be wiped clean using clean cloths and clean solvents, per SSPC-SP1

3.5 MECHANICAL CLEANING

All mechanical cleaning shall be in accordance with SSPC-SP3 using only equipment recommended. The use of chipping tools which produce cuts, burrs and other excessive roughness shall not be permitted. Slight shadows, streaks or discolorations caused by rust stains or mill scale oxides, which cannot be removed except by blast cleaning will be acceptable.

3.6 BLAST CLEANING

All structural steel surfaces are to be cleaned in accordance with SSPC-SP10 (near white) unless otherwise specified.

TABLE 3-1

STRUCTURAL STEEL PAINT SYSTEM REQUIREMENTS

(Refer to SSPC, Vol. 2, "Systems and Specifications" for details)

ITEM	SURFACE PREP	PRIMER COAT	INTERMEDIATE COAT	TOP COAT	SSPC PAINT SYSTEM
Seacoast Env. Exterior surfaces exposed to weather	SP-10 (near white)	Paint #20 (Inorganic Zinc-Rich)	Paint #22, (Epoxy Polyamide)	Urethane	Guide No. 12.00 PS 13.01 Guide No. 17.00
Interior surfaces not exposed to weather	SP-10 (near white)	Paint #20 (Inorganic Zinc-Rich)	N/A	Urethane, 2 coats (abrasion & solvent resistant)	Guide No. 12.00 Guide No. 17.00

Approved Sources

1. Carbo-Zinc 11 Primer, with subsequent coatings as recommended by the supplier: Carboline Co.

2. Mobilzinc 7 Primer, with subsequent coatings as recommended by the supplier: Mobil Chemical Co.

SECTION 4

4.0 STEEL PAINTING (FACTORY)

4.1 SURFACE CLEANING

All structural steel surface areas are to be cleaned immediately prior to painting in accordance with the requirements of Table 3-1.

4.2 PRIME PAINTING

Prime paint all surface areas per Table 3-1.

4.3 FINAL PAINTING

Final paint all surface areas per Table 3-1. Paint colors to be per Section 12.0

4.4 UNPAINTED SURFACES

All areas left unprimed for later welds or structural connections shall be given one coat of Carboweld 11 from the Carboline Paint Company, or its equivalent.

SECTION 5

5.0 STEEL PAINTING (FIELD)

5.1 TOWER SURFACES

All exterior surfaces of the tower to be final painted in the field at the construction site, per Section 4.3 and Section 12.0

5.1.1 OTHER SURFACES

All other external surfaces of the rotor, yoke, nacelle, fairing and yaw sections shall be touch-up painted as required.

5.2 SCHEDULE OF FIELD PAINTING

Field coats on steel surfaces can be applied during, before or after erection as determined by erection techniques and accessibility to surfaces to be painted.

5.3 SURFACE PREPARATION

Prior to final painting all surfaces must have been prime coated per Table 3-1. All primed surfaces must be solvent cleaned per SSPC-SP1. Any rust or abraided areas should be cleaned back to base surface and primed per Table 3-1. Where sandblasting of steel is required in the field, use blast cleaning in accordance with Table 3-1 to produce a minimum surface profile of 1.5 mils on all areas to be painted or touched up. Power tool cleaning in accordance with SSPC-SP3 and hand tool cleaning in accordance with SSPC-SP2-63 may be substituted on surfaces which cannot be readily blast-cleaned.

5.4 TOUCH-UP PAINTING

Touch-up finish coat on shop-painted steel and the field prime coats on unprimed steel may be brushed or sprayed as required.

SECTION 6

6.0 STRUCTURAL JOINTS

6.1 ABUTTING STEEL SURFACES

Joints and open seams between abutting steel surfaces that cannot be given the paint coverage specified in section 4 or 5 shall be sealed with a weather proof adhesive, permanently resilient, polysulfide caulking compound.

6.2 CONTACT SURFACES

Open seams at contact surfaces of built-up members which can retain moisture shall be sealed with the weather proof sealant compounds of Section 6.1.

SECTION 7

7.0 STAINLESS STEEL SURFACE FINISH

7.1 SURFACE CAUTION

Stainless steel surfaces shall not be painted or cleaned under any condition, unless specifically noted on the drawing. Care should be exercised to ensure that halogenated solvents and/or paints do not come into contact with stainless steel components or materials.

SECTION 8

8.0 ALUMINUM SURFACES FINISH

8.1 SURFACE CLEANING

All aluminum surfaces to be painted shall be dry, clean and free from moisture, dirt grease or other contaminates. Clean per Section 3.0

8.2 PRELIMINARY TREATMENT

All aluminum surfaces to be painted shall be given one coat of vinyl metal conditioner prior to finish coat, or primed with Alodine 600 or 1200 per GE EMPIS spec. F65E1F4, F65E1G or Anodized per GE EMPIS spec. F65B10.

8.3 PRIME COAT

Prime paint with one coat of zinc chromate primer.

8.4 FINAL COAT - GENERAL

Final paint with one coat (1.0 to 1.5 mils thick) of enamel synthetic semi-gloss paint per Federal Spec TT-E-529 (color to be as noted on applicable drawings.)

SECTION 9

9.0 NON-METALLIC TYPE SURFACE FINISH (WOOD, RESIN FIBERGLASS, ETC.)

Later (TBD)

SECTION 10

10.0 ELECTRICAL EQUIPMENT SURFACE FINISH

10.1 FACTORY FINISH

All electrical equipment shall be per manufacturer's recommended factory finishes for seacoast environments.

10.2 TOUCH-UP GENERAL

Indoor load centers, motor control centers and switchgear shall be touch-up painted as required with a coating compatible with factory finish.

10.3 TOUCH-UP TRANSFORMERS

Transformers and other outdoor metal painted surfaces of electrical equipment shall be touch-up painted as required with the same or equivalent shop prime and finish paint in accordance with manufacturer's recommendations.

10.4 SURFACE PREPARATION

Flaws in painted surfaces of electrical equipment shall be cleaned to sound base metal per SSPC-PA1 instructions.

SECTION 11

11.0 MISCELLANEOUS EQUIPMENT

11.1 FACTORY FINISH

All miscellaneous equipment to be as supplied by manufacturer, with corrosion protection as specified. Any touch-up or field painting to be per sections 5.0, 8.0, or 9.0 as appropriate.

11.2 UNPAINTED SURFACES

No paint shall be permitted on any chrome, polished metal parts, name tags, valve stems, or glassware of any description. Any such parts shall have full protection against painting. Any paint or coating on such material shall be completely removed.

SECTION 12

12.0 FINISH COLOR SCHEME

12.1 FEDERAL STANDARD

All paint colors shall conform to Federal Standard No. 595A.

12.2 INTERNAL COLOR SCHEME

AREA	COLOR	FED. STD. NO.	REF. DWG.
FAIRING WALLS	SEMI-GLOSS WHITE	27875	
BEDPLATE (FACING INBOARD TO NACELLE)	SEMI-GLOSS BLUE	25177	
GENERATOR	SEMI-GLOSS BLUE	25177	
HIGH SPEED SHAFT ASSY.	SEMI-GLOSS BLUE	25177	
ELECTRONIC CONTROL CABINET	SEMI-GLOSS WHITE	27875	
HI-VOLT DISTRIBUTION CABINET	SEMI-GLOSS WHITE	27875	
GEAR BOX	SEMI-GLOSS BLUE	25177	
TOWER	SEMI-GLOSS WHITE	27875	
GROUND ENCLOSURE	SEMI-GLOSS BLUE (GRAY)	25526	
YAW SUBASSEMBLY	SEMI-GLOSS WHITE	27875	

12.3 EXTERNAL COLOR SCHEME

AREA	COLOR	FED. STD. NO.	REF. DWG.
BEDPLATE (NOT ENSHROUDED BY FAIRING)	SEMI-GLOSS WHITE	27875	
FAIRING (SEE ALSO SECT. 12.4)	SEMI-GLOSS WHITE	27875	
ROTOR BLADE (INCL. PARTIAL SPAN SECTIONS. SEE ALSO SECTION 12.4)	SEMI-GLOSS WHITE	27875	
YOKE	SEMI-GLOSS WHITE	27875	
LOW SPEED SHAFT	SEMI-GLOSS WHITE	27875	
YAW SUBASSEMBLY	SEMI-GLOSS WHITE	27875	
TOWER (SEE ALSO SECT. 12.4)	SEMI-GLOSS WHITE	27875	
GROUND ENCLOSURE INCL. TRANSFORMER & BATTERY HOUSING	SEMI-GLOSS BLUE	25177	

12.4 AIRCRAFT WARNING STRIPES AND WTG MARKINGS

AREA	COLOR	FED. STD. NO.	REF. DWG.
ROTOR BLADE (A/C WARNING)	SEMI-GLOSS ORANGE	22510	
NACELLE (MARKINGS)	TBD	TBD	
TOWER (A/C WARNING)	SEMI-GLOSS ORANGE	22510	

ELECTRICAL

FABRICATION AND WORKMANSHIP

STANDARD

SEPTEMBER 1982

Responsible Engineer — DATE: 10-19-82

Subsystems Engineer — DATE: 11-4-82

Systems Engineering — DATE: 11-5-82

Quality Assurance — DATE: 11-1-82

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REVISION LOG

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4.4 Dowel Pins	90
4.5 Assembly	90

1.0 SCOPE

1.1 This standard establishes the minimum manufacturing workmanship requirements for Electrical Control & Instrumentation Components & Systems.

1.2 This standard identifies the most commonly experienced fabrication and assembly techniques and sets forth the minimum standards of acceptance for each one. Where specific customer needs identified by contract dictate more stringent requirements, they shall be identified on Drawings or other related documents provided by Engineering, Manufacturing or QC.

2.0 REQUIREMENTS - WIRING

2.1 General

The wire harness assemblies are one of the most critical components. They must be fabricated, handled, installed and tested with skill and care. The requirements of this document are aimed at accomplishing this task. This drawing is to be referenced on all cable or harness drawings.

2.1.1 Precedence of conflicting requirements - When a conflict exists between this document and the requirements of the applicable drawing, the requirements of the applicable drawing shall take precedence.

2.1.2 All wiring of component assemblies shall be in accordance with this standard as specified in subsequent paragraphs, views and figures unless otherwise specified by drawing.

2.2 Materials and Parts

Only the parts, materials, etc., specified on the wiring assembly drawing parts list shall be used. The only exception shall be as called out in the parts size selection authorization. (See Para. 3.2)

2.3 Lay of Wire

2.3.1 Random or parallel lay shall be used throughout the harness.

2.4 Bend Radii

Unless otherwise specified on the wiring assembly drawing, bend radii shall not be less than the values given below unless special provisions are made. (See Para. 2.4.1)

Type	Minimum Radii
Coaxial	10 x O. D. Or Bend Radius shall not unduly effect the cable characteristics.
Bundles	6 x O. D.
Wire & Cable (Other than Coaxial)	6 x O. D.

2.4.1 When it is impossible to install wires and harness to the minimum requirements of 2.4, the minimum radii may be exceeded only if the wire is preformed individually.

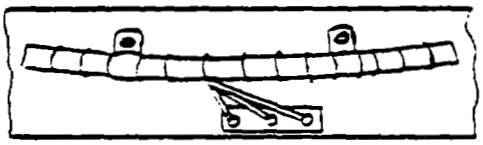
2.5 Stress and Strain Relief

2.5.1 At initial manufacture, service loops shall be provided for each wire to the extent necessary to permit at least two reconnections. Service loops shall be routed so that all symbols are in view. Bundles shall then be laced and supported as specified herein and on the assembly drawing.

2.5.2 Wired Assemblies. This standard establishes the requirements for harness assemblies in the design areas not specifically covered by drawing. (See attached typical examples (Sketches 1 - 14)

2.3.2 (Cont'd)

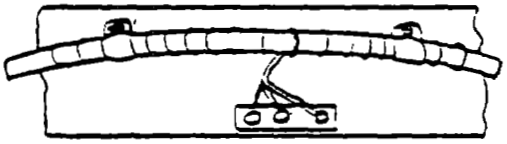
(1) NOT APPROVED



BREAKOUT WIRE TOO TIGHT (BREAKOUT TOO FAR FROM TERMINAL).

SINGLE TIE USED ON MULTI-WIRE BREAKOUT.

(2) APPROVED



BREAKOUT OPPOSITE TERMINAL-WIRE HAS .50 INCH MINIMUM RADIUS, RELIEVING STRAIN ON WIRE AND TERMINAL

DOUBLE TIE USED ON MULTI-WIRE BREAKOUT.

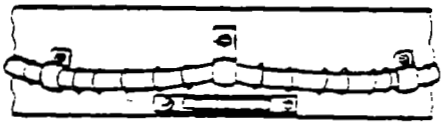
SUFFICIENT BREAKOUT WIRE TO MAKE TWO RECONNECTIONS.

(3) NOT APPROVED

HARNESS SAGS, CONTACTS ADJACENT COMPONENTS.

HARNESS CRUSHED, CLAMPED OR LACED TOO TIGHT.

(4) APPROVED

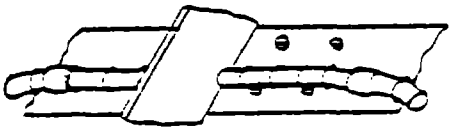


HARNESS STRAIGHT AND PROPERLY CLAMPED - CABLE ROUTE AVOIDS CONTACT WITH ADJACENT COMPONENTS.

HARESS SECURELY LACED AND CLAMPED WITHOUT EXCESSIVE PRESSURE TO DAMAGE INSULATION.

2.5.2 (Cont'd)

(5) NOT APPROVED



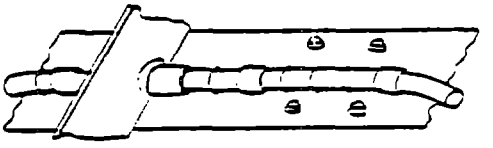
HOLE HAS NOT BEEN DEBURRED, NO CHAMFER EVIDENT

CLAMP MORE THAN SIX INCHES FROM HOLE.

CIRCUIT SYMBOLS OBSCURED.

COMPONENT FASTENERS OBSCURED BY CABLE

(6) APPROVED



HOLE HAS BEEN DEBURRED AND GROMMET INSTALLED.

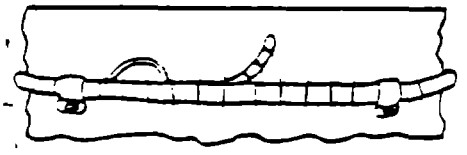
CABLE CLAMPED WITHIN SIX INCHES OF THE HOLE.

CIRCUIT SYMBOLS LEGIBLE AND NOT OBSCURED BY CABLE.

COMPONENT FASTENERS EASILY REMOVED, NO INTERFERENCE FROM CABLE.

SLEEVING ADDED OVER CABLE WHERE IT PASSES THRU GROMMET (OPTIONAL)

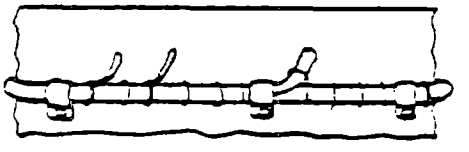
(7) NOT APPROVED



SINGLE WRAP IN LACING AT TERMINATION

WIRE LOOP IN AND OUT OF CABLE

(8) APPROVED



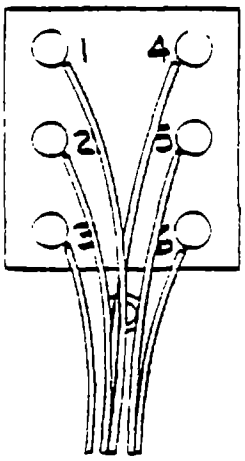
DOUBLE WRAP IN LACING AT TERMINATION

ALL WIRES NEATLY WITHIN CABLE

2.5.2 (Cont'd)

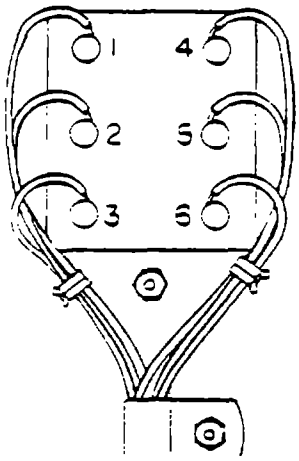
WIRING SHALL BE ROUTED THROUGH THE SHORTEST ROUTE POSSIBLE, EXCEPT FOR THE ADDITION OF SERVICE LOOPS AS REQUIRED. ALL WIRING SHALL BE NEAT, STURDY, AND DRESSED AGAINST THE CHASSIS OR SUPPORT MEMBER.

(9) NOT APPROVED



TIGHT LEAD, NO SERVICE LOOP
SYMBOLS OBSCURED
NO LACING OR CLAMPS

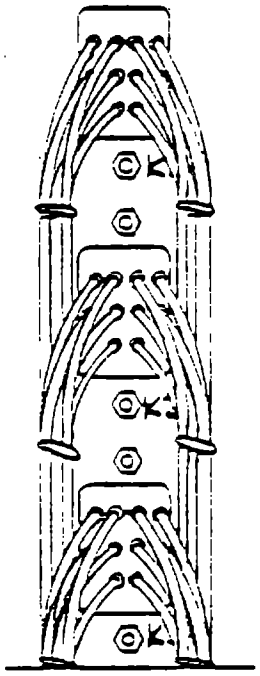
(10) APPROVED



SERVICE LOOPS PERMIT TWO RECONNECTIONS
ALL SYMBOLS IN VIEW AND LEGIBLE
CABLE LACED AND CLAMPED AS REQUIRED.

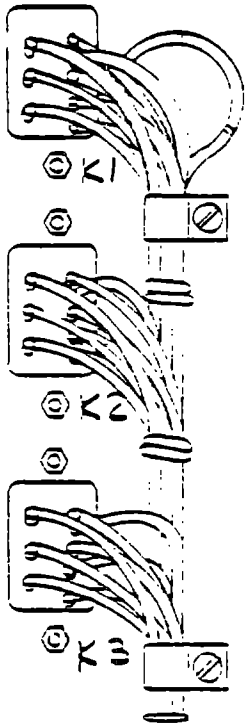
2.5.2 (Cont'd)

(11) NOT APPROVED



IMPROPER LACING KNOTS.
SPECIFIED CABLE CLAMP OMITTED.
TERMINALS NOT ACCESSIBLE.
NO SLEEVING ON CLOSELY SPACED TERMINALS.
WIRE OR CABLE ASSEMBLY ROUTED ACROSS FASTENER, ADJUSTMENT HOLE, ETC.
WIRES DRESSED TIGHT.
NO SERVICE LOOPS.
WIRE BUNDLE ROUTED CLOSE TO SHARP OBJECTS SUCH AS TERMINALS OR MECHANICAL HARDWARE, DAMAGING THE INSULATION.

(12) APPROVED

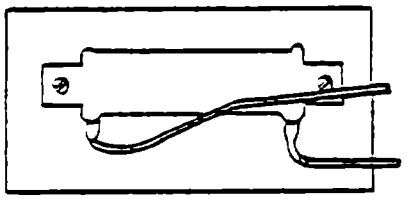


PROPER LACING KNOTS USED. (SEE LACING SECTION FOR ADDITIONAL INFORMATION.)
CABLE PROPERLY CLAMPED.
TERMINALS ACCESSIBLE.
SLEEVING USED ON CLOSELY SPACED TERMINALS.
WIRES AND CABLE ASSEMBLY ROUTED TO AVOID PASSING OVER FASTENERS, ADJUSTMENT HOLES, ETC.
SERVICE LOOPS PROVIDED FOR EACH CONNECTION.
WIRE BUNDLE ROUTED AWAY FROM ALL SHARP OBJECTS.
IDENTIFICATION OF INDIVIDUAL CONDUCTORS CLEARLY VISIBLE.

2.5.2 (Cont'd)

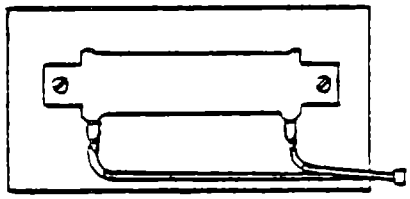
HEAT PRODUCING PARTS.

(13) NOT APPROVED



LEADS NEAR HOT COMPONENT SUCH AS RESISTOR, TUBE, LAMP, ETC.

(14) APPROVED



LEADS DRESSED AWAY FROM HOT COMPONENTS.

2.5.3 Special Provisions for Logic Wiring

2.5.3.1 Point to Point Wiring - Wires designated between logic cards within a logic rack or tray and wires designated between logic card on different racks or trays will be random wired, shortest route, point to point.

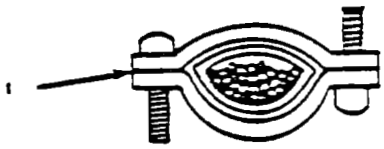
2.5.3.2 Wire Tension. Taper pin wire tension for random wires shall be such that the taper pin is not in a bent or distorted position after insertion into the connector. The wire bend as measured from the rear of the taper pin will be no less than .125 inches.

2.5.3.3 Logic connectors which have two insertion points per contact will use the contact nearest the center of connector if only one wire is designated for that contact.

2.5.4 Strain Relief. Provision for strain relief must be provided. Strain relief in the form of encapsulation or mechanical means shall be employed in all assemblies. If connector does not have a strain relief integral with connector a lacing tie must be provided. (See Section 2.6.2) When a connector is installed, there must not be strain imposed for any reason.

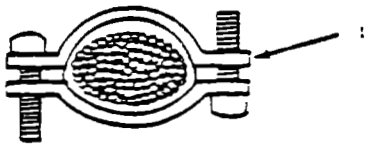
2.5.4.1 Strain Relief clamping devices shall be sufficiently tight before complete closure to prevent wires from sliding or turning when the connector is pulled or twisted.

NOT APPROVED



Clamp closed, wires not tight.

APPROVED

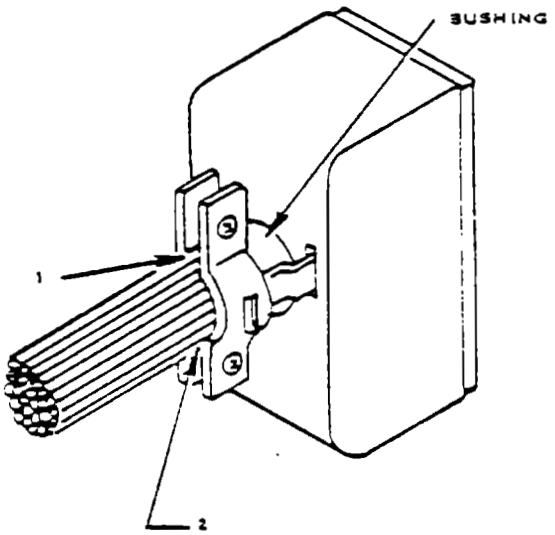


Clamp tight with sufficient pressure to prevent slippage.

Clamp Screws not completely bottomed

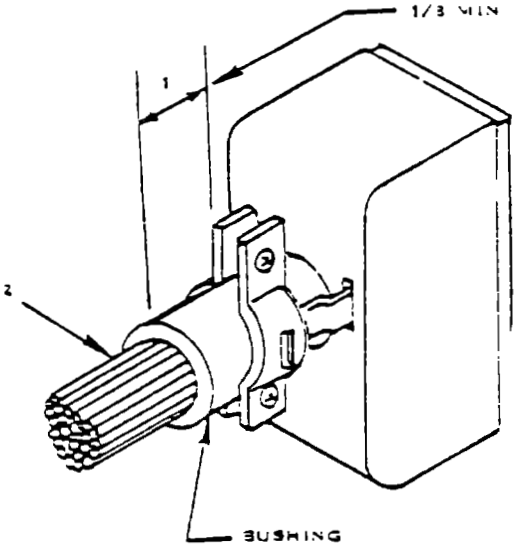
2.5.4.2 Bushings, tape or insulation sleeving shall be used over all wire bundles in strain relief clamps to prevent pinched or damaged wire insulations. When required, additional tape or insulation sleeving buildup under the clamp area shall be used to provide a positive clamping action to avoid wire or cable damage. This buildup shall extend a minimum of 1/8" on each side of clamp.

NOT APPROVED



1. Bushing not protruding from clamp.
2. Wires capable of being pinched.

APPROVED

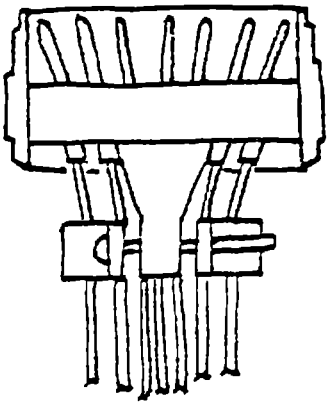


1. Bushing at least 1/8 inch beyond clamp.
2. Wires not pinched.

2.5.4.3 After tightening of strain relief clamp device on cable bundle, there shall be no splaying or dislocation of contacts at face of the connector or strain on wire termination at rear of the contact.

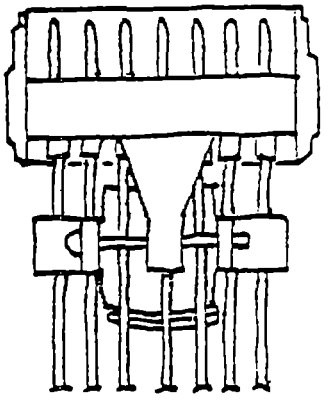
When splaying of pins or strain on wire connection results from tightening of strain relief clamp a filler of rolled insulation sleeving or tape shall be used inside wire bundle to prevent excessive strain on outside wires.

NOT APPROVED



-SPLAYED PINS
TIGHT WIRES

APPROVED



STRAIGHT PINS
NO STRAIN ON WIRES
INTERNAL FILLER OF
INSULATION SLEEVING

2.6 Lacing and Ties

Wire bundles shall be secured by the use of individual spot ties. Spot ties shall consist of a clove hitch secured by a square knot.

2.6.1 The harness shall be tied using lacing tape. The ends of the lacing tape shall be inspected after lacing. The ends must show no evidence of having the individual strands pulled.

2.6.2 For cables of approximately one (1) inch diameter or greater, the first tie shall be within six (6) inches of the rear of the connector.

Bundle Diameter	Distance to Start
½ in or less	3 in or less
½ in - 1	4 in or less

2.6.3 Lacing of harness or wire bundle runs shall be spaced per the following table.

Bundle Diameter	Interval (Approx.)
½" or less	1 - 1½"
½" to 1"	2"
1" or greater	3"

2.6.4 Breakout Ties. All Breakouts shall be securely tied on all points of exit from the breakout, spaced a maximum of ½ in on either side of the breakout. See Figure 1. Use Double spot ties on bundles of five wires or more.

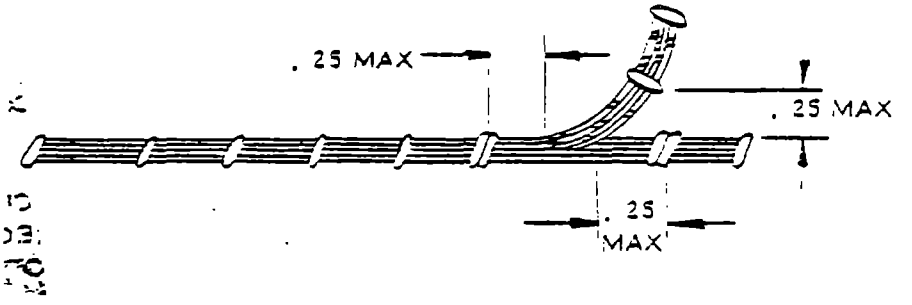


FIGURE 1

2.6.5 Duct

2.6.5.1 When wiring bundle is contained in a wiring duct, ties shall be loose at a maximum of 18 inch spacing.

2.6.5.2 When diameter of wire bundle leaving the duct exceeds slot width duct tabs may be removed as required to provide sufficient slot width.

2.6.6 All ties shall be made tight enough to contain wires but not tight enough to deform bundle or to pinch insulation.

2.6.7 Harnesses shall be fabricated with sufficient length to allow full extension of slide mounted electrical assemblies and maintain proper wire dress to connectors.

2.7 Abrasion Protection

Applicable harness assembly drawings shall specify areas needing special abrasion protection.

Manufacturing shall install abrasion protection where required during cable installation. Sleeving, thermofit tubing, Grommet material or tape shall be employed for this protection. Drawing coverage is not required to define these areas.

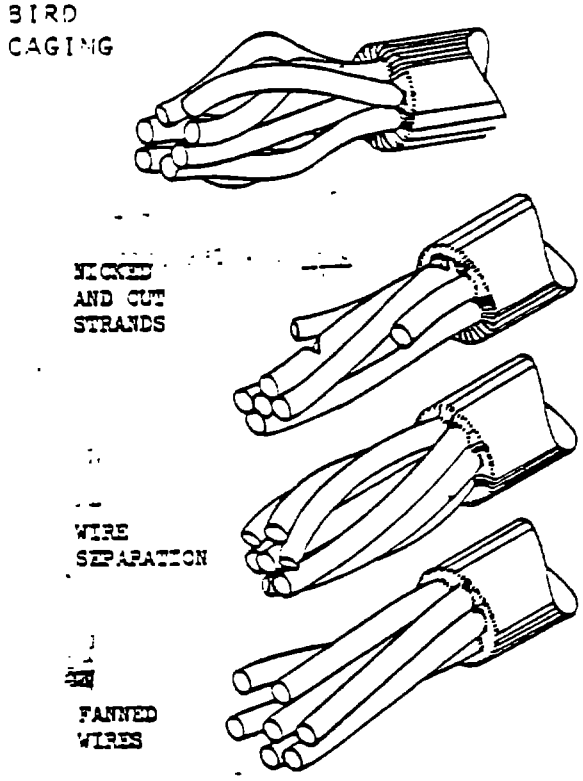
2.7.1 Abrasion protection shall be installed wherever wire or cable routing passes through, over or adjacent to any sharp edges or mounting hardware that present a potential cause of wire insulation chafing or damage.

2.8 Wire and Lead Preparation

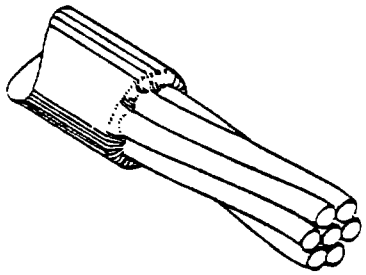
2.8.1 Insulation stripping of wires shall be performed using precision mechanical strippers such as Ideal Stripmaster or thermal type. Operators are not permitted to use operator adjusted mechanical stripping tools.

The stripping operation shall be performed to ensure there are no broken, cut, nicked or deformed conductors or strands. After insulation stripping, the conductor strands shall approximate their original twist and lay.

NOT APPROVED



APPROVED



CORRECTLY STRIPPED WIRES
NO BROKEN OR NICKED STRANDS
CONDUCTOR STRANDS CLOSELY
TWISTED IN ORIGINAL LAY

2.8.2 Wire tinning and forming is covered in Solder paragraphs of this standard.

2.8.3 Part Lead Forming. The radius of the part lead bend shall be equal to or greater than the lead diameter. The minimum distance from the component end seal to the start of the bend shall be 2XDIA. On parts that have a welded bend the start of the bead shall be 2XD or more from the weld bead. See Figure II.

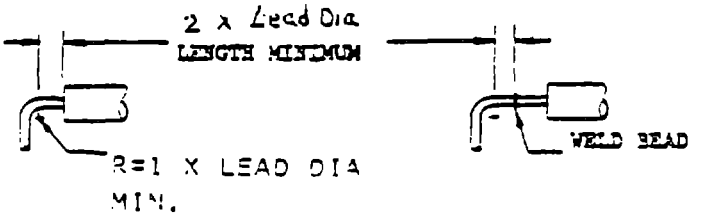


FIGURE II

2.8.4 Part lead tinning and specific forming criteria are covered in Solder paragraphs of this standard.

2.8.5 In wire and lead preparation, consideration shall be given to provide required stress relief per paragraphs 2.5 and 2.9 of this standard.

2.9 Solder Connections

2.9.1 Cleanliness. The area in which solder operations are performed shall be kept free of dirt, grease or other contaminants. All wires, part leads and terminals shall be clean and free of oxidation immediately prior to any tinning or soldering operation. This cleaning will be done using isopropyl alcohol and soft bristled brush and/or Kim-wipes except on electrical contact devices as noted in paragraph 2.9.12. Immediately after tinning or soldering the tinned part or solder connection shall be cleaned using isopropyl

alcohol and soft bristle brush to exhibit clean and bright solder surface.

2.9.2 Tinning. All wires, parts leads, terminals and connector solder cups shall be pretinned with a light solder coating prior to soldering and before the wire or leads are trimmed to finish length.

The tinned part shall then be cleaned per paragraph 2.9.1. After tinning of stranded wires the lay of individual strands shall still be visible.

2.9.3 General

2.9.3.1 Solder used for soldering electrical connections shall be 60/40 or 63/37 rosin core conforming to QQ-S-571 SN60WRAP2 orSN63WRAP2 unless otherwise specified on the applicable assembly drawing.

2.9.3.2 Flux - Only non-corrosive and non-conductive rosin type fluxes shall be used. All evidence of flux shall be removed immediately after soldering per paragraph 2.9.1.

2.9.3.3 Soldering is the joining of two metals, usually a wire to a terminal by bonding them with an alloy called solder. The bonding of the two metals into one common mass is brought about by the melting and flowing of solder over and around the wire and onto the terminal.

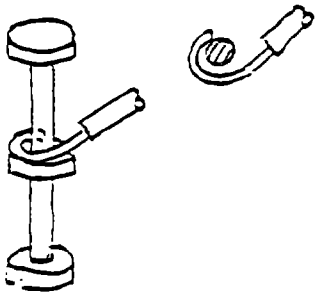
In order to obtain proper bonding of the two metals, proper forming and placement of the wire or component lead in or on the terminal is critical. Insulation gap and wire forming are covered in following applicable paragraphs.

No connections shall be made when lead size or number of leads prohibits proper placement on a terminal. In these instances, Design Engineering shall be notified for Drawing Change such as wiring change or addition of tie point terminals.

2.9.3.3 (Cont'd)

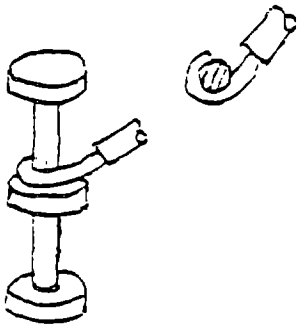
See following general examples.

NOT APPROVED

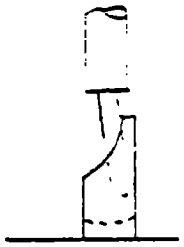


LOOSE WRAP WILL ALLOW BUILDUP OF SOLDER BETWEEN WIRE & POST

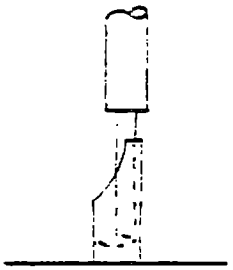
APPROVED



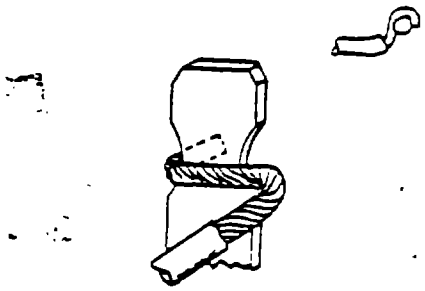
GOOD WRAP, WIRE FORMED AND LAYS AGAINST POST & TURRET



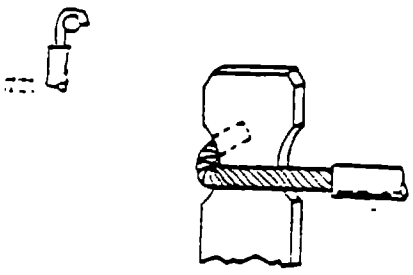
WIRE NOT AGAINST WALL OF SOLDER CUP
WIRE NOT BOTTOMED IN SOLDER CUP



WIRE PROPERLY POSITIONED AGAINST WALL OF SOLDER CUP
WIRE BOTTOMED IN SOLDER CUP



WIRE OR PART LEAD DRESSED AWAY FROM CONNECTION, BEND AND LAY COULD CREATE TEARING ACTION AT SOLDER CONNECTION



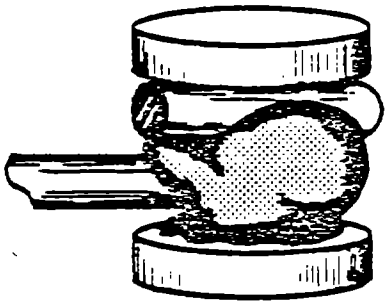
PROPER WIRE DRESS AWAY FROM CONNECTION

2.9.3.4 Good solder joints, regardless of construction shall have like characteristics. The solder shall be clean and smooth. The degree of brightness will vary with the solder alloy being used and the age of the joint.

The surfaces joined shall be covered with a coating of solder that leaves the general outline of the surfaces being joined. A smooth fillet between the surfaces shall taper to a feathered edge away from the joint exhibiting proper flow and wetting action.

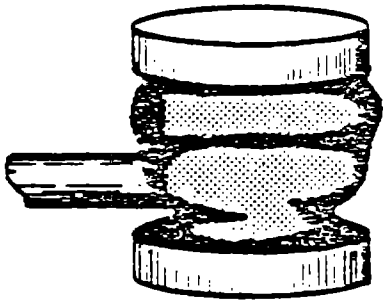
The following examples of workmanship are typical and may be applied to similar terminations and connections.

NOT APPROVED



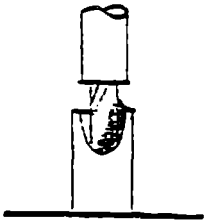
INSUFFICIENT SOLDER,
PART OF CONNECTION WITH
NO SOLDER
WIRE END NOT COVERED
WITH SOLDER

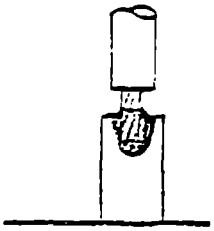
APPROVED

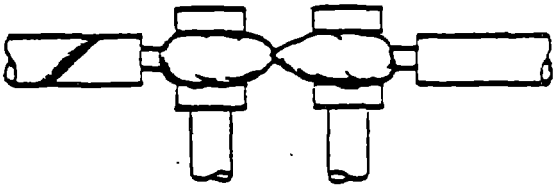


ADEQUATE SOLDER
ENTIRE CONNECTION COVERED
SOLDER FILLET TAPERS
TO FEATHERED EDGE

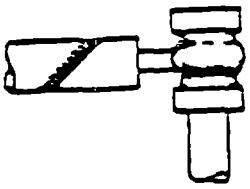
2.9.3.4 (Cont'd)



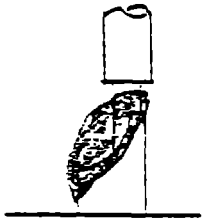




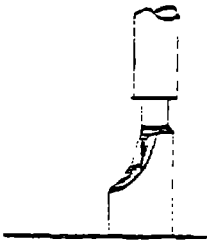
Excess solder, globules of solder – projecting from terminals, and impossible to determine if solder has properly alloyed with wire and terminal.



Minimum use of solder to completely cover joint.
Outline of wire still visible.

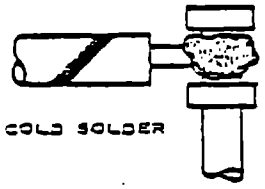


EXCESS SOLDER HIDING WIRE PLACEMENT AND SOLDER CONNECTION
SOLDER PILE-UP AND SPILLAGE CREATE POTENTIAL SHORTING CONDITION

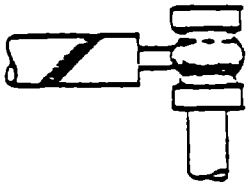


CORRECT SOLDER AMOUNT AND FILLET ALLOWS ASSURANCE OF GOOD PHYSICAL AND ELECTRICAL CONNECTION

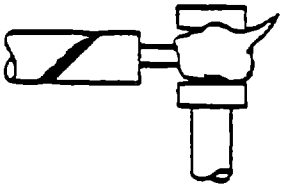
NOT APPROVED



Solder has not bonded wire and terminal together. Has chalky appearance and lacks a metallic luster, and generally presents a rough piled up appearance.



Solder completely covers joint and has a clean, bright appearance.



Points due to improper withdrawal of soldering iron.

2.9.3.4.1 Other classifications of general soldering workmanship not illustrated in previous examples and not approved are as follows:

(a) cracks or fractures in solder;

(b) disturbed joint caused by relative motion between the lead and terminal while solder is in solidification stages and has a frosted "piled-up" appearance;

(c) splatter of solder or flux on adjacent connections or parts;

(d) evidence of burning or other heat damage to solder joint;

(e) rosen joints which exhibit a chalky, rough appearance;

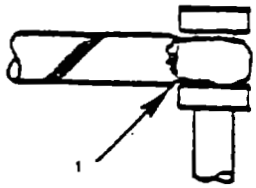
(f) pitted joints, showing scars or holes in solder; and

(g) piggy backup - soldering of one conductor to another before a term.

2.9.4 Insulation Clearance

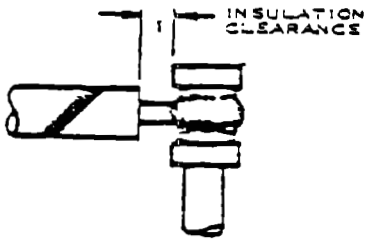
Insulation Clearance shall be a minimum of 1/32" and a maximum of insulation O. D. plus 1/16". Insulation clearnace is the distance between the end of the insulation and the solder of the connection. When different size wires go to one terminal, the clearance shall be based on the dimensions of the larger wire.

NOT APPROVED



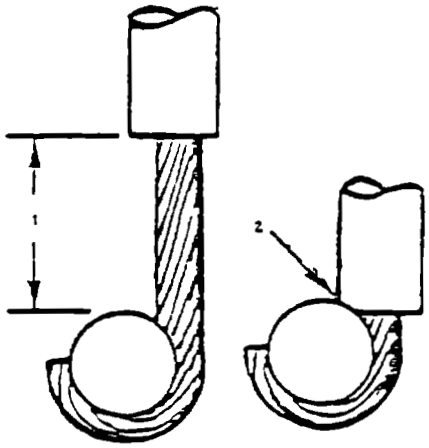
Insulation within solder connection.

APPROVED



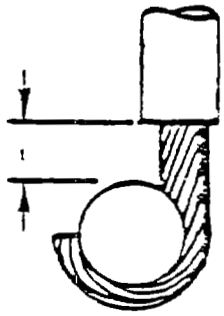
Insulation not within solder connection.

NOT APPROVED



1. Excess clearance, wire could short to adjacent terminal
2. Insufficient clearance insulation within solder connection.

APPROVED



Correct Clearance—about one finished diameter of the wire.

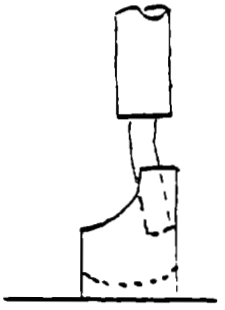
2.9.5 Solder Cups - Hollow, Cylindrical Terminals

This terminal will not normally accommodate more than one wire. However, more than one wire may be soldered in larger cups if all wires bottom fully in cup without modifying or deforming wire lay.

The solder cup shall be cleaned and pre-tinned before soldering. All conductors or ferrules terminating in a solder cup shall bottom in the cup with the conductor positioned against the rear wall of the cup.

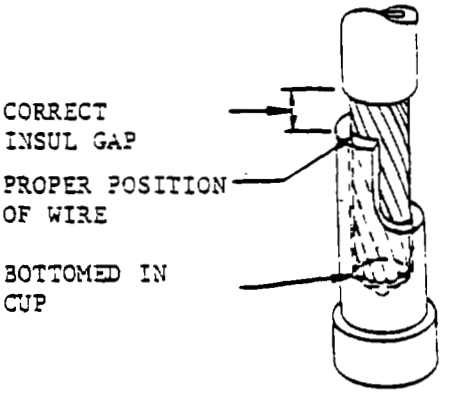
The solder shall completely fill the cup and fill the contour of the cup entry slot. Any buildup, globules or peaks of solder on the outside of the cup shall not be allowed.

NOT APPROVED



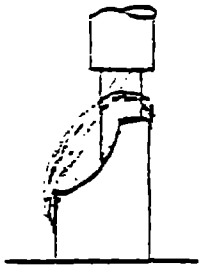
WIRE NOT PROPERLY POSITIONED
WIRE NOT BOTTOMED IN CUP

APPROVED



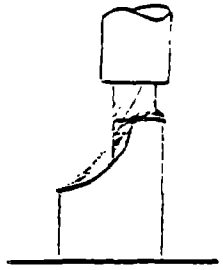
2.9.5 (Cont'd)

NOT APPROVED

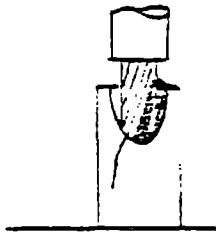


EXCESSIVE SOLDER
SOLDER SPILLAGE

APPROVED



GOOD WIRE POSITIONING
GOOD SOLDER FILLET
CORRECT INSUL GAP



INSUFFICIENT SOLDER
FILLET NOT AROUND WIRE
CONTOUR OF CUP ENTRY
SLOT NOT FILLED
WIRE STRAND OUTSIDE OF CUP

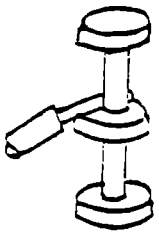
2.9.6 Turret Terminals

2.9.6.1 Lead and wire wrap around. A wrap of 180° to 270° shall be used to attach wires to terminals. The wrap shall be snug to the post and to the base of the turret. If more than one wire is soldered to a terminal or turret section, additional wires shall fit snug to the post without deforming the conductor.

2.9.6.1 (Cont'd)

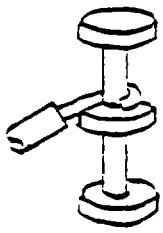
Piggy-backing or soldering, one wire to another ahead of the solder connection is not allowed.

NOT APPROVED

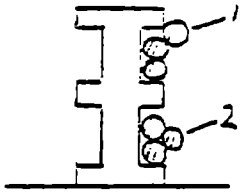


LESS THAN 180° WRAP ON TERM POST

APPROVED

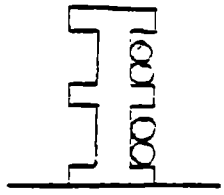


GOOD WRAP ON POST, 180° - 270°



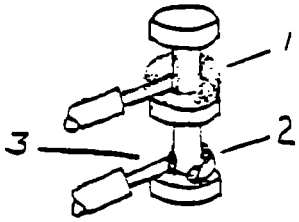
CROSS SECTION VIEW

1- Wires not positioned on term post.
2- Wire soldered on other wires.

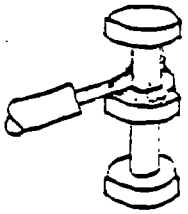


CROSS SECTION VIEW

Wires properly positioned against term post.



1- Excess solder hiding connection.
2- Insufficient solder at wire end.
3- Insufficient solder on wire to edge of term.



Good solder fillet from wire to term post and good flow onto base of turret.

Contour of wire still visible.

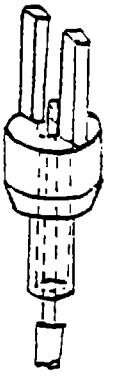
2.9.6.2 Straight Pins or Posts. All requirements of preceding paragraphs on turret terminals are applicable in regard to insulation clearance, wrapping, placement and forming of wire and solder except those pertaining to turrets.

2.9.7 Bifurcated Terminals

Wires may be terminated to bifurcated terminals by three different routes - bottom route, side route and top route. Any other method of terminating wires to bifurcated terminals other than those shown in this paragraph shall not be allowed. The solder requirements of paragraph 2.9.3 and insulation clearance requirements of paragraph 2.9.4 of this standard apply to all three approved methods of terminating wires to bifurcated terminals.

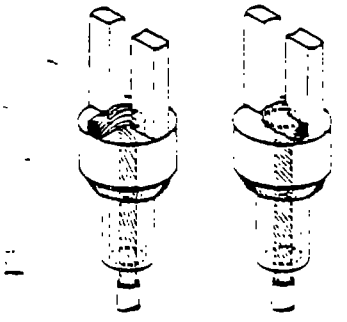
2.9.7.1 Bifurcated terminals, bottom route - Wires shall terminate with a $90^{\circ} \pm 20^{\circ}$ bend and shall be soldered to the terminal shoulder. Wires may be bent to lie along the face and one side of the vertical post.

NOT APPROVED



WIRE NOT AGAINST TERM SHOULDER

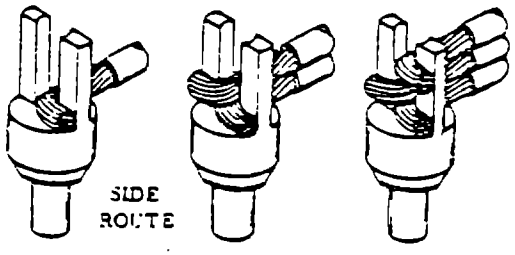
APPROVED

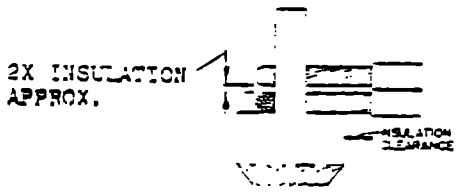


90° BEND OF WIRE AGAINST SHOULDER OR SHOULDER AND POST

2.9.7.2 Bifurcated Terminals, Side Route. The wire shall enter the terminal slot at a right angle and be terminated with a $90^{\circ} \pm 20^{\circ}$ bend of tinned wire. The first wire shall be soldered to the base and vertical post. The direction of the 90° bend on each additional wire shall alternate. The additional wires shall be soldered to alternating posts as close as possible to the preceding wire maintaining a clearance between the stranded wire equal to the thickness of the two wire insulations.

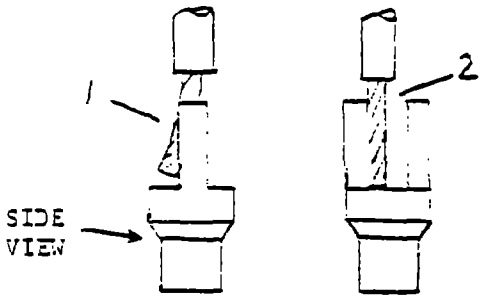
APPROVED





2.9.7.3 Bifurcated Terminals, Top Route. A wire which enters bifurcated terminals from the top shall be parallel with and fill the gap between the vertical posts with no bend and requires only solder for retention. When the wire does not fill the gap, a filler wire shall be used or wire may be bent into a U-shape and inserted providing the U-Shape fills the gap.

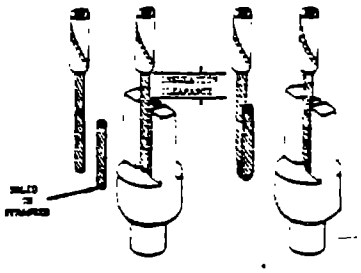
NOT APPROVED



1- Wire not positioned properly between bifurcated post.

2- No filler wire to fill gap between posts.

APPROVED

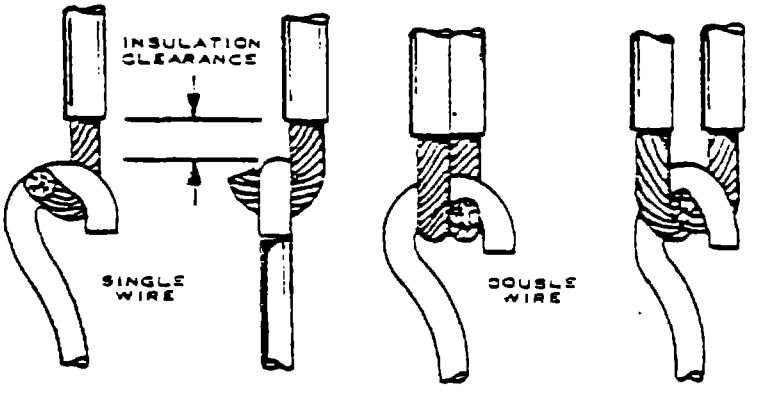


Proper wire placement and gap between posts filled.

2.9.8 Hook Terminals

Wires shall be attached to hook terminals by forming the tinned wire to a 90° - 270° angle before soldering. Wires shall only be attached to the curved portion of the hook except for special part attachments per Paragraph 2.9.11.

APPROVED



Hooked Terminal

Proper wire placement and bends 90° - 270° for single and double wire terminations

2.9.9 Pierced Terminals

Wires shall be attached to pierced terminals by forming the tinned wires to a 90° - 270° angle before soldering. Only as many wires shall be soldered as will fit into terminal hole without modification of stranded wire or terminal hole.

2.9.10 Component Assembly & Soldering. Components shall be assembled in such a manner as to minimize stress or damage.

2.9.10.1 Component lead bend radius and location shall be per paragraph 2.8.3 of this standard. See paragraph 2.9.10.9

2.9.10.2 Wire and location of leads to terminals shall be per applicable terminal of paragraph 2.9 of this standard. See paragraph 2.9.10.9.

2.9.10.3 Components shall be mounted with their value and identification visible. An exception to this would be transistors or similarly packaged components which are mounted with cap flush to the board. See paragraph 2.9.10.9.

2.9.10.4 Resistors rated 1 watt or more shall be raised off the board one diameter of Resistor body to allow an air space completely around component body.

2.9.10.5 Stress Relief. All component leads terminated at a terminal shall have sufficient slack in the form of a gradual bend to relieve thermal expansion or contraction. See paragraph 2.9.10.9.

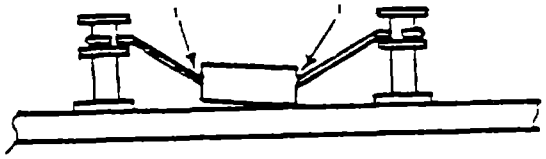
2.9.10.6 Uniformity in assembly and forming of component leads is preferred.

2.9.10.7 Soldering of component leads shall conform to paragraphs 2.9.1, 2.9.2, 2.9.3 and 2.9.4 of this standard.

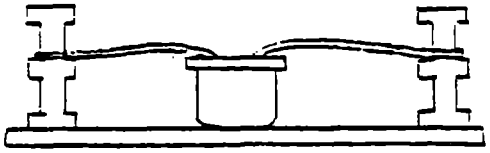
2.9.10.8 Parts shall be mounted on the board so that reference designations are visible and legible.

2.9.10.9 EXAMPLES OF COMPONENT ASSEMBLY AND SOLDERING-

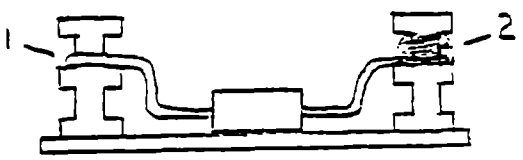
NOT APPROVED



1. Lead bent at component part, no stress relief.



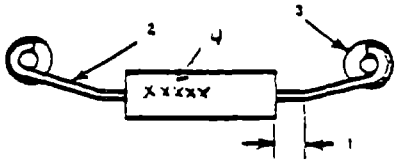
Leads formed too close to comp body, 2X LEAD DIA. min not maintained. No stress relief.



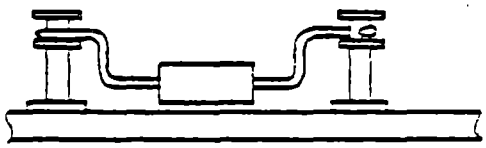
1- Insufficient solder.

2- Excess solder hiding connection.

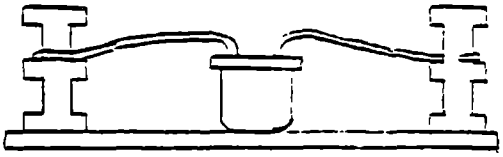
APPROVED



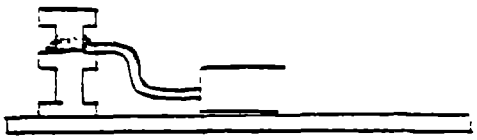
1. Minimum of 2 x lead dia. maintained.
2. Lead formed in gradual bend greater than radius of 1 x lead diameter.
3. Lead wrapped around post min. of 180° (180° - 270° required).



Proper position and stress relief within tolerance shown above.



Proper bend radius and forming for stress relief. Minimum of 2X DIA straight Lead from comp body maintained.

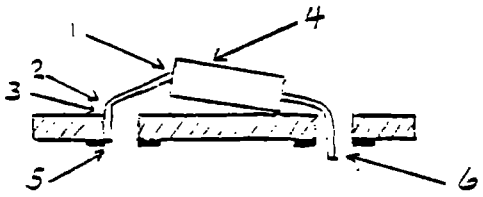


Good solder flow and fillet covers entire lead and term interface with lead contour and placement visible.

2.9.10.10 Printed Wiring Board Wiring. Component parts shall be mounted, when practical, in such a manner that markings are visible.

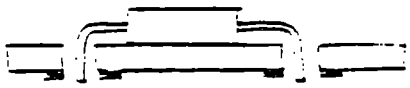
Parts shall be mounted flush to the board within .025" except resistors rated 1 watt or over require air space. Component lead bend radius and locations shall be per paragraph 2.8.3 of this standard. Component lead protrusion shall be minimum of 1/32" to a maximum of 0.10". Component parts shall be mounted within the confines of board edge and clear of mounting hardware or other components as much as possible. Uniformity in assembly and forming of component leads is preferred.

NOT APPROVED



1. Lead bent within 1/16" of comp body or bead.
2. Bend less than 2 x dia. of lead.
3. Lead not approx. center in hole.
4. Component not within .050" flush with board.
5. Lead protrusion not through board pad.
6. Lead protrusion exceed 0.10" through board.

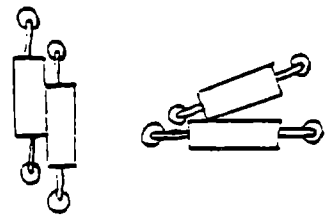
APPROVED



1. Proper bend location and radius.
2. Leads approx. centered in holes.
3. Component mounted flush within .050"
4. Lead protrusion 1/32 to 0.10 through board.

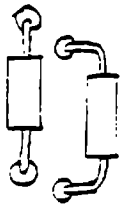
2.9.10.10(CONT.)

NOT APPROVED

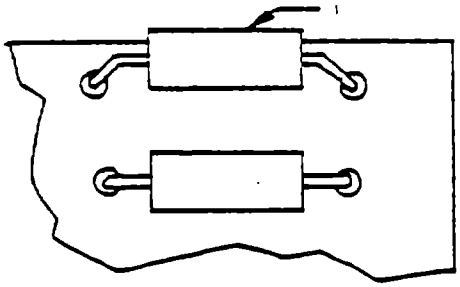


Parts in direct contact.

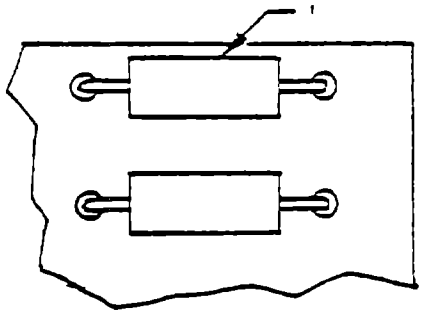
APPROVED



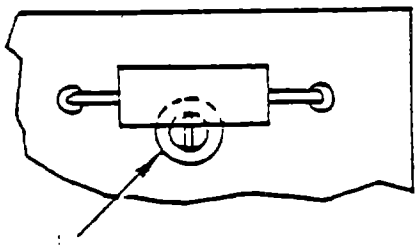
Correct forming of part leads to avoid contact.



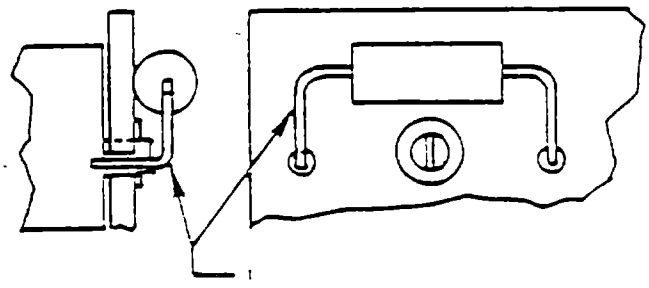
1. Part body beyond edge of board.



1. Part body is within edge of board.



1. Part body directly over and in contact with mounting hardware.



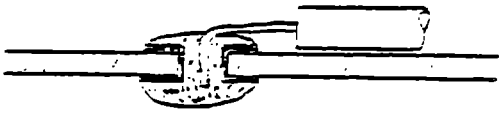
1. Part formed to avoid contact with mounting hardware.

2.9.10.10.1 Soldering of Component Leads and Jumper Wires to P.W.B.'s.

Solder preparation, cleaning, tinning and application shall meet the applicable requirements of paragraph 2.9.1, 2.9.2 and 2.9.3 of this standard.

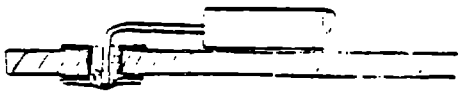
Solder shall be applied from the exposed lead end of hole and shall be at least 50% through plated through holes, shall be 360° around lead and show good flow and wetting to plated through hole and pad and shall cover end of lead without excessive pile up of solder which hides the connection.

NOT APPROVED



Excessive solder pile-up either side of board

APPROVED

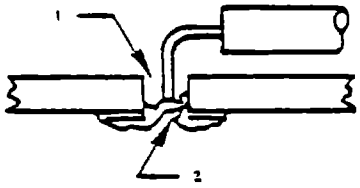


Good solder flow and wetting of plated through hole, pad, lead and lead end

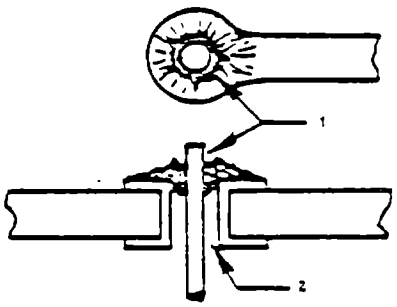
2.9.10.10.1 (CONT.)

NOT APPROVED

1. Solder barely flowed in hole. Poor wetting.

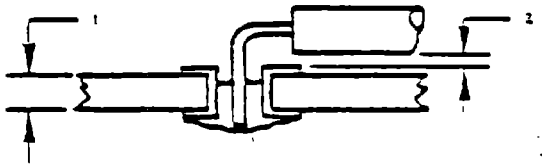


1. Lead protrusion less than 1/32 inch and not discernible in solder.
2. Poor solder wetting as evidenced by blow hole.

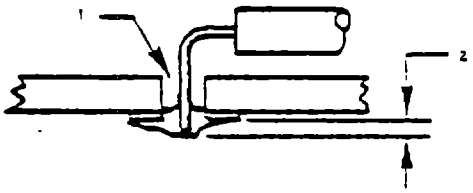


1. Solder did not wet top of lead and is fractured around lead.
2. Solder did not flow up lead. This could cause intermittent electrical connection.

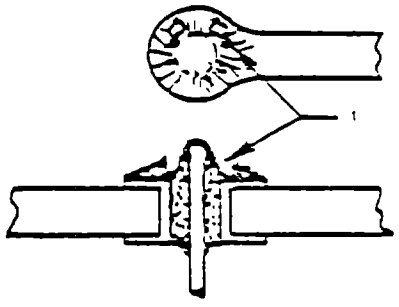
APPROVED



1. Hole is 50% full and shows good wetting.
2. Spacing does not exceed 0.050 inch.



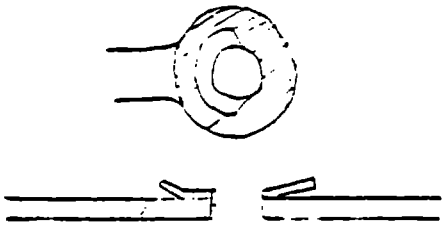
1. Solder does not fill unplated holes but shows good wetting.
2. 1/32 minimum lead protrusion. Contour of lead is discernible.



1. Pin holes exposing conductor or terminal area, but still have good wetting action to lead and plating.

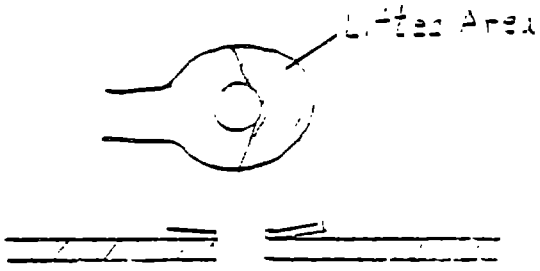
2.9.10.10.2 PAD LIFTING OR PRINTED CIRCUIT DAMAGE. LIFTING OR SEPARATION OF THE PAD FROM THE BASE MATERIAL SHALL NOT EXCEED 50% OF THE PAD AREA ON OPPOSITE SIDE OF THE CIRCUIT. A MAXIMUM OF 25% OF THE PAD AREA MAY BE MISSING IF IT DOES NOT CAUSE A SOLDER VOID IN THE HOLE. NICKS OR CUTS IN THE PRINTED CIRCUIT SHALL NOT REDUCE THE CONDUCTOR CROSS SECTION BY MORE THAN 25%.

NOT APPROVED



LIFTED AREA EXCEEDS 50% OF PAD AREA AND LIFTED ON CIRCUIT.

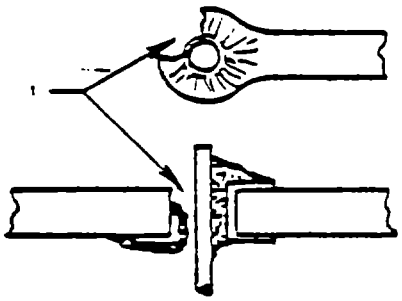
APPROVED



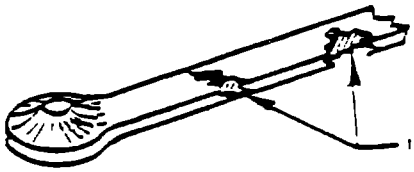
LIFTED AREA DOES NOT EXCEED 50% OF PAD AREA.NO LIFTING ON CIRCUIT SIDE.

2.9.10.10.2 (CONT.)

NOT APPROVED

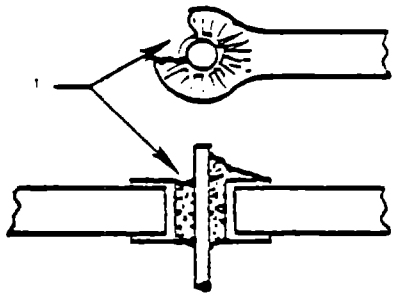


1. 25 percent of pad and plated wall missing causing void in hole.

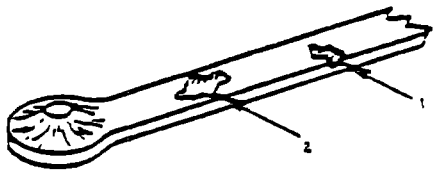


1. Nicks or cuts that reduce conductor cross section more than 25 percent.

APPROVED



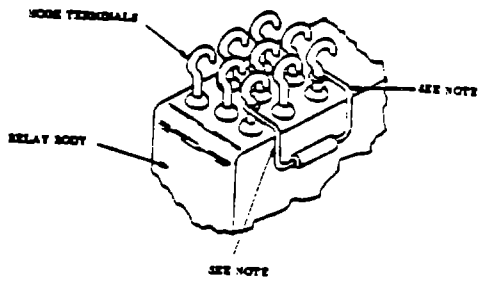
1. 25 percent of pad missing but solder is present between lead and hole.



1. Nicks or cuts less than 25 percent of conductor cross section.
2. Voids in conductor. Diameter less than 25 percent of conductor width.

2.9.11 Special Parts Attachment. When special parts must be attached close to parts such as relay headers, leads shall be attached adjacent to the curved or normal connection portion of the hook or terminating device and shall avoid contact with the body or terminal seal.

APPROVED



NOTE: CONNECTION CLEAR OF TERMINAL SEAL AND LEADS FORMED TO AVOID CONTACT WITH BODY.

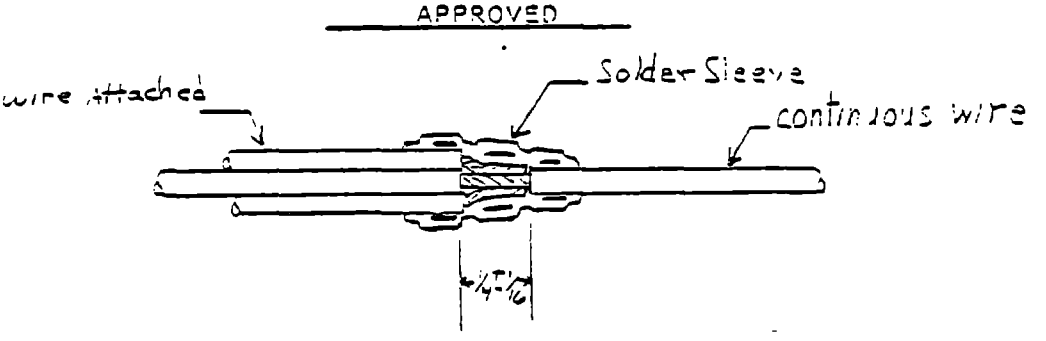
2.9.12 Electrical Contact Contamination. Extreme caution shall be exercised when soldering wires to non-hermetically sealed switches, relays and indicators or to any component or device having open electrical contact surfaces.

No Flux shall be added at these connections. The absolute minimum of cleaning fluid necessary for clean connections shall be used and the device positioned with terminals directed downward to avoid seepage or drainage of contamination toward the device. On certain devices with enclosed contacts such as Grayhill Rotary Switches, no cleaning fluid should be used. Cleaning shall be accomplished with dry brush or wiping only.

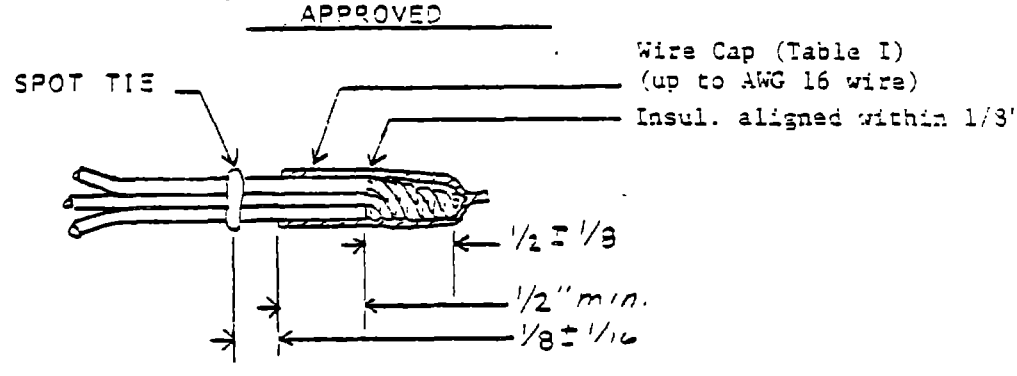
2.9.13 Solder Splices.

Splicing of wires by means of solder sleeves or twist, solder and cap when indicated by the drawing or for authorized rework per paragraph 2.9.13.3 of this standard is approved. Either of these solder splice methods shall be staggered along a sufficient length of harness and shall not be located on bends.

2.9.13.1 Solder Sleeve Splices. A maximum of two wire ends may be spliced to a continuous wire using appropriate size solder sleeve. Wires shall be prepared by making a 1/4 ± 1/16" window in the continuous wire insulation and stripping the attaching wire insulation 1/4 ± 1/16". Attaching wire ends shall be positioned 90° - 180° apart on the continuous wire aligned ± 1/16" with the continuous wire window.



2.9.13.2 Soldered and Capped Splices. A maximum of 6 wire ends may be spliced together by twisting, soldering and capping with the appropriate size wire cap. Prepare wires by stripping insulation to allow 1/2 ± 1/8" from wire insulation to end of twisted wires with a minimum of one complete twist or revolution before soldering. Align insulation ends uniformly within 1/8" of each other and twist wires together a minimum of one complete revolution. Trim to ½ ± 1/8" and solder twisted strands together. Install appropriate size wire cap and spot tie wires together 1/8 ± 1/16" below wire cap. Wire cap shall overlap wire insulation by 1/2" minimum after shrinking.



If more than 6 wires are to be spliced together use additional splice assemblies and jumper one splice to the other. Jumpers to be included in max of 6 wires.

TABLE I

WIRE CAPS FOR SOLDER SPLICES

No. of Wires	Part No.	Color
2	Rayclad Tubes, TC4003CRN	Red
3-6	Rayclad Tubes, TC4005CRN	Gray

For wires larger than AWG16, use wire cap size as required.

2.9.13.3 Instructions for use of solder sleeve or twisted solder splices after initial fabrication for authorized repair. (Rework disposition or Failure Repair).

(a) Splice shall be properly staggered and located and meet the requirements of paragraph 2.9.13.1 or 2.9.13.2 of this standard.

(b) Wires that can be readily replaced shall not be spliced.

(c) No drawing changes will be made to reflect authorized repairs.

2.9.14 Insulation sleeving of solder connections shall conform to the drawing list of materials. Sleeving shall be installed over all solder connections where the wire or wires exit perpendicular from the terminal or solder cup and the connections are not encapsulated with potting compound. The insulation sleeving shall overlap onto wire insulation a minimum of 1/16" or diameter of wire insulation after being positioned over the solder connection. Insulation sleeving shall not be shrunk in place until after final acceptance and check out of the wired assembly.

2.10 Mechanical - Electrical Connections

Crimped, solderless terminals and contacts shall be used with stranded wire only, except that when indicated by drawing solid leads may be crimped and then soldered in uninsulated crimp termination devices. Stranded wire ends shall not be tinned when terminated in crimp terminations or splices. When used, the wire/terminal/tool combination shall be in accordance with the terminal manufacturer's recommendations or an equivalent tool combination per Manufacturing Engineering instructions. When subjected to test, the mechanical connection of the wire to crimp device shall be such that the wire shall not pull out or break at the crimp with an applied tensile force as follows:

Wire Size	Load, Tensile (Pounds)
30	3
26	7
24	10
22	15
20	19
18	38
16	50
14	70
12	110
10	150
8	225
6	300
4	400

2.10.1 Butt Splices

2.10.1.1 Butt splices shall be crimped with the proper tools. Only Butt Splices defined by Drawing are acceptable except those allowed for Authorized Repair per paragraph 2.10.1.2 of this standard. Butt splices shall normally be located near connectors and staggered 3 to 12 inches from the pins or other wire termination point unless otherwise defined by drawing or Authorized Repair. Butt splices shall not be located on a bend. A maximum of 4 wires may enter a Butt Splice (max of 2 wires per end).

2.10.1.2 Instructions for use of Butt Splices after initial fabrication for Authorized Repair - (Rework disposition or Failure Repair).

(a) No more than two splices shall be used in series.

(b) Splices shall be staggered along a sufficient length of harness.

(c) Splices shall not be located within 3 inches of a connector or on a bend.

(d) Wires that can readily be replaced shall not be spliced.

(e) Splices must be in view.

(f) No drawing change shall be made to reflect authorized repair.

2.10.1.3 Selection of Butt Splice and Crimp Tool - Selection of the proper size Butt Splice and proper crimping tool shall be made in accordance with the Circular Mil Area tables per Butt Splice and Wire Size as follows:

CIRCULAR MIL AREA PER BUTT SPLICE & TERMINAL

Butt Splice or Term Lug	CMA		Crimp Tool
	Min.	Max	
Yellow	202	810	59275
White	320	1290	59275
Red	509	3260	59250
Blue	2050	5180	59250
Yellow	3260	8230	59239

CIRCULAR MIL AREA PER WIRE SIZE

AWG WIRE	CMA	AWG WIRE	CMA
26	250	16	2432
24	475	14	3838
22	754	12	6080
20	1216	10	9361
18	1900	8	17024

Select the Butt Splice which has a CMA range to accommodate the CMA of the wire or wire combination being crimped. If the CMA of the wire falls within the CMA range of two different splices, use the larger splice. Filler wire may be crimped in and capped when necessary to meet CMA requirements. The crimp tool die color code must match the color of the splice.

2.10.1.4 Butt splice assembly and crimping. The insulation shall be stripped from wire ends to meet the following dimensions before inserting in the butt splice:

AWG 10 - 18 wire - 1/4 to 5/16"

AWG 20 - 30 wire - 3/16 to 1/4"

Before insertion, the wire strands should be finger twisted together in their natural lay to prevent protruding or cross over of strands. When two wires are installed in one end of a splice, they may be finger twisted together with insulation ends aligned evenly for easier assembly.

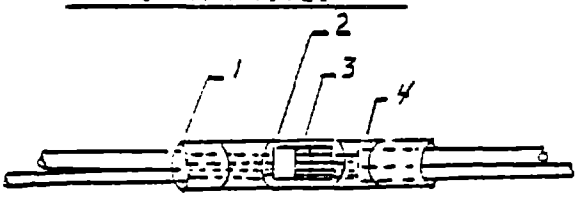
Insert the prepared wire or wires into the splice until it bottoms against the stop visible in the inspection window using a slight twisting motion in the direction of normal strand twisting.

After crimping the wire strands shall be visible in the inspection window but not extending over 1/2 of the center stop.

There shall be no wire insulation visible in the inspection window or bare wire showing at the insulation crimp.

2.10.1.4 (CONT.)

NOT APPROVED



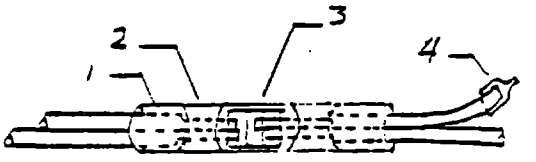
1- Bare wire would show at insul crimp.

2- Wire strands not visible in window.

3- Wire strands extend over 1/2 stop.

4- Insulation extends into conductor crimp area.

APPROVED



1- Insulation properly positioned in insul crimp area.

2- Conductor properly positioned in crimp area and visible in window.

3- Wire strands visible in window and not past 1/2 of stop.

4- Three to six inch filler wire capped.

2.10.2 Terminal Lugs

Only terminals defined by the drawing shall be used. Normally there shall be one wire per terminal, except that when the number of wires terminating at a stud exceeds the number of terminal lugs the stud will accommodate, more than one wire may be crimped per lug.

2.10.2.1 Selection of terminal lugs and crimp tool shall be made in accordance with the circular Mil Area tables in paragraph 2.10.1.3. The crimp tool die color code must match the color of the terminal lug.

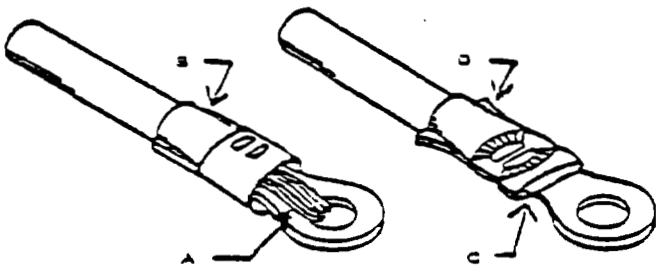
2.10.2.2 Terminal Lug Assembly and Crimping. The insulation shall be stripped from the wire ends to meet the following dimensions before inserting in the terminals.

AWG 10 - 18 wire - 1/4 to 5/16"

AWG 20 - 30 wire - 3/16 to 1/4"

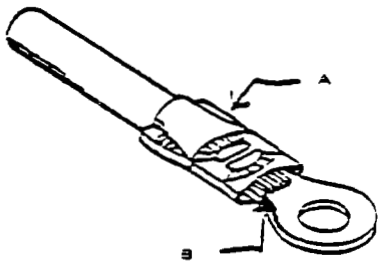
Before insertion, the wire strands should be finger twisted together in their natural lay. The stripped conductor protruding through the terminal barrel shall be flush as a min. and with max. so as not to interfere with final installation.

NOT APPROVED



A. Stands protruding into installation hole.
B. Under-crimped.
C. Strands not visible.
D. Over-crimped.

APPROVED



A. Proper crimp for specified type terminal.
B. Strands visible and will not interfere with installation.

2.10.3 Crimp Connector Contacts

For crimp style connectors, all wire shall be assembled so as to allow flexibility. There shall be no undue stress on wires.

Prior to insertion of contact into the connector, there shall be no evidence of wire being bent or distorted at the crimp joint. When inserting contact into connector, the proper insertion tool shall be used so wire is not bent or distorted at the crimp joint in any way.

Crimp style connectors shall have unused contacts installed to insure 50% of connector filled.

Crimp style connectors with rear environmental seal grommet shall have grommet sealing plugs installed in all unused rear cavities.

2.10.3.1 Machined Solid Barrel Contacts. Wires shall be stripped to allow insulation gap as follows with wire bottomed in contact crimp barrel:

Min. - Insulation flush with back of crimp barrel

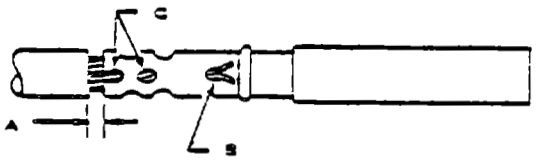
Max. - 5/64"

The proper crimp tool shall be used and crimp indents centered so as not to cause any deformation at rear of crimp barrel or at inspection port.

2.10.3.1 (Cont'd)

o Non-Insulation Support Contacts

NOT APPROVED

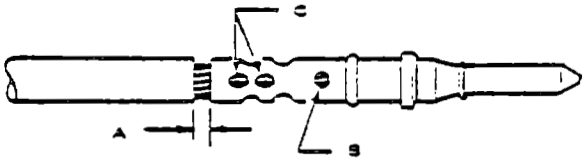


A. Insulation gap exceeding maximum of 5/64 (0.078).

B. Strands not visible or strands are protruding through inspection port.

C. Indents on rear of barrel causing deformation.

APPROVED



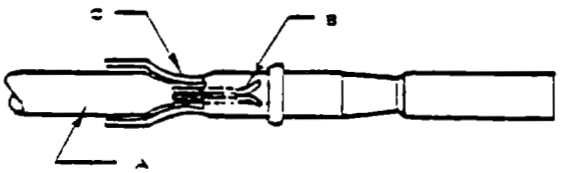
A. Insulation gap
Min: Insulation flush with back of crimp barrel.
Max: 5/64 (0.78)

B. Strands visible in inspection port

C. Indents uniformly centered and away from rear of barrel.

o Insulation Support Contacts

NOT APPROVED

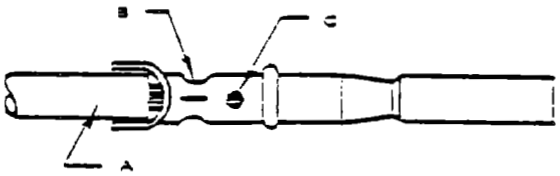


A. Conductor insulation in crimp area.

B. Strands not visible or strands are protruding through inspector port.

C. Crimp indents not in correct location per approved tooling.

APPROVED



A. Conductor insulation within insulation support barrel but not within crimp area.

B. Crimp indents uniformly centered and away from rear of barrel.

C. Strands visible through inspection port and appear to be bottomed.

2.10.3.2 Stamp formed contacts. All contacts with open tab insulation and conductor crimp tangs shall have wires stripped so that the wire insulation extends through the insulation crimp tang but not into the conductor crimp. The conductor exposed strands shall be through the conductor crimp tangs but not overlapped or fanned onto the contact barrel.

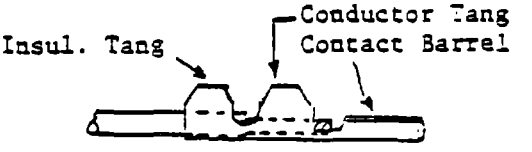
NOT APPROVED

Uncrimped Contact

Insulation extends into conductor crimp area.

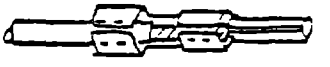
Conductor strands overlapped onto contact barrel.

APPROVED



Proper position of insulation end and conductor strands.

Insulation not visible at end of insul. crimp area. Conductor strands not visible at end of conductor crimp area.



Proper position of insulation end and conductor end.

2.10.4 Wire Wrap Connections

A solderless wrapped connection is a number of turns of solid wire wrapped onto a square post designed for that purpose.

Wire wrapping may be accomplished by Electric Hand Gun, Gardner Denver model 14 x 2-3 or equivalent with Bit and Sleeve per gun manufacturers recommendation, or by semi-automatic or automatic wire wrap machine.

Insulation stripping shall be accomplished by thermal stripping or by precision mechanical stripper which produce no nicks or damage to exposed conductor.

The minimum number of uninsulated turns of wire to produce a satisfactory and reliable electrical connection shall be as delineated in the following table:

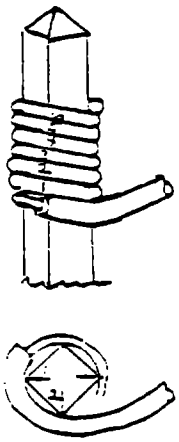
AWG Wire	No. of Turns
30	7
28	7
26	6
24	5
22	4
20	4
18	4
16	3

A turn of wire is defined as a complete, single helical ring of wire wrapped 360° around a post.

2.10.4 (continued)

A modified wire wrap connection shall be used which requires that the start of the wire wrapping to the terminal have as a minimum, insulated portion of the wire wrapped around 3 corners of the terminal (2 turns max.).

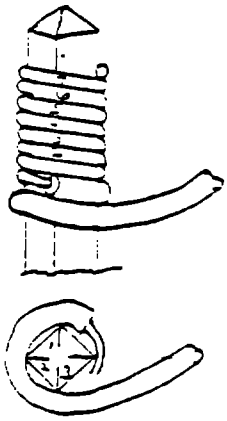
NOT APPROVED



Less than 7 turns uninsulated AWG 30 wire.

Insulated portion of wire not wrapped around 3 corners.

APPROVED



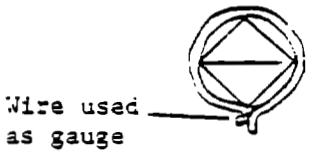
Seven turns min uninsulated AWG 30 wire.

Insulated Portion of wire wrapped around 3 corners of term post.

2.10.4.1 Requirements for solderless wire wrapping include the following:

A. End tail requirements - max. of one wire diameter.

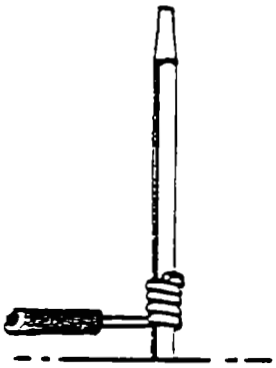
NOT APPROVED



APPROVED

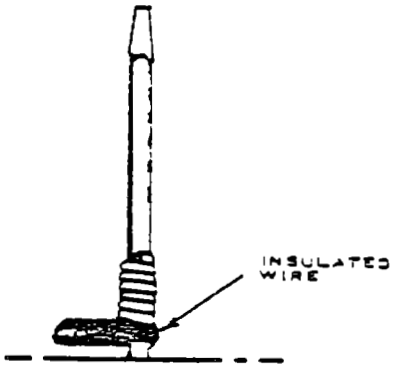
B. Turns and Insulation Wrap -

NOT APPROVED



1. Insufficient turns of stripped wire.
2. Insufficient turns of insulated wire.

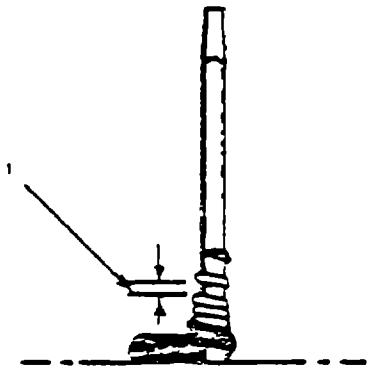
APPROVED



Sufficient turns of both stripped and insulated wire.

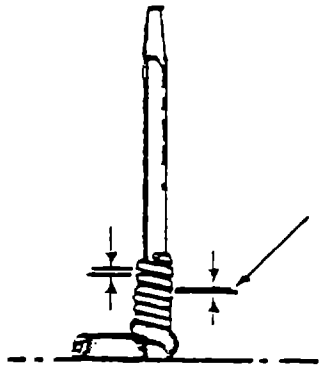
2.10.4.1 B (Cont'd)

NOT APPROVED



1. Excessive spacing or gaps between turns. In excess of 50 per cent of wire diameter.

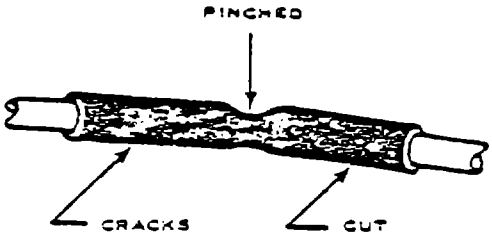
APPROVED



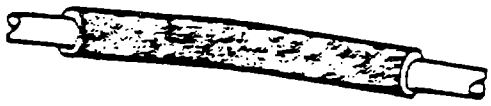
1. Individual gaps between turns less than one-half the wire diameter. Exclusive of gaps on first or last turn.

C. Insulation damage. Damaged insulation as a result of stripping or wrapping is not permissible.

NOT APPROVED



APPROVED

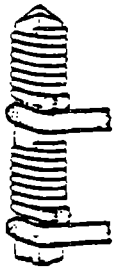


D. Wrap Levels and Positioning - A maximum of three Wrap Levels is permissible. No part of the wrap connection shall extend onto the tapered section of the terminal.

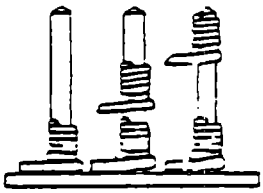
NOT APPROVED

WRAP EXTENDED INTO THE APEX

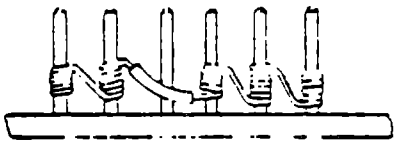
APPROVED

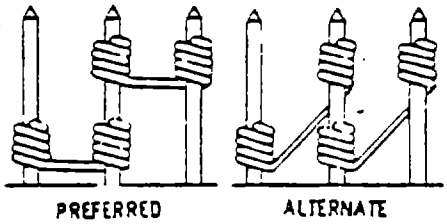


TOP WRAP BELOW WRAP POST APEX



ACCEPTABLE WRAP LEVELS (MAXIMUM 3)



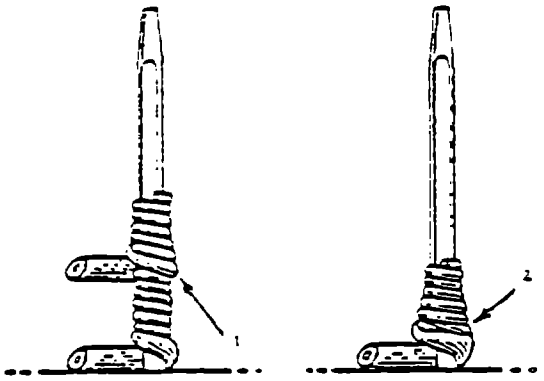


PREFERRED ALTERNATE

E. Overlap and Overwrap of Connections - A connection shall not overlap another wrapped connection except that the end tail of any connection may be overlapped by the first turn of a base conductor.

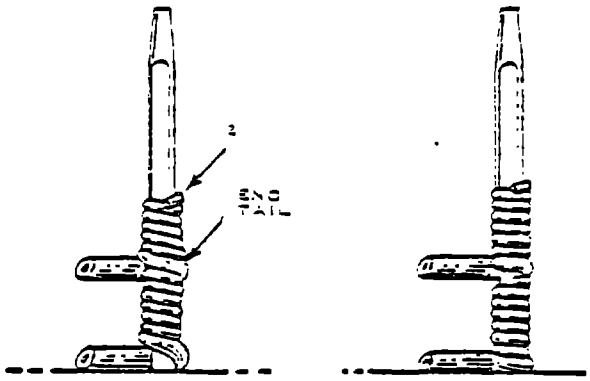
Overwrapping, i.e., a piling up of succeeding turns of wire over one or more previous turns shall not be allowed.

NOT APPROVED



1. Wire overlaps lower connection
2. Wire overwrapped on lower turns.

APPROVED



1. No overlap or overwrapping of turns evident.
2. The end tail of a connection may overlap the adjacent turn provided the overlap does not extend around more than one corner of the terminal.

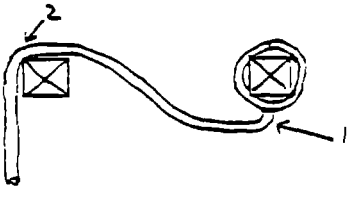
F. Soldering to wire wrap terminals - Solderless wrapped connections and soldered or other connections may be used on the same terminals providing the terminal length for the solderless wrapped connection is free of solder or contamination deposited from the solder process.

G. Wire Dressing of Wire Wrap Wire - The wire shall be dressed in such a manner that it will not tend to unwrap the connection. Wires shall be kept as short as possible, however, there shall be sufficient slack so as to prevent stress on either the wire or terminal.

The routing or dressing of wires on a wire wrap board will be governed by the design. Wires shall be random lay and shall lay within the confines of terminal posts both in vertical and lateral planes so as not to interfere with other boards or mating guide slots.

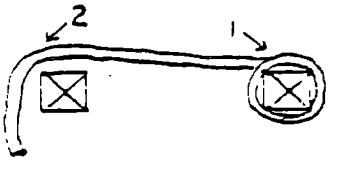
Wires routed around cornering posts shall be dressed away from the post so no tension is placed on the post or the wire. Taut or damaged wires are not acceptable.

NOT APPROVED



1. Tension on the wire would tend to unwrap the connection.
2. Taunt wire around post could damage wire or bend posts.

APPROVED



1. Wire dress from connection in such a manner that unwrapping will not occur when tension is applied to wire.
2. Generous Radius in wire formed away from cornering post.

H. Rewrapping - When a connection does not meet the requirements of this standard or during rework, the wrap will be taken off the post with an unwrapping tool only Never unwrap a conductor by pulling on it and never straighten out a wire and re-wrap it. If wire is of sufficient length, cut off the previously wrapped end and re-strip. Otherwise, replace the entire wire.

Do not attempt to correct a separated wire wrap by pushing down on the wrap. This will affect the Electrical connection.

2.10.4.2 Hand Wire Wrap Procedure.

A. Locate Wrap - posts from the running list. Place a plastic or wire cap on each wrap post. This cap will function to locate wrap posts after wire has been loaded into gun.

B. Using wire from a reel or pre-cut and pre-stripped wire, select proper length wire or strip wire from reel using thermal or precision mechanical wire strippers.

C. Insert stripped wire into the wire feed slot of tool bit until it bottoms. This will insure a wrap with the proper number of turns of insulation and bare conductor. Bend the wire over the shoulder of the gun wire anchor, then slide tool bit over wrap-post until protruding wire bottoms on post or previous wrap level.

See Figure III and IV.

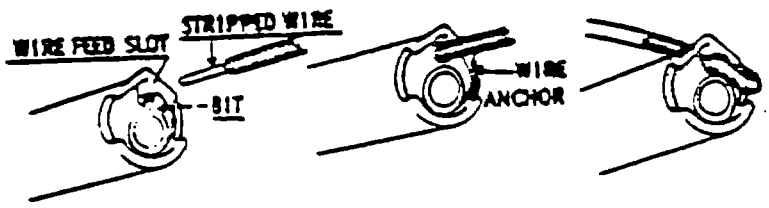


FIGURE III

INSERTING WIRE

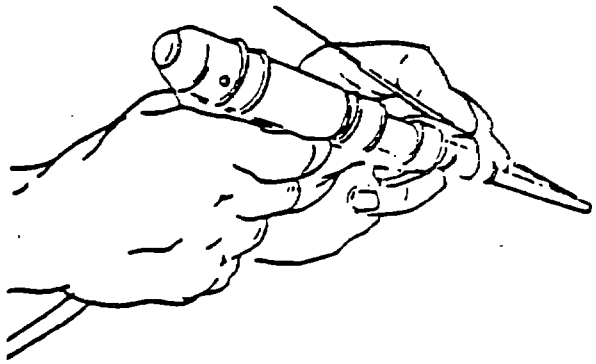


FIGURE IV.

ANCHORING WIRE

D. Making certain the bit is held perpendicular to base of the post to prevent bending or marring the finish of the post, rotate the gun until the wire is pointed in the direction of the second wrap post.

E. Still making certain the bit is held perpendicular to the base of the post, press the trigger. The weight of the gun will provide sufficient pressure to make a qualified wrap.

The wrap-post shall not be turned or twisted more than 10 degrees nor shall it be bent to reduce the air - gap between adjacent uninsulated conductors or posts to less than 0.050".

F. Route wire to second terminal, prepare wire, load gun and wrap per previous steps in this paragraph.

2.10.4.3 Protection and Handling of Wire Wrap Boards. Operations prior to wrapping shall not impair the board (dirt, metal chips, bent pins, contaminates, etc.) to the extent that connections made are not capable of meeting all of the requirements in this standard.

The terminal shall not be subjected to operations that will destroy corner sharpness or basic terminal cross section along the wrapping length.

The terminals shall not be deformed or bent along the wrapping length so as to prevent easy insertion of the terminal into the wrapping tool.

Suitable containers and/or protective material shall be used to transport and store wire wrapped boards.

2.11 Fabrication Criteria for Connectors

2.11.1 All unused holes in hermetic sealing grommets shall have a grommet sealing plug inserted. Drawing will specify size and type of sealing plug to use, where plugs are not normally supplied with connector.

2.11.2 All cable connector back shells and cable clamps and chassis connector jam nuts are to be tightened with connector pliers, spanner wrench or other suitable hand tools.

2.11.3 Where necessary to achieve proper wire bundle support with a general duty cable clamp, bundle diameter shall be built up using insulation sleeving or electrical tape as needed.

2.11.4 If a specific connector orientation is not defined by the drawing, chassis mount connectors shall be oriented with major index toward top of panel or chassis.

2.12 Break Outs.

Breakouts shall be controlled during fabrication and shall provide a minimum of stress on the conductors in the area of the bend.

Where required for protection for subsequent handling or because the conductors exceed the minimum bend radius, tape or other specified means shall be used to support the breakout.

See paragraph 2.5.2 of this standard for stress relief requirements at breakouts and paragraph 2.6.4 for lacing and tieing requirements at breakouts.

2.13 Insulation Sleeving

The type and location of sleeving shall be specified on assembly drawing, except that insulation sleeving from the drawing material list may be added over wire bundles at potential abrasion areas or to provide a flexible bend area of a bundle. When added for these reasons, the insulation sleeving shall be spot tied in place at each end of sleeving.

Selection of the appropriate size sleeving will be accomplished at fabrication and shall be 10 to 30% larger than the mean diameter of the wire bundle.

Cable lacing and ties shall be removed from sleeved areas of cables.

2.13.1 Cable sleeving material may be vinyl thermofit, braided or other approved material listed on drawing parts list. In all cases the sleeving shall extend through the connector strain relief clamping device and be secured under the clamp by use of tape, or build-up of cable diameter as required for a tight fit.

When braided sleeving such as Ben-Har "Expando" is used, it shall be cut using a hot knife or hot blade device in order to fuse the cut strands and eliminate the tendency of braid ends fraying.

Braided sleeving shall be installed with cut ends folded or "cuffed" inside for improved appearancy and to further prevent fraying or damage to cut ends.

2.14 Shield Termination

Shield terminations shall have no sharp edges or frayed shield ends that might abrade, pierce, cut or otherwise damage conductor insulation.

Extreme care shall be exercised that shields are not shorted to the center conductor.

Shield tie jumper wires are to be stranded, insulated AWG 20 black, made as short as practical with a 4" maximum loop and secured into the bundle.

2.14.1 Individual Shields All shields shall be terminated as shown in either Figure V using sleeving per Table 1 or equivalent or per Figure VI. Fig. V is preferred and shall be used for all floating shields or where shields are tied by use of a feed through solder sleeve. Figure VI is an alternate method and may be used for a termination and tie point in certain areas where space is limited.

2.14.1 (CONT.)

TABLE I

SHIELD TERMINATION COVER

WIRE SIZE	PART NO.
SCS 22	1/8 RNF-100 TUBING
SCS 20-16 TCS 22-20	3/16 RNF-100 TUBING
TCS 18-16 T3S 22-20	1/4 RNF-100 TUBING
T3S 18-16	3/8 RNF-100 TUBING

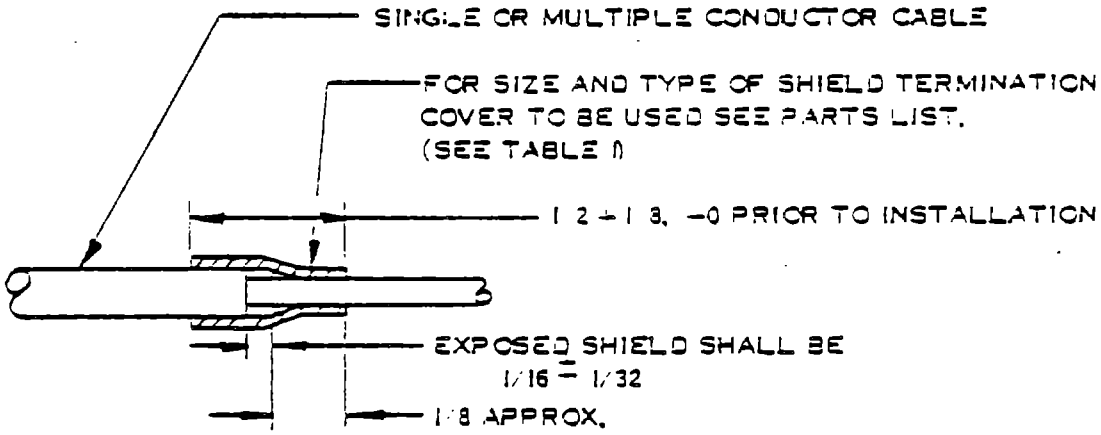


FIGURE V - SHIELD TERM. COVER (PREFERRED)

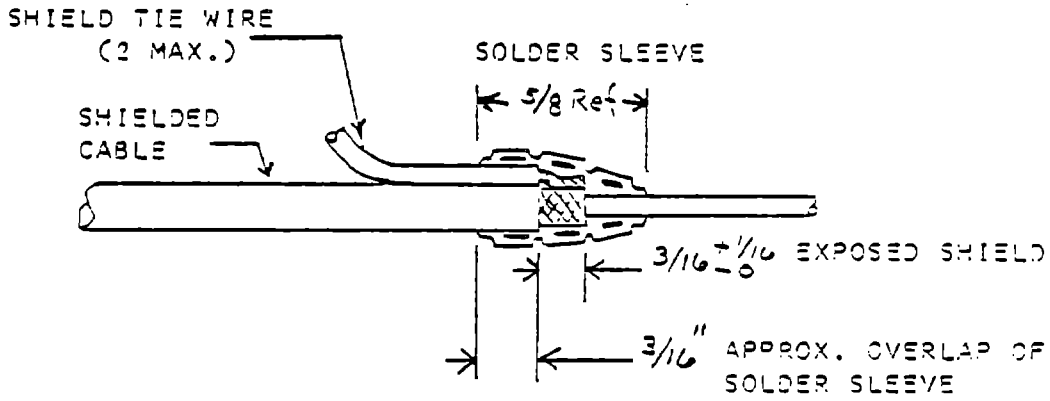


FIGURE VI
SOLDER SLEEVE TERMINATION AND TIE POINT
(ALTERNATE METHOD)

2.14.1.1 Shield tie wires shall be tied to single or multi-conductor shielded cable using solder sleeves installed as shown in Figure VI or Figure VII. Figure VII is preferred method

Solder sleeves at terminal boards shall lie in the main run of the harness and shall lie a minimum of 3/4 inch to a maximum of 1 1/2 inches from the first breakout for multi-conductor cable. For single conductor cable the shield shall be terminated 1/2 to 5/8" from aft edge of the terminal lug.

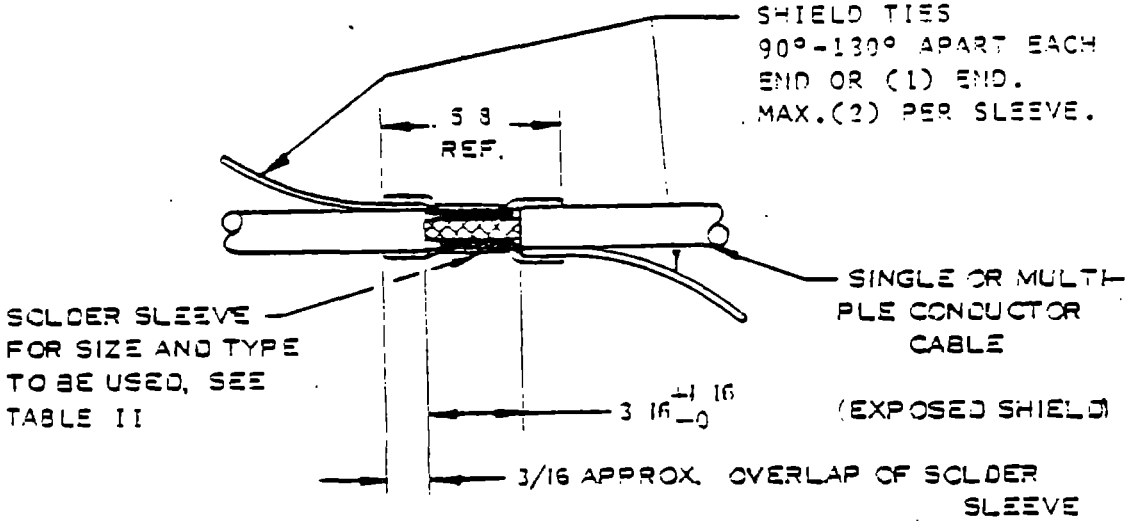


FIGURE VII.

Solder Sleeve Installation Detail

TABLE II. SOLDER SLEEVES

WIRE SIZE	PART NO.	COLOR
SC	RAYCLAD TUBES D100	Blue
S2S 22-16 T2S 22-20	RAYCLAD TUBES D101	Blue
SCS T2S T3S T4S	RAYCLAD TUBES D103	Blue

2.14.1.2 Individual Shields. For solder type connectors and crimp type connectors without environmental grommets unless otherwise specified on the Detail Drawing, shields of single conductor shielded cable shall be terminated within 3/8" max. from aft edge of solder cup or contact.

Shields of multi-conductor shielded cable shall be terminated a maximum of 1" from aft edge of solder cup or contact for strain relief or unpotted connectors or 3/8" for potted connectors.

Shield ties shall be feed through solder sleeves per Figure VII as a preferred method, and staggered 1 to 5" from solder cup or contact. End of shield solder sleeve shield tie and termination per Figure VI is acceptable only when defined by drawing or required because of limited space.

See Figure VIII for individual shield installation for solder connectors and crimp connectors without environmental grommets.

2.14.1.2 (CONT.)

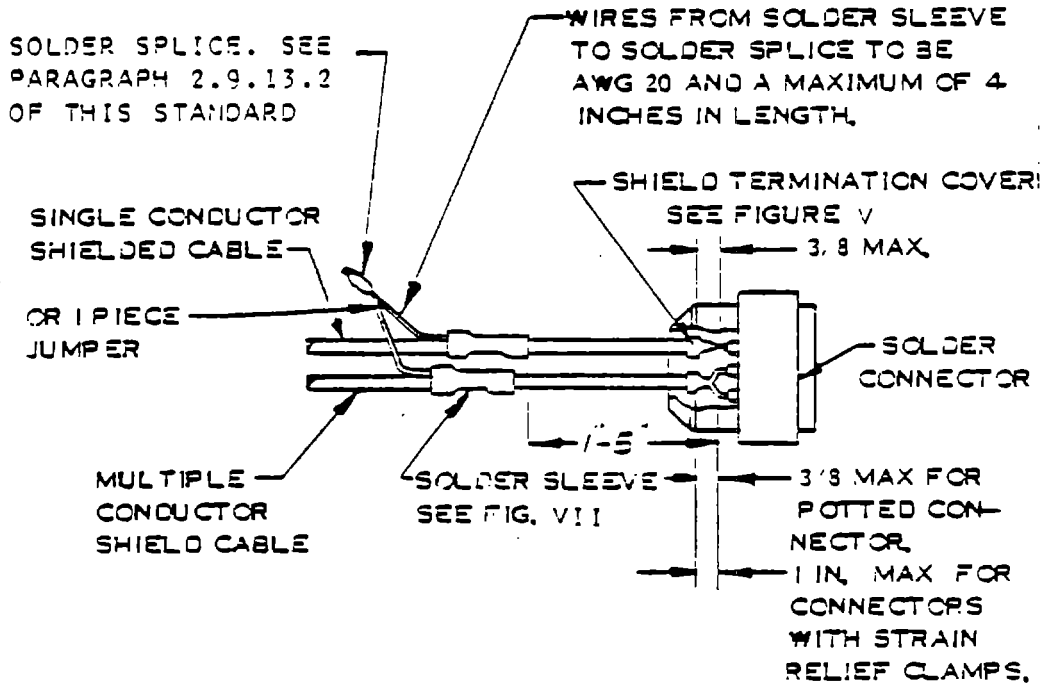


FIGURE VIII

SOLDER CONNECTORS
& CRIMP CONNECTORS WITHOUT
ENVIRONMENTAL GROMMET

2.14.1.3 Individual Shields. For Crimp Connectors with environmental grommet, unless otherwise specified on detail drawing shield shall be terminated within one inch of rear surface of environmental grommet when grommet is in assembled position. Shield ties shall be feed through solder sleeves per Figure VII and staggered 2 to 5 inches from the contacts. See Figure IX for individual shield installation for crimp type connectors with environmental grommet.

2.14.1.3 (CONT.)

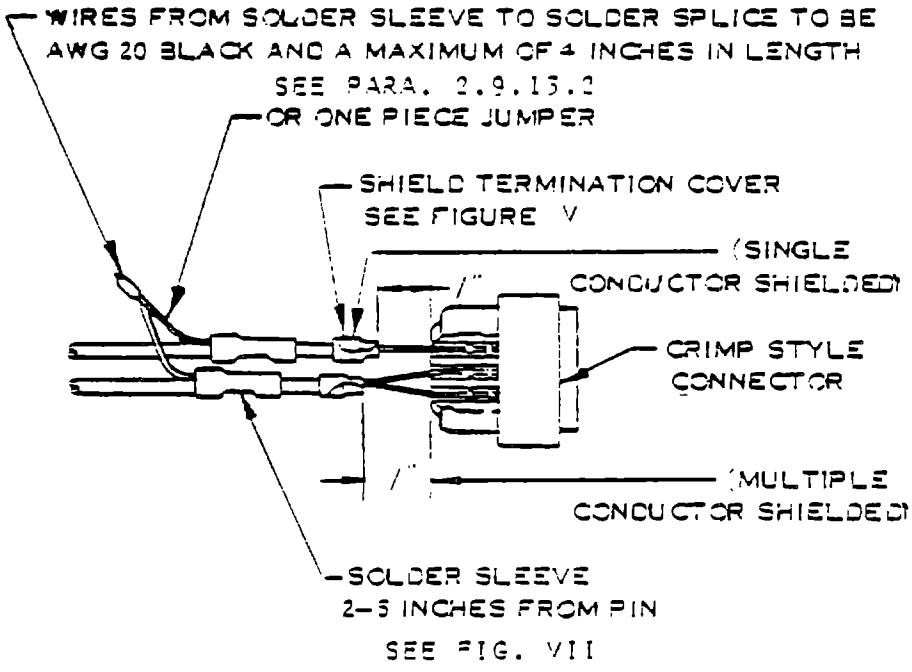


FIGURE IX

CRIMP CONNECTORS WITH
ENVIRONMENTAL GROMMET

2.14.2 Shielding Groups of Conductors. When specified by drawing, groups of unshielded conductors shall be shielded using copper braid and shrink sleeving or tape per the drawing list of materials per Figure X. Termination and/or shield ties shall then be installed per applicable parts of paragraph 2.14.1 of this standard.

2.14.2 (CONT.)

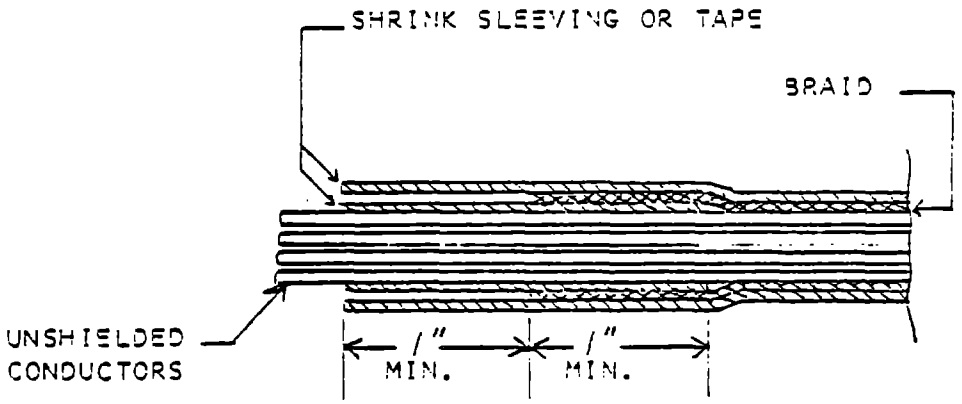


FIGURE X

SHIELDING UNSHIELDED CONDUCTORS

2.14.3 Shielding Cables or Bundles. When specified by Drawing, overall shielding of Cables shall be accomplished by installing copper braid of appropriate size to stretch snug on the wires and shrink sleeving or tape per drawing list of materials. The complete length of exposed braid shall be covered with insulation sleeving per Drawing list of materials.

Overall shielded Cable terminations and/or shield tie shall be installed per manufacturer's recommendation when using RFI adapters or as defined by the drawing.

Overall shielded Cable terminations and/or shield tie shall be installed per Figure XI when using non-RFI type connectors or adapters.

2.14.3 (CONT.)

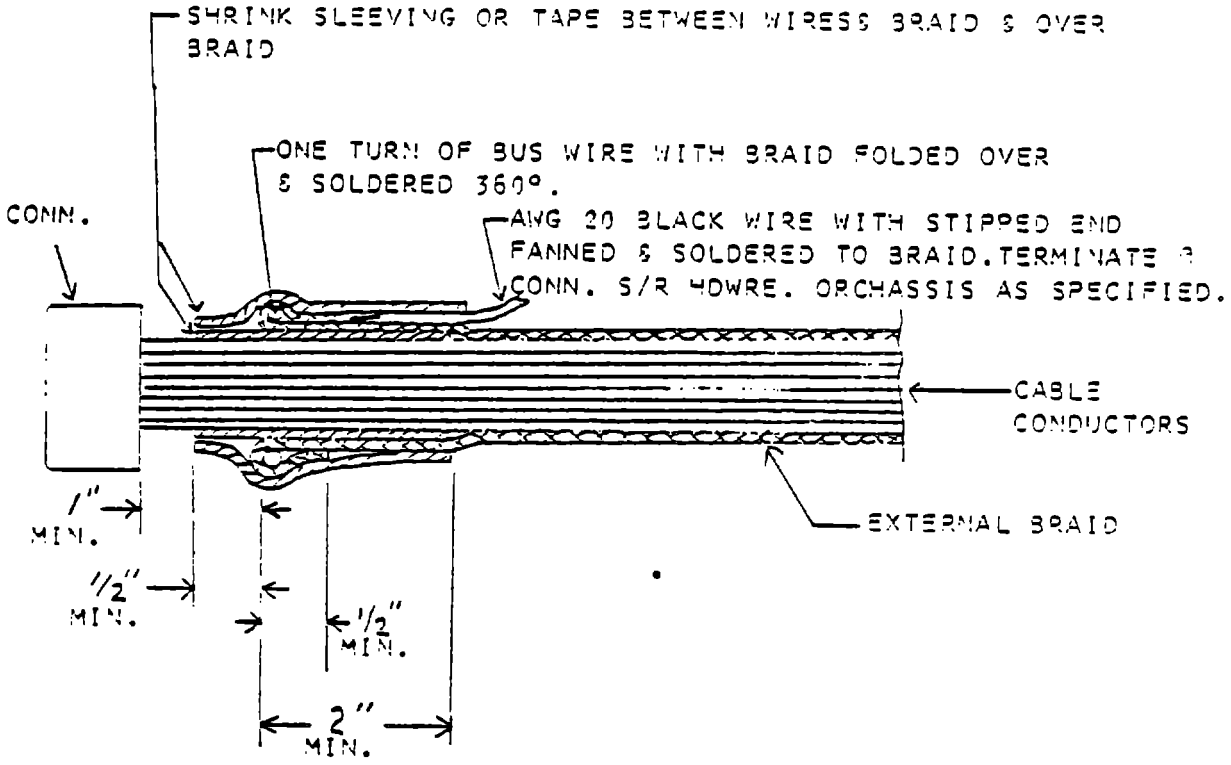


FIGURE XI

SHIELDED CABLE TERMINATION

2.15 Potting

2.15.1 Potting. Connectors that can be potted shall be potted only when specified on drawing.

2.15.2 A sealer shall be used when potting connectors with floating pins.

2.15.3 A release agent shall be used when the potting boot is to be removed after cure.

2.15.4 The first several ties from rear of potting boot shall be installed only after potting has cured.

2.15.5 Where density of wires permits, each wire shall be sufficiently separated from all others to permit complete encapsulation by potting at the point of termination.

2.15.6 The top of the potting shall be within 1/16 inch of the top of the cup (either above or below). This restriction does not apply to the fillet of potting around the wires. (See Figure XII). Fillet due to meniscus may rise an additional 1/16 inch.

2.15.7 Bubbles and voids shall be acceptable except in the following cases:

a. A bubble or void on a soldered connection.

b. One bubble or void touching two (2) or more wires. This restriction does not apply to any bubbles which are on the surface of the potting.

2.15.8 Contact alignment shall be maintained during potting by installation of a mating connector to those connector types having floating pins (e.g. Cannon "D" connectors).

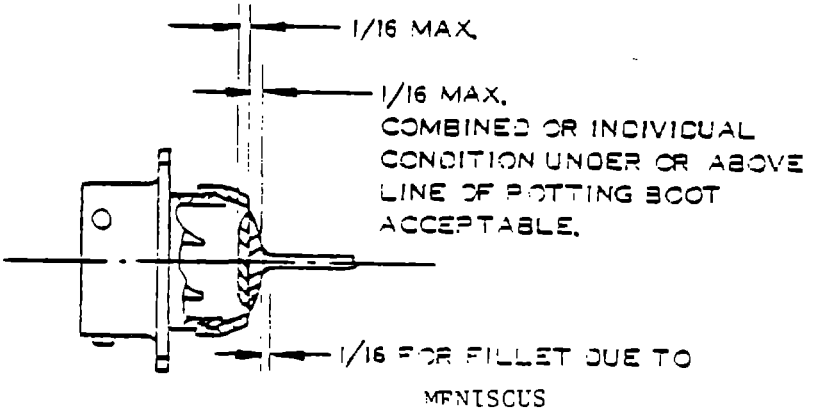


FIGURE XII.

2.16 Coaxial Cable Assemblies

All Coaxial Cable terminations shall be prepared and assembled per the connector manufacturers instructions.

Extreme caution shall be exercised to prevent nicks or damage to the cable shield, dielectric or center conductor strands.

2.16.1 Flexible Coaxial Cable Assemblies

The cable end shall be prepared in accordance with connector manufacturers instructions to assure correct dimension of exposed braid, dielectric and center conductor. The shield braid must be trimmed clean to correct dimension with no loose strands remaining after fanning as required. See Figure XIII-A.

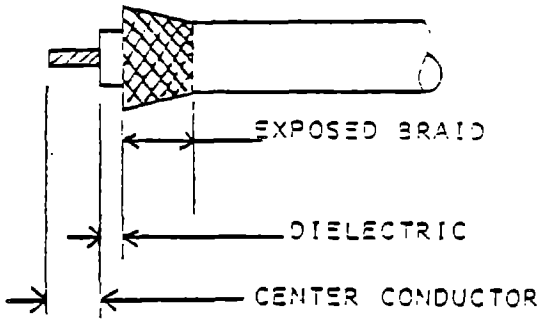


FIGURE XIII - A
COAXIAL CABLE END PREPARATION

All connector parts shall be assembled to coaxial cable per manufacturers instructions in proper sequence. Solder connections shall be made to insure good solder melting with no flux residue evident and with no solder spill or buildup. Crimp connections shall be made using connector manufacturer's recommended tooling. The finished assembly, shall show no damaged, fractured or bent connector parts.

2.16.1.1 Solder sleeve coax terminations, such as Raychem Coax terminations, may be used to terminate coaxial cable at standard connector contacts. Exposed Coaxial Cable shield and center conductor to be approximately centered in solder rings per Figure XIII-B. The black wire of solder sleeve coax termination device to be in the solder ring with coax shield braid and the white wire in the center conductor solder ring. The overall length of leads out of the termination to be 1" max unless otherwise specified.

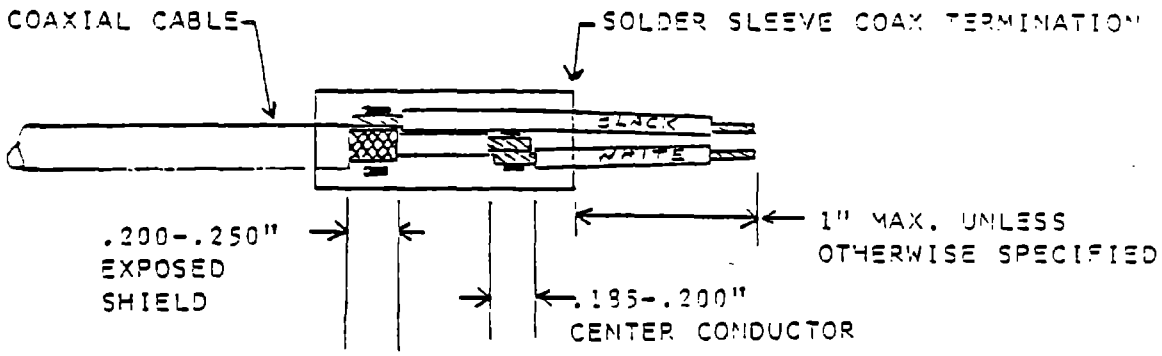


FIGURE XIII-B
SOLDER SLEEVE COAX TERMINATION

2.16.2 Semi Rigid Coaxial Assemblies.

All semi-rigid coaxial cable shall be straight before using. There shall be NO wrinkles, kinks or surface damage to the outer jacket. Any attempts to remove bends by hand straightening will result in wrinkles or kinks to the outer jacket.

2.16.2.1 Semi Rigid Coaxial Cable Forming. Cable shall be formed to correct configuration using the proper bending tool to control bend radius and prevent wrinkles and twisting in outer jacket. Care shall be taken not to overbend because attempts to remove part of a bend will result in outer jacket wrinkling. The cable should be routed the most direct route possible with minimum degree and quantity of bends. (See para. 2.16.2.5) Preferrably, cable assemblies should be bent and formed by duplicating a "Mock-Up" assembly fabricated for that purpose.

After proper cable form and fit is assured, cable ends shall be cut off 1/4" to 1/2" longer than required finish length using AMP cable cut-off fixture No. 307053-2 and No.0 jewelers saw. When required by drawing, semi-rigid cable shall be pre-conditioned per Para. 2.16.2.2.

2.16.2.2 Pre-conditioning Requirements for Semi-Rigid Coaxial Cable.

Semi-rigid coaxial cables shall be pre-conditioned in accordance with the following procedures after final forming and prior to installation of connectors:

(a) cables shall be preformed to design configuration and shall allow a minimum of 0.25 inches on each cable end beyond the design dimensions. Trim cable dielectric flush with the edge of outer conductor;

(b) the pre-conditioning procedure consists of a minimum of four of the following temperature cycles:

2.16.2.2(CONT.)

1. Heat the cable to + 120°C and maintain at this temperature for one hour min.

2. Return Cables to room ambient temperature and maintain one hour min.

3. Cool cables to -45°C and maintain for 1 hour min.

4. Return cables to room temperature and maintain 1 hour min.

NOTE: After step 1 of the third temperature cycle, measure the protruding dielectric or jacket, then complete the cycle. After completion of the fourth cycle, should the change in dielectric protrusion or recession be greater than .005 inches, the temperature cycling shall be continued until the change in dielectric protrusion or recession is less than .005 inches. After the last temperature cycle, the dielectric shall be trimmed flush with the edge of the outer jacket. Where measurements are required, record the changes in length of dielectric.

(c) After the last temperature cycle, maintain the cables at room temperature for 24 hrs. minimum before proceeding with further processing.

2.16.2.3 Solder type Connector Assembly Procedure (ARM, OSM, SRM Series) - Ref OSM Tool Set T200/500.

(a) Trim cable to proper length using AMP cut-off fixture #307055-2.

(b) Finish the cable end using modified Omni-Spectra T-4367 fixture. Insert cable end in proper fixture hole, place jeweler saw in adjacent slot and saw through copper sheath while slowly rotating the Cable. See Figure XIV.

Remove copper jacket by gripping the cable at cut end with thermal strippers, pulse heat to cable and pull off copper jacket with a slight twisting motion.

Carefully cut down through dielectric with an Xacto knife to center conductor; crush dielectric around its circumference with flat part of long nose pliers and carefully pull off dielectric stub.

2.16.2.3(CONT.)

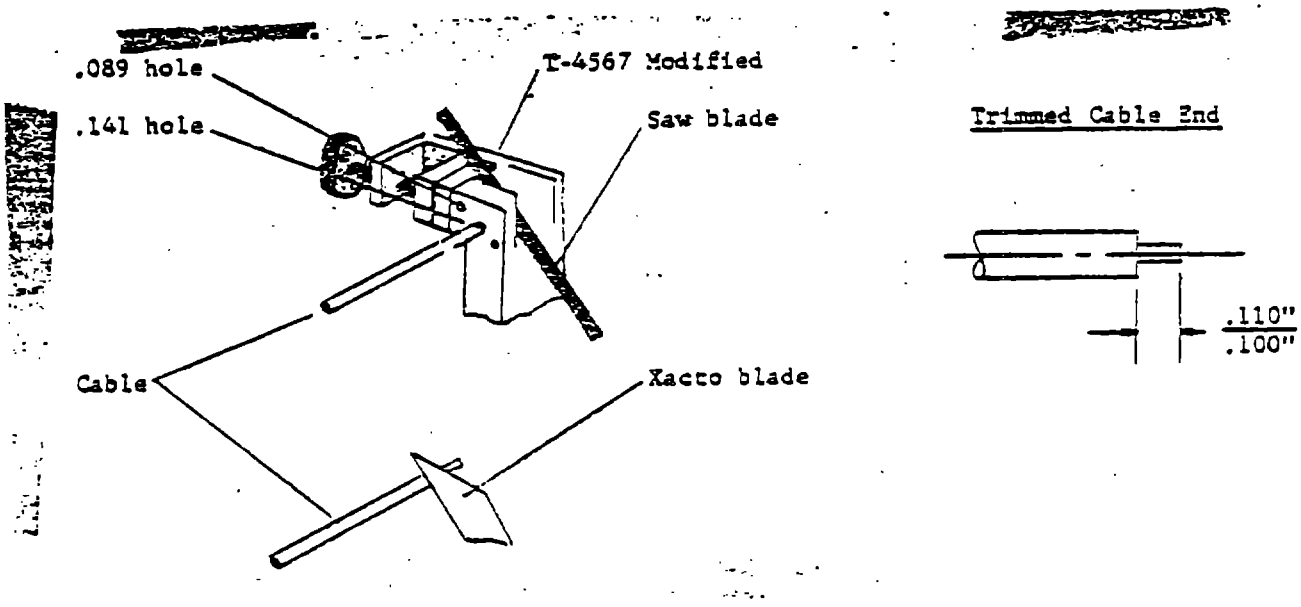


FIGURE XIV

CABLE END PREPARATION

(c) Final trim the prepared cable end using AMP trimmer tool #220047-1 and 400 grit garnet paper. Brush off all metal chips from dielectric. Visually examine the trimmed cable end for burrs, copper embedment in teflon, dielectric and for conductor straightness.

(d) Tinning the inside of connector shell - (Remove dielectric bushing and save) - Set up a hot plate to obtain 525°F. When hot plate has attained 525°F, set the rear end of connector shell on hot plate. See Fig. XV. Apply a nominal amount of liquid flux to area to be tinned.

2.16.2.3(CONT.)

Tin the inside rear end of the shell thoroughly, but do not tin past the ring inside the shell.

Remove the connector from hot plate with a pair of pliers and allow to cool. Wick out the gold from connector using braid (Wik-it) coated with liquid flux while pulsing heat to thermal strippers holding connector shell. See Fig. XVI.

After connector shell has been wicked and excess solder buildup removed, clean thoroughly with isopropyl alcohol and soft bristle brush.

Visually examine the connector shell to assure it has uniform tinning on inside with no voids or evidence of flux residue, and is free of contamination.

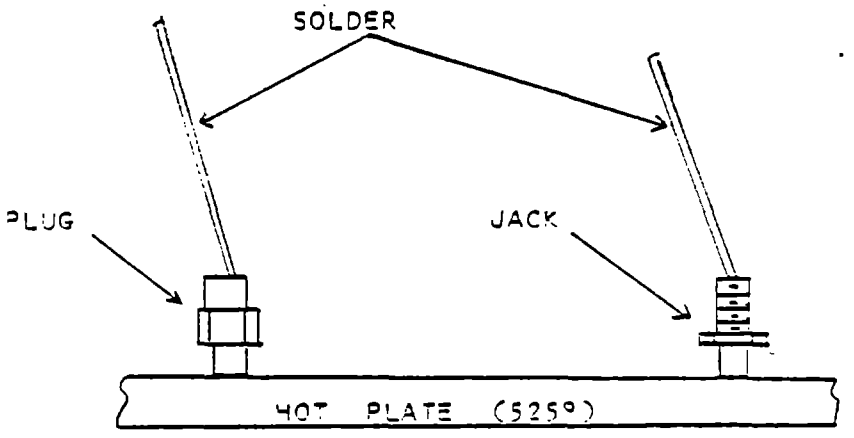


FIGURE X V

TINNING INSIDE OF CONNECTOR SHELL

2.16.2.3(CONT.)

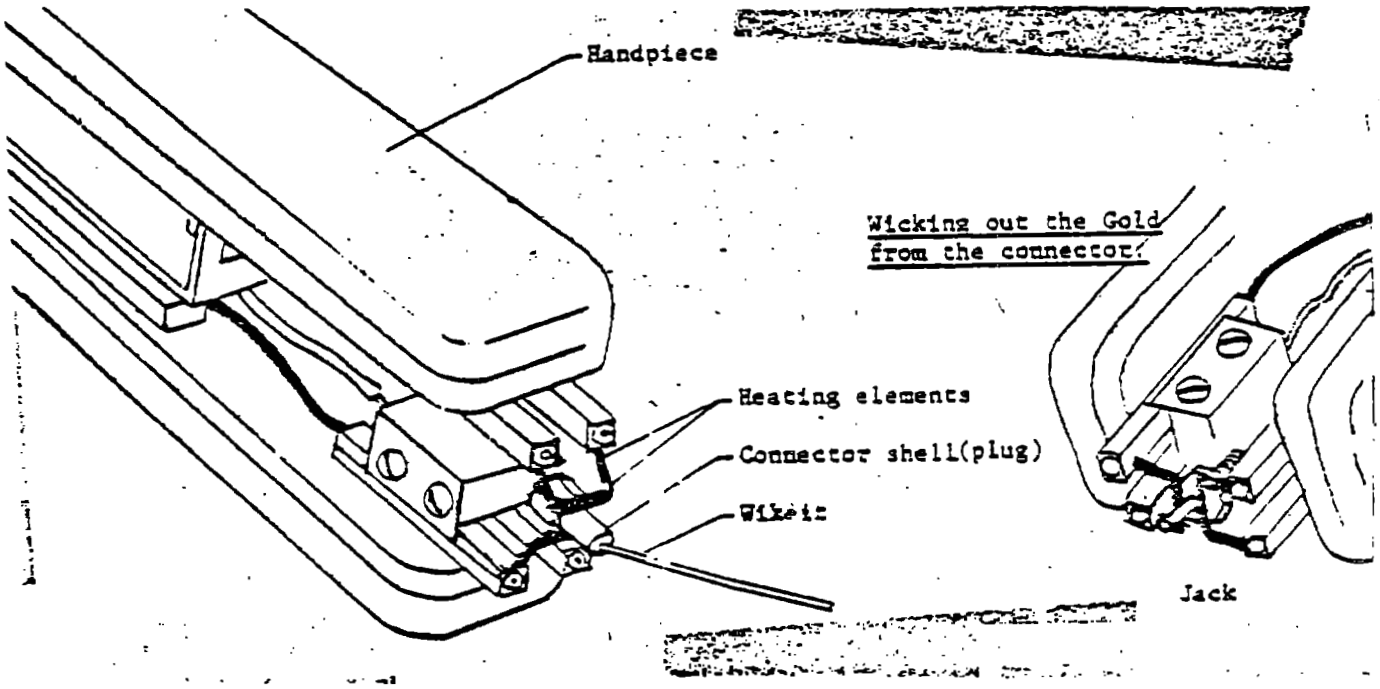


FIGURE XVI

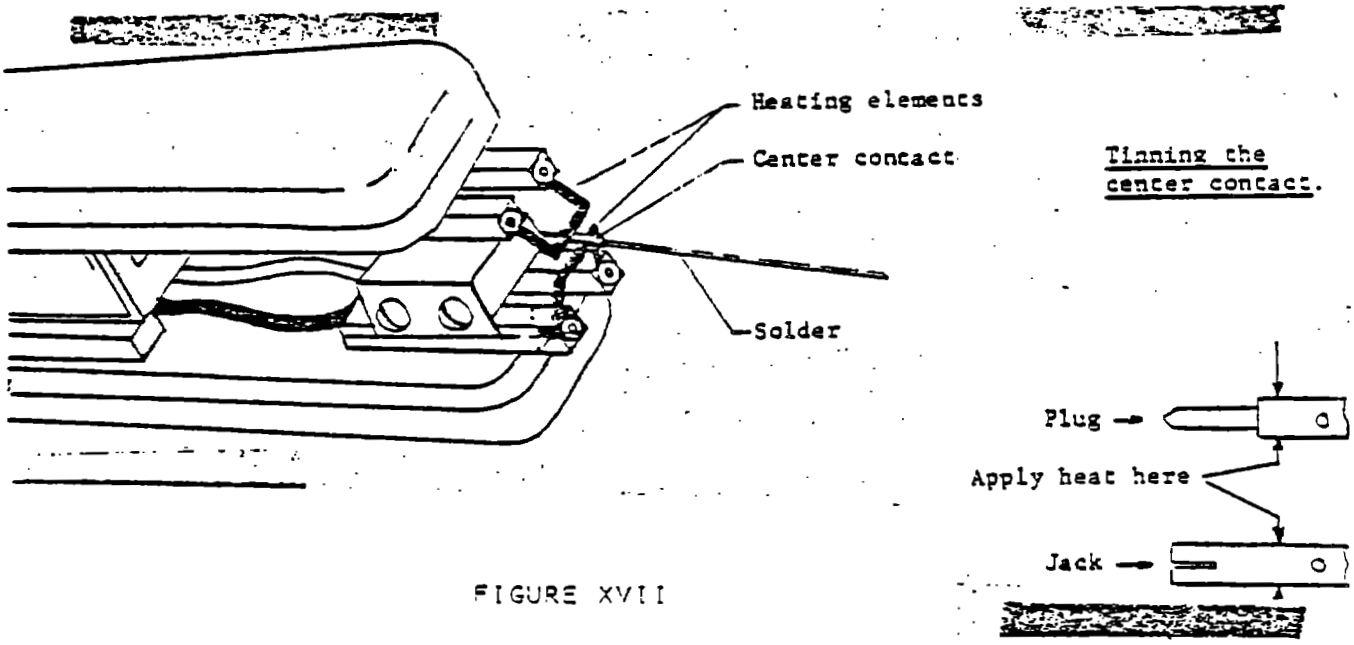


FIGURE XVII

2.16.2.3 (e) Tinning the center contact - Using thermal strippers, set the temperature control to obtain only the heat necessary for tinning. Hold the barrel of the center contact with the thermal strippers, pulse heat to the contact and tin the inside of the contact with .020" dia. solder. See Figure XVII. Wick the gold from inside contact using stranded AWG 22 silver plate wire. Clean, then add 1/16" .020 solder. Visually examine to insure that the center contact is uniformly tinned on the inside and that the outside of the contact is free of solder buildup.

(f) Tin the center conductor of the cable using a 1/8" conduction soldering iron and .032 diam. solder. Use care not to melt or sear the dielectric with the tip of the iron. Clean with isopropyl alcohol.

(g) Soldering the center contact to the cable inner conductor - See Figure XVIII, or alternate step (h) Figure XIX. Secure the cable centrally in the Omni Spectra T-4567 fixture. Place the solder gauge on the inner conductor so it is flush with the dielectric. Insert the center contact in the T-4578 holder and place the holder in the fixture to align with inner conductor. Heat the center contact with a resistance soldering iron by pulsing heat to it and carefully push the contact over inner conductor until it rests firmly against the solder gauge. Add solder if required, but do not allow solder to be deposited on the outside of contact barrel. Allow the solder to cool, then remove from fixture. If required, trim the cable dielectric flush with copper sheath and shave off any solder buildup from perimeter of center contact. Clean thoroughly with isopropyl alcohol.

2.15.2.3(CONT.)

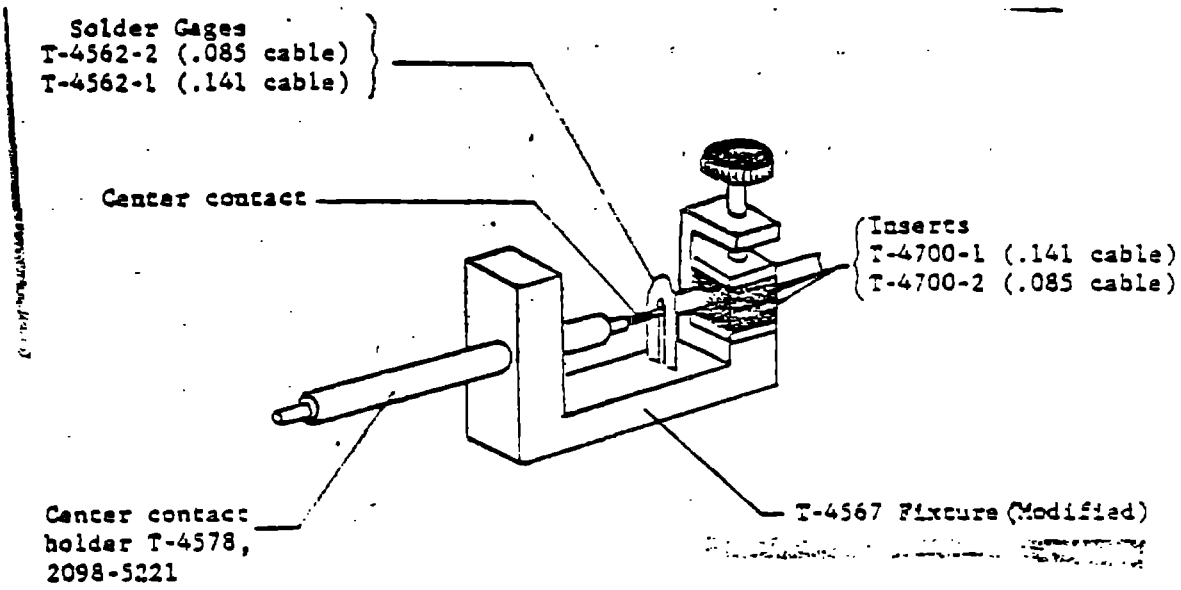


FIGURE XVIII

(h) If the T-4567 fixture cannot be used because of Cable bends, an acceptable alternate method is to pulse heat to the contact held in thermal stripper elements and position and solder to inner conductor supported in a bench vise with suitable blocks per Figure XIX.

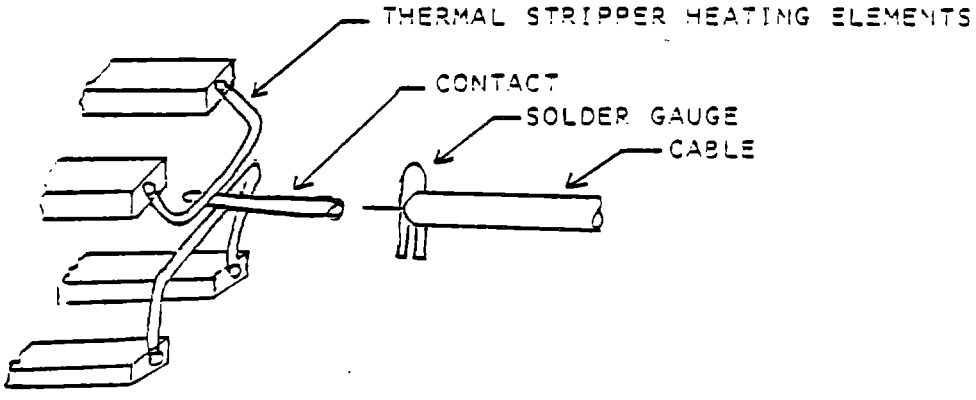


FIGURE XIX

8.16.2.3(CONT.)

(i) Soldering the connector shell to the Cable - See Figure XX.

NOTE: If Omni Spectra T-4367 Fixutre cannot be used, this operation shall be done per step (j) of this paragraph.

Abrade the copper jacket for a length of 1/2" using 400 grit garnett paper. Clean cable end with isopropyl alcohol. Place connector shell on cable, making sure center contact is axially straight, nest the center contact in the locator tool. Tighten the knurled screw to secure the cable between inserts. Tighten the location tool to seat the cable firmly. Clamp the fixture in bench vise. Slide the shell over the nose of locator tool. Apply a nominal amount of flux to area to be soldered. Grip the barrel of the shell with resistance iron adjacent to area to be soldered. While pulsing heat, apply .032 diam. solder carefully to junction of shell and cable. Wipe the solder lightly around the junction to form a smooth 360° joint. Remove assembly from fixture and clean inside and outside with isopropyl alcohol and soft bristle brush.

2.16.2.3(CONT.)

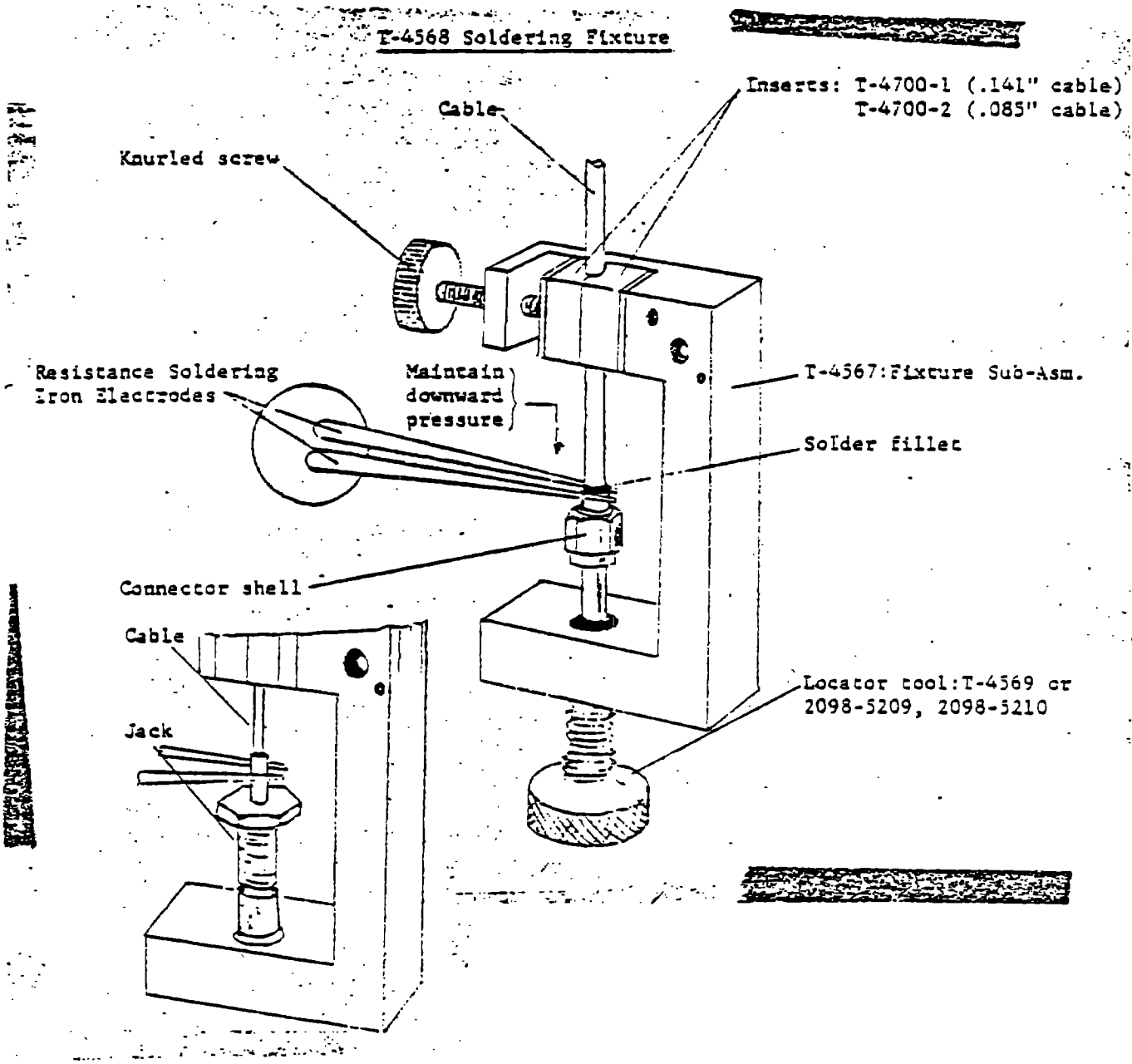


FIGURE XX

2.16.2.3 (j) Alternate method of soldering the connector shell to Cable - Place locator tool T-4569 in a bench vise per Figure XXI. Position the loose assembly so center contact nests in the location tool. Slide the shell over the nose of locator tool. Grip the connector shell with resistance soldering iron adjacent to the solder area. Apply liquid flux. Pulse heat and apply solder to flow 360° around the junction. Clean with isopropyl alcohol.

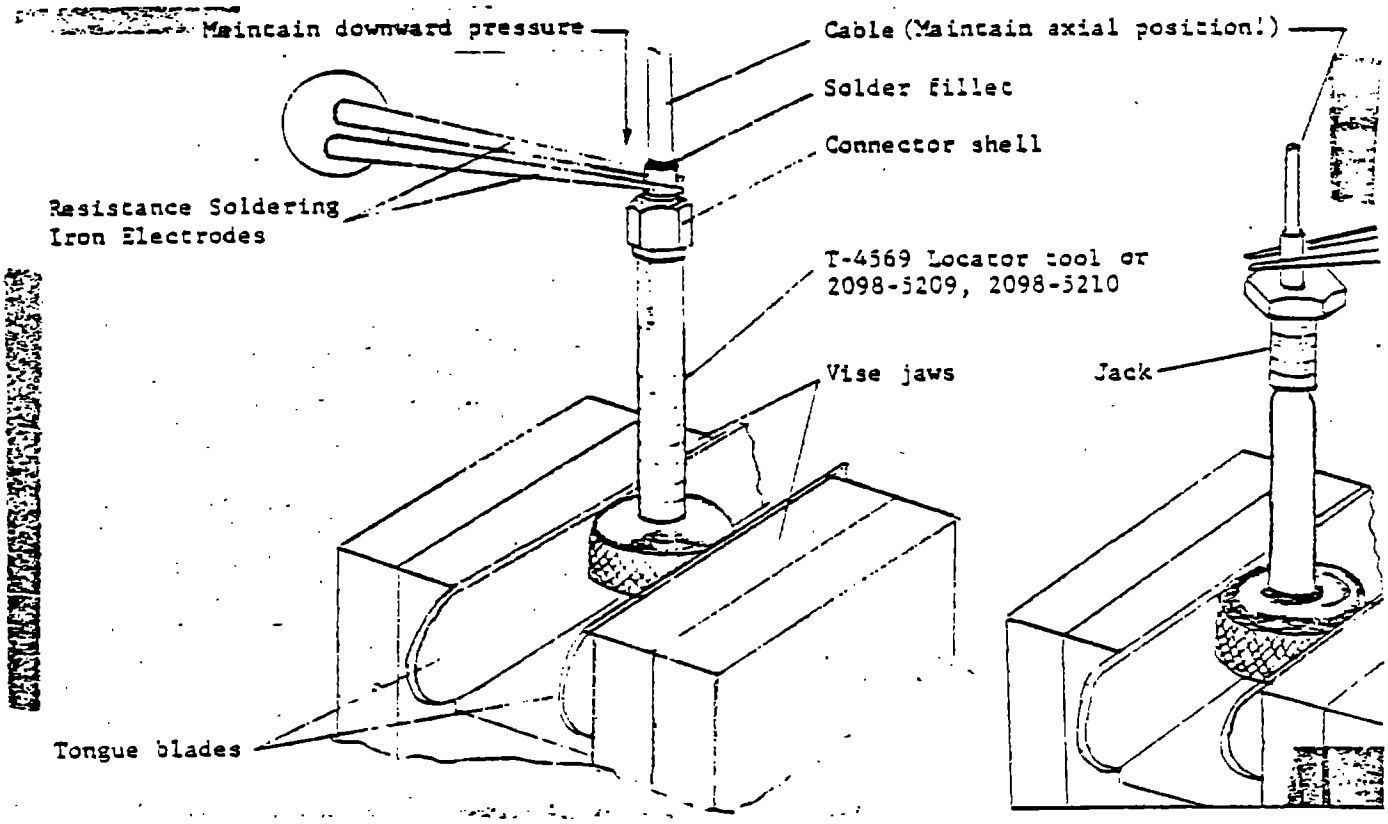


FIGURE XXI

2.16.2.3(CONT.)

(k) Insert the dielectric bushing into the connector using Omni Spectra T-4554 or T4551 or Americon 2098-5214 or 5215.

(l) Assure center contact not bent and is positioned .030 $^{+015}_{-010}$ below connector face.

2.16.2.4 Crimp Type Connector Assembly Procedure (AMP)

(a) Cut cable square to final design length using AMP #307055-2 cut off fixture and jewelers saw. See Figure XXII.

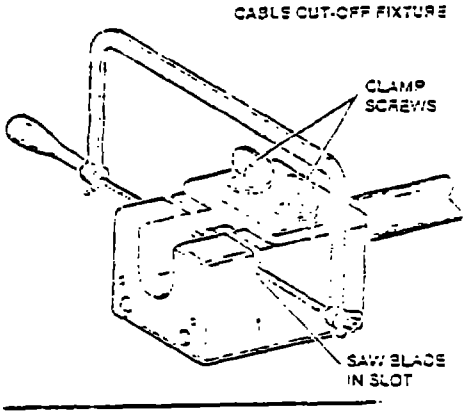


FIGURE XXII

(b) Dress cable end by placing in cable dressing fixture #220134-1. See Figure XXIII. Saw through jacket while slowly rotating cable. Remove cable from fixture and use Xacto knife to cut through and remove dielectric to expose center conductor.

2.15.2.4(CONT.)

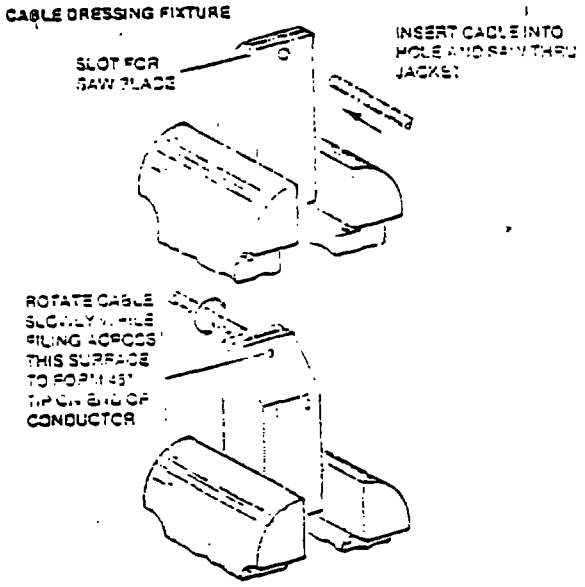


FIGURE XXIII

Trimmer tool #220047-1 is now used to smooth end of copper sheath and dielectric by pushing lightly and revolving clockwise 2 or 3 complete revolutions. Remove tool and clean away any chips. Cable is then inserted into dressing fixture again to file end of center conductor on 45° surface using small pillar or mill file. Remove from fixture and brush away all chips.

(c) Knurl the end of cable using knurling tool #220126-1 by bottoming cable end in tool and making 2 or 3 complete revolutions with tool.

2.16.2.4 (CONT.)

(d) Set up hand crimping tool #220130-1 with proper locator from staker and locator kit #220131-1 per manufacturers instruction sheet.

Caution: Be sure locator is properly installed. When pushed approx. 1/4" into tool, it should return under spring pressure.

Alternate: Set up pneumatic crimping tool #220127-1 per manufacturers instruction sheet.

(e) Crimp connector to Cable - Insert prepared cable into connector. Be sure cable is bottomed in Conn. Open tool handles, position connector on locator, close handles while applying pressure on cable against locator. See Figure XXIV for hand crimp tool.

For alternate pneumatic crimp tool, crimp connector to cable per manufacturers instruction sheet.

After making sure stakers will enter end of connector, close handles until certi-crimp ratchet releases. Open handles and remove terminated part.

(f) After crimping, assure center conductor not bent and is positioned .030 $^{+.015}_{-.010}$ below connector face.

2.6.2.5 Semi Rigid Coax Cable Support. Semi rigid cable should be clamped or supported approx. every 12" or as required to prevent vibration or damage during operation or transporting. Install tie blocks or standoffs as required or route cable over existing rails or tie points. Secure using cable clamps, ty-wraps or suitable tie down devices as specified.

2.15.2.4(CONT.)

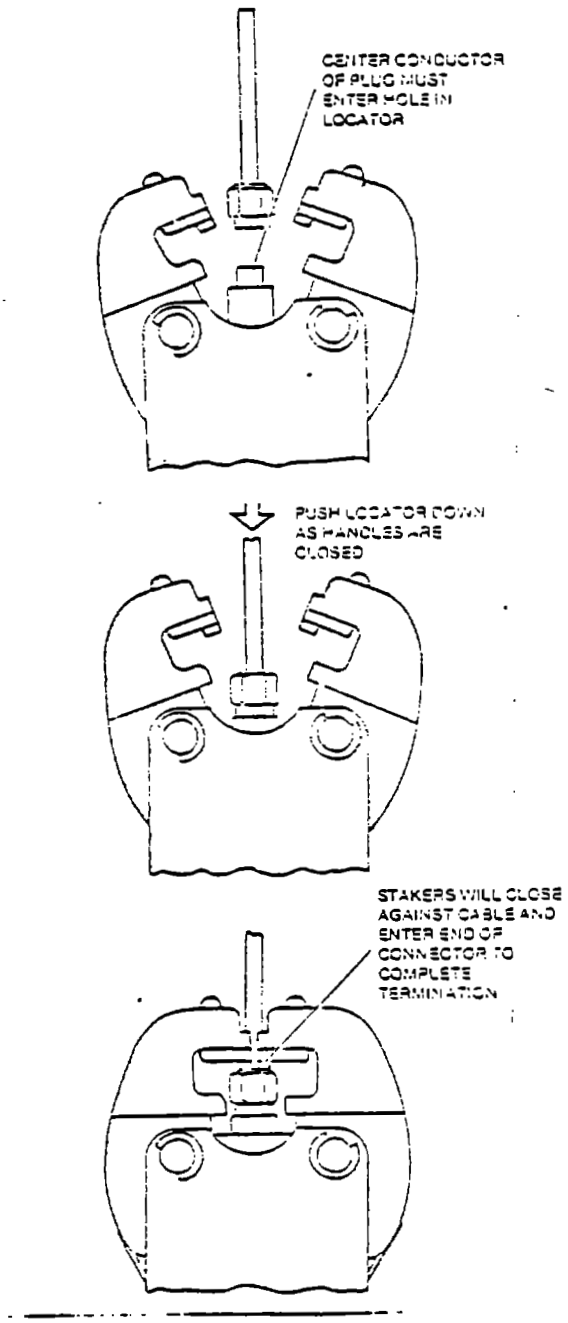
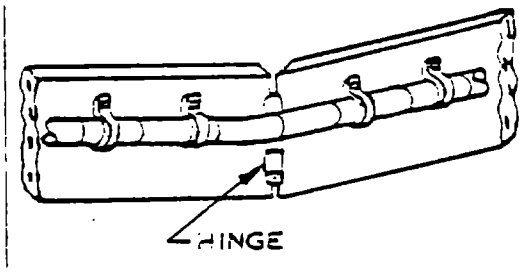


FIGURE XXIV

2.17 HARNESS INSTALLATION AND SUPPORT

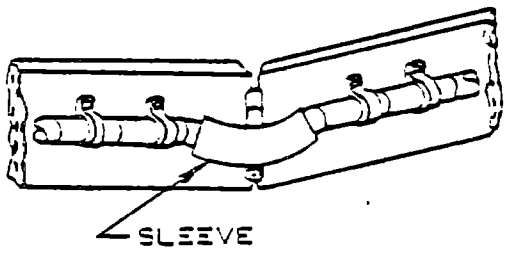
2.17.1 Sufficient Manpower and mechanical aids shall be employed to assure complete protection to the harness during installation and removal from the console.

NOT APPROVED



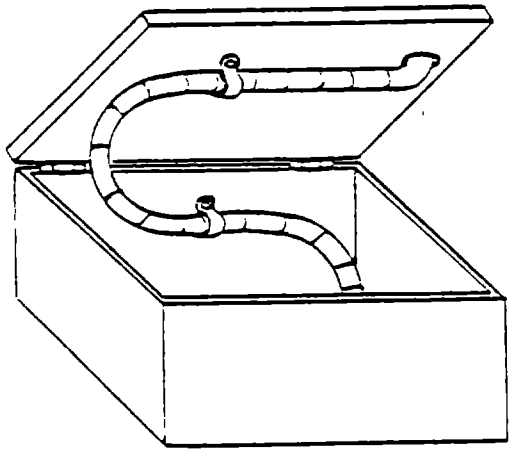
CABLE ROUTED BETWEEN MOVABLE HINGED PARTS WITHOUT SLACK OR PROTECTIVE SLEEVE

APPROVED



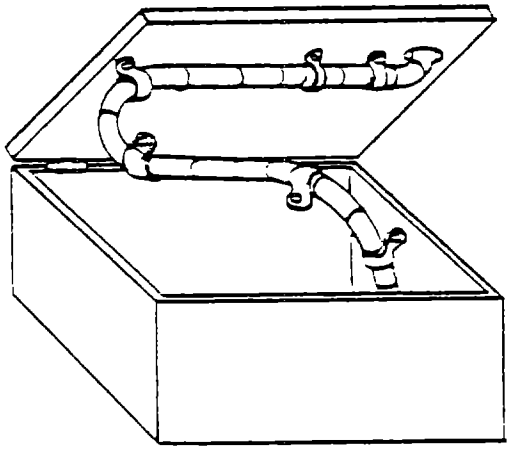
CABLE HAS SUFFICIENT SLACK & PROTECTIVE SLEEVING TO PREVENT BREAKING OR CHAFING CABLE.

NOT APPROVED



SHORT BEND ON HINGED DOOR

APPROVED



CABLE PARALLEL TO HINGE AXIS

WHERE POSSIBLE TWO CLAMPS SHOULD BE USED ON BOTH SIDES OF HINGE.

2.17.2 Clamping of harness will be in such a sequence as not to induce any strain during installation or when connectors are mated.

2.17.3 Tape or sleeving will be employed in areas susceptible to chafing. Areas requiring protection will not necessarily be specified on drawing.

2.17.4 Harness clamps and/or supporting devices of a suitable size and shape will be used to hold the wire bundles securely in place without damage to the insulation. Where tape or other protection is required under the clamp it shall be used. Type of clamp will be as specified by the drawing. Size and location of clamps will be determined at assembly to provide adequate support. Particular areas requiring special clamping will be identified by the drawing.

2.18 HARNESS HANDLING.

Harnesses shall be handled with the same respect shown all other electronic components.

During transportation and storage, the harnesses shall be secured to prevent strain on connectors or preformed bends. Connectors shall be mated and demated by handling the connector only. Do not pull the harness bundle to remove a connector. Do not use unauthorized tools to mate or demate connectors. Do not hang T boxes, etc. from a connector or harness without supporting the weight. Do not twist or flex connectors in attempting to locate a fault. Loosen the ties around the connector and move the suspect wire only.

2.19 Drawing Interpretations

2.19.1 General

Unspecified features of the design drawings, such as bend radii, shield terminations, lay, splices, protective sleeving, lacing limitations, twist location and extent, alternate materials, etc., shall meet or exceed the minimum requirements specified in this document.

2.19.2 Dimensions

2.19.2.1 Cable Length - Unless otherwise specified, cable lengths shall be measured from connector face to connector face except where right angle connectors are used the dimension will be to the outermost extremity of the connector case.

3.0 REQUIREMENTS - FABRICATION AND ASSEMBLY

3.1 General

High quality fabrication and assembly techniques are imperative to assure reliability & expected life. The purpose of this section is to assure that fabrication and assembly is accomplished in a uniform fashion and is of high quality.

3.1.1 Precedence of Conflicting Requirements. (See para. 2.1.1)

3.2 Parts Size Selection Authorization

Except as identified in the following paragraphs, only those parts and materials specified by the Design drawings will be used. Deviations in parts or material beyond those specified will be acceptable only if covered by a drawing change.
variation authorization.

3.2.1 Cable Clamps, Electrical

A clamp one dash size larger or smaller than that specified on the drawing will be allowed if required.

NOTE: Normally the design drawing will specify the cable clamp type followed by part AR (i.e., as required) (providing the clamp is within the range of sizes normally stocked). Under these circumstances the proper size clamp will be selected in accordance with paragraph 2.17.4.

3.2.2 Screw Lengths

Screws or bolts shall extend at least the full chamber plus 1 1/2 threads through any nut, but protrusion should not exceed chamfer plus 3 1/2 threads. An increase or decrease in screw length of one or two length increments, or the addition of one flat washer under the head or nut of the type specified is acceptable and does not require drawing change coverage.

3.2.3 Shaft Lengths

Shaft lengths of general purpose switches will be adjusted in length to assure proper knob to panel distance without specific drawing coverage.

3.2.4 Where required by terminal screw or stud size, a terminal lug (of the same basic part number of one stud size larger or smaller than that specified by the drawing may be used without drawing change. No deviation in wire cup size is acceptable.

3.3 Use of Silicone Rubber Adhesive

Silicone rubber adhesive (RTV - 102) may be used without specific drawing coverage as a means of cable bundle or wire support where necessary providing it is identified on the wiring diagram parts list.

3.4 Component Identification - Electrical component identification marking (meters, switches, lights, terminal boards, power supplies, resistors, diodes, etc.) is required for all chassis and panels.

The conponent icentification numbers shown on the wiring drawing will be permanently marked on the panel (rear side) or chassis in the approximate area shown on the drawing. Marking shall be made with characters, .12, .25, .50 inch high using epoxy ink.

Identification markings shall be clear, legible, and of a color contrasting with the background. Where practical, the identification shall be located so that it is not obscured by the component when mounted or by other components, leads, harnesses, etc. Terminal identification - internal console wiring that terminates on a barrier strip shall have each termination identified with the barrier strip point number. Suitable Brady Markers shall be used unless specified otherwise by drawing.

3.5 Tightness of screw, nuts, and bolts - Good manufacturing practice shall be the criteria for establishing tightness of mounting screws, nuts and bolts unless specified torque or turn requirements are identified by the drawing. All fasteners will be tightened using appropriate tools. (i.e., finger tight nuts on jam nut connectors, switches, etc. are not acceptable).

3.6 All assemblies shall be identified by drawing and group number using epoxy ink and/or GE nameplate when specified by drawing. All cable assemblies shall be identified by drawing and group number and connector identification.

3.7 Revision Status Tag

The revision status tag specified by the assembly drawing will normally be used on all assemblies and major sub-assemblies. Upon completion of

the incorporation of a change to either the assembly or wiring of the unit it will be stamped by inspection in the appropriate block to document the incorporation of the change. The date of the change will also be noted on the tag.

3.8 Location of assembly location tags ("A" Tags)

Equipment consoles having multiple sub-assemblies (panels and panel/chassis assemblies) will have assembly location tags located in the following fashion when specified by drawing if definite locations for the tags are not shown.

3.8.1 Sub-Assembly "A" Tag

Locate on the lower right hand corner of the rear of each chassis (if the panel assembly does not have a chassis, locate tag on lower right hand corner of the rear of the panel).

3.8.2 Panel Tapped Mounting Rail "A" Tag

The appropriate number "A" tag will also be mounted on the front face of the enclosure bay left hand tapped panel mounting rail in a position such that it is obscured when the corresponding panel assembly is installed and also such that it does not interfere with the panel mounting screws.

3.9 Component Terminal Designations

Component terminal designations defined by a pictorial view on the drawing shall be followed even though the component may have conflicting terminal designations marked on it by the vendor, unless there is a functional difference affecting performance. In such cases the conflict is to be resolved by design engineering.

4.0 REQUIREMENTS - WAVEGUIDE ASSEMBLY

4.1 General-

The assembly of waveguide and waveguide components must be accomplished with skill and care to assure good alignment and cleanliness. This section will assure meeting the requirements of proper waveguide assembly.

4.1.1 Precedence of Conflicting Documents

See paragraph 2.1.1.

4.2 Flatness and Finish

Visually check flatness of flange mating surfaces, especially around holes. Visually check for damage to flange mating surface within the gasket sealing area. Lap as required to assure flatness and finish. Surface roughness shall not exceed 63 microinches. Use extreme care to prevent dirt or foreign material on inside surface of waveguide.

4.3 Flange Mounting Holes

Modify as required to match components by using proper fixture to drill out threads and prevent chips, oil or other foreign material from getting on inside surface of waveguide.

4.4 Dowel Pins

Insert (2) dowel pins in one mating half of flange to assure alignment of gasket and mating flanges.

4.5 Assembly

Install gasket on dowel pins. Mate flanges and install hardware to assure 1 1/2-3 threads exposed on thru holes (use 5/8" screws). Use hardware of length not to bottom on blind holes (usually 1/2"). Alternately hand tighten screws.

NOTE: Final torque to 17" lbs should be avoided during initial assembly and fit check to prevent crushing of gasket. Gaskets should not be re-used after final torque.

Alternately torque to 17" lbs. After initial torque, alternately re-torque to 17" lbs. Torque stripe after final torque.

Do not place wave guide in vise or any other clamping type device.

GENERAL ELECTRIC

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47A380053 CONT ON SHEET ii SH NO. i	FIRST MADE FOR: WTG-MOD-5A

47A380053 CONT ON SHEET ii SH NO. i

REVISION

ELECTRICAL AND SYSTEMS TEST EQUIPMENT

DESIGN, FABRICATION AND TEST SPECIFICATION

SEPTEMBER 1982

[signature] Responsible Engineer DATE: 9-14-82

[signature] Subsystems Engineer DATE: 10-15-82

[signature] Systems Engineering DATE: 16 OCT 82

A. Cheddar Quality Assurance DATE: 10-15-82

[signature] WTG Integration DATE: [illegible]

TOTAL NUMBER OF PAGES 33

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REVISION LOG

This log identifies those portions of this document which have been revised since original issue. Revised portions of each page, for the current revision only, are identified by marginal striping.

Revision	Page No.	Paragraph Number(s) Affected	Rev. Date	Approval

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1.0 SCOPE

This specification covers the philosophy of design and general requirements for design and manufacture of electronic equipment and systems test equipment. Detail requirements for specific equipment shall be specified by the design drawings and related documents. Specific program requirements are to be detailed by the program instruction (and applicable revisions) authorizing the task. The procedures of this document shall be followed in lieu of supplemental instructions.

2.0 APPLICABLE DOCUMENTS

The following documents of the issue in effect on the date of this specification form a part of this specification to the extent specified herein.

ANSI

Y1.1	Abbreviation for use on drawings and in technical type publications
Y14.5	Drawing terms and tolerances
Y32.2	Graphic symbols for electrical and electronic diagrams
Y32.16	Electrical and electronic reference designations

MILITARY

MIL-STD-202	Test methods for electronic and electrical component parts
MIL-STD-189	Racks, electrical equipment, 19-inch and associated panels

FEDERAL

FED STD NO. 595	Federal Standard Colors

GENERAL ELECTRIC

47A380052	Electrical Standard Fabrication Wiring And Installation Drawing
47A380056	Electrical Preferred Parts And Practices Drawing

3.0 REQUIREMENTS

3.1 GENERAL

The equipment shall meet the requirements of the following as specified herein.

a)	End Item Quality	3.2
b)	Design	3.3
c)	Design Documentation and Drawings	3.4
d)	Standard Parts	3.5
e)	Standard Circuits and Panels	3.6
f)	Selection - Quality of Material	3.7
g)	Processes	3.8
h)	Identification and Marking	3.9
i)	Fabrication and Workmanship	3.10
j)	Acceptance Test Requirements	3.11

3.2 END ITEM QUALITY

Quality of design and fabrication shall be the highest practicable consistent with program objectives. The procedures of this specification have been selected to assure high quality design and fabrication while maintaining flexiblity and a rapid response capability.

3.3 DESIGN

3.3.1 TECHNICAL REQUIREMENTS

All equipment designs shall be based on the requirements of this specification and written technical requirements or specification which will define the

3.3.1 TECHNICAL REQUIREMENTS (continued)

required functions and accuracies, interface requirements, special environmental requirements if any; power, size, weight, location limitations if any, and any special requirements. Basic technical requirements shall be defined by the cognizant systems engineer. Where necessary the basic requirements will be further detailed by a written design plan prepared by the equipment design engineer and concurred with by the cognizant systems engineer.

3.3.2 SERVICE CONDITIONS

Unless the equipment specification or technical requirements specify otherwise the equipment shall be designed to withstand the following service conditions.

MECHANICAL

A) OPERATING

Ambient Temperature	-30^0 Celsius to 40^0 Celsius.
Relative Humidity	Up to 95 percent, non-condensing.
Barometric Pressure	31 to 20.58 inches of mercury.
Orientation	(1) Cabinet type equiment - inclination at any angle up to 10^0 from the normal position.
	(2) Portable equipment - inclination at any angle up to 90^0 from the normal position.

B) NON-OPERATING, STORAGE AND TRANSPORTATION

Ambient Temperature	-40^0 Celsius to 50^0 Celsius.
Relative Humidity	Up to 95 percent.
Barometric Pressure	31 to 5.54 inches of mercury.

3.3.2 SERVICE CONDITIONS (continued)

Orientation

(1) Cabinet equipment - inclination at any angle up to 40^0 from the normal position.

(2) Portable equipment - inclination at any angle.

C) SHOCK AND VIBRATION

No specific levels of shock and vibration for operation or transportation are defined by this specification. Unless specified otherwise by the technical requirements all units shall be built to conform to sound design practices consistent with the use and handling (as described by the requirements document) the equipment will be subjected to.

D) VACUUM - THERMAL

Units or modules designed for use in the vacuum - thermal chamber shall be designed to operate at a pressure of 10^{-5} mm Hg or less and over a temperature range of 0^0 to 50^0 Celsius unless specified otherwise by the technical requirements.

ELECTRICAL

The equipment shall be designed to operate and maintain proper performance from power sources having the following characteristics unless specified otherwise by the technical requirements.

A) Voltage - 120 volts plus or minus 10 volts AC 60 Hertz, single phase.

B) Frequency tolerance plus or minus 1 percent.

C) Maximum available current/unit will be 60 Amperes.

D) Power factor correction is not considered as a normal requirement.

3.3.3 SIZE AND WEIGHT

Equipment designs shall be such as to minimize size and weight consistent with functional requirements. All floor type cabinets (unless otherwise specified) shall be equipped with casters and leveling pads or caster locking devices. Lifting pads will be provided where applicable. Unless specified otherwise maximum overall dimensions of the largest enclosure used shall not exceed 74 inches height, 72 inches width, 39 inches depth, exclusive of writing surface. Writing surfaces shall be detachable or retractable to facilitiate shipment. Unless design restrictions dictate otherwise a minumum of 10 percent of space shall be allowed to accomodate future expansion.

Standard panel widths for cabinets shall be 19 inches nominal. (18.96 ±.03 actual). Panel heights and mounting slots shall be per MIL-STD-189 (1 3/4 inches height increments). Normally closed mounting slots will be used. Unless specified otherwise material used for test panels mounted in cabinet enclosures shall be 3/16 inch in thickness. Rear connector panels for enclosures shall be 1/8 inch in thickness.

3.3.4 USE OF PREFERRED PARTS, PANELS, CIRCUITS AND MATERIALS

A basic design objective will be standardization of parts, panels, circuits, and materials wherever possible. Sections 3.5, 3.6, and 3.7 define the selection criteria.

3.3.5 WORST-CASE DESIGN

All circuits shall be designed to perform properly under worst case conditions of temperature, part tolerance, input voltage variations, and component aging. Where circuit application dictates, detailed worst case analysis will be performed.

3.3.6 COMPONENT DERATING

No specific levels of component derating are dictated by this document. Component parts shall be derated according to good design practice considering life, duty cycle, power dissipation, etc. Any derating guidelines identified in the preferred parts and practices drawing (see section 3.5) shall be followed. The design shall not require that a part be subjected to stresses greater than rated levels without analysis of the circuit effects. (e.g. Fuses may be subjected to currents higher than rated to simulate bridge wire burn-out or resistors may be subjected to short duration pulses in excess of rating, providing the effects of operation in this mode have been properly analyzed.)

3.3.7 EQUIPMENT LIFE, MAINTAINABLILITY

Unless specified otherwise, equipment shall be designed for a nominal 5-year operating life and minimum 4-year storage life. Major equipments shall be repairable, minor items may be repairable or replacable depending on good design practice to achieve the operating life requirements. This document does not establish mean time between failure requirements. Specific MTBF levels and MTTR levels will be designed to only if identified by equipment requirements.

3.3.8 BREADBOARDS

Engineering breadboards will be used as necessary to demonstrate circuit performance, effects of temperature variations, and to facilitate circuit analysis. Normally only those portions of equipments requiring detailed study will be breadboarded to assure proper design. Scope of breadboard work shall be defined by the design engineer. Breadboards may be used to supplement worse case design analysis but do not replace the requirement of such analysis where necessary (para. 3.3.5).

3.3.9 DEVELOPMENT MODELS

Development models and/or brassboards will be built only when authorized.

3.3.10 DESIGN REVIEWS

Unless defined otherwise by contract or program requirements normally only one formal design review shall be held for each end item equipment. It will be held after the technical requirements and overall design approach have been sufficiently identified to make the review meaningful. This review will consider in detail the hardware interface as well as the internal design of the equipment. Informal design reviews will be held within the design group thoughout the design phase. Attendees at the formal design review will be in accordance with the established program procedures. All action items resulting from the formal design review will be resolved and a written document prepared to define action taken.

3.3.11 E. M. I.

Good design practices will be followed to reduce electro-magnetic interference and susceptability. Design emphasis shall be placed on suppression of relay coils, shielding, separation of signal and power functions, grounding, etc. Extreme E. M. I. prevention precautions (such as RFI shielded, gasketed enclosures) will not be used unless specifically indicated by the technical requirements, and/or the end item application.

3.3.12 GROUNDING

The following grounding practices shall be followed unless special requirements stipulate otherwise.

3.3.12 GROUNDING (continued)

A) Each equipment cabinet shall have a ground stud located on the rear connector panel which shall be tied with a visible ground cable to an authorized building or installation ground.

B) The AC power input ground lead shall be connected internally to the connector panel ground stud.

C) In no case will the AC power neutral (return) or any high (hot) line be connected to any equipment enclosure.

D) Normally no equipment output or input signals or returns will be connected to the enclosure ground. All outputs shall be electrically floating. Special attention shall be directed to assure that power supplies, oscilloscopes, voltmeters, etc., do not cause inadvertent grounding of input or output signals through case grounds.

E) Each panel/chassis assembly located in an equipment cabinet shall be connected by a ground strap from a ground stud located on the panel or chassis to the cabinet ground bus bar.

F) The preferred parts, defined in accordance with paragraph 3.5 identify ground bus bars, ground studs for enclosures and chassis, and ground straps to be used.

G) Where necessary ground wires shall be used within panel/chassis assemblies to tie individual trays, parts, etc., to the chassis ground stud.

H) Shields will be returned to the equipment ground network where dictated by good design practice. Normally, shielding (except RF) will be grounded at one point only, to avoid ground current loops.

I) Equipment ground studs may or may not be used on portable equipment depending on the nature of the equipment.

3.3.13 INTERLOCKS

Electrical interlocks shall be used for safety on equipment using input voltages of 150 volts or greater, or where dangerous levels of voltage are present that create hazardous conditions for operators or maintenance. Normally such interlocks shall be installed on <u>each</u> cabinet door and for each slide mounted panel/chassis assembly. If cheater type interlock switches (those with mechanical by-pass provisions to facilitate maintainence) are used they must be of the type which automatically return to operation upon closure of the cabinet door.

3.3.13 INTERLOCKS (continued)

Equipment shall be designed to preclude accidental contact with voltages in excess of 28 volts.

3.3.14 ENCAPSULATION

Normally, encapsulation will not be used for connectors and modules to facilitate maintenance. However, connectors shall be potted if required by connector design. Modules shall be encapsulated wherever required for mechanical strength, reduced size, or environmental capability.

3.3.15 CONNECTOR FUNCTIONS

Connector functions on panel and chassis assemblies will normally be isolated as defined by the following list:

1) AC POWER IN
2) DC POWER IN*
3) AC POWER OUT
4) DC POWER OUT**
5) SIGNAL IN*
6) SIGNAL OUT**

*Functions 2 and 5 may be combined.
**Functions 4 and 6 may be combined.

3.3.16 WIRING AND CABLES

A minimum of 10 percent spares will be allowed at original design for all connectors or cables subject to expansion, unless dictated otherwise by mating connectors. Butt splices, if specified by the drawing, will contain no more than four (4) wires (2 wires each end). Dust caps shall be provided for all un-mated connectors.

3.4 DESIGN DOCUMENTATION AND DRAWINGS

3.4.1 DESIGN NOTEBOOK

The equipment design engineer shall maintain a comprehensive design notebook. This notebook shall identify all design requirements and assumptions plus all design solutions, record the results of all laboratory breadboard work, and identify or contain all related documents (i.e. drawings, PIRS, memos, etc.).

3.4.2 DRAWINGS

A) Drawing abbreviations symbols, and reference designations will conform to ANSI Y1.1, Y32.2, and Y32.16 unless defined otherwise by this document. The preferred parts and practices drawing, para. 3.5, will identify preferred representations for certain parts. Where shown these representations shall be used to assure uniformity of symbols and nomenclature.

B) The following guidelines unless defined otherwise by contract or program requirements will be followed with regard to quantity and type of drawings:

1) The total number of drawings for an end item will be kept to a minimum consistent with required definition of the end item. Simplified drafting practices shall be used.

2) Previously detailed standard parts, assemblies, etc., will be used wherever possible in lieu of new drawings.

3) Multiple groups and multiple part drawings will be used wherever possible.

4) The coordinate system will be used for panel dimensioning.

5) All top assembly drawings will show reference dimensions to define overall size of the assembly.

   Approximate weight will be included when available.

6) Issued "A" size drawing lists will be provided for all complex equipments.

3.4.2 DRAWINGS (continued)

C) Drawing revision control will be applied to all drawings. The method of drawing control will conform to the program instructions.

Drawing revisions are instituted by alteration notice (AN). The AN procedure will conform to standard department policy. Approval requirements for AN's will be in conformance with program instructions.

3.4.3 INSTRUCTION MANUALS

A) Instruction manuals shall be provided when specified by the program instruction.

The standard format shall be:

1) General Description

2) Theory of Operation

3) Installation Instructions

4) Operating Instructions

5) Maintenance Instructions (including Calibration)

6) Logistical
   - Operating Supplies
   - Recommended Repair Parts

7) Drawing List

B) Drawing reference manuals shall be provided when specified by program instructions.

The standard format shall be:

1) Contents/Equipment List

2) Interconnection Diagrams

3.4.3 INSTRUCTION MANUALS (continued)

3) Equipment Drawings

Including assemblies, schematics, wiring diagrams, panel details, interconnection cables, sub-assemblies, etc., but excluding minor details such as brackets, chassis details, itc., which do not add to an understanding of the functional capability of the item.

3.5 PREFERRED PARTS

3.5.1 GENERAL

The electrical preferred parts and practices document 47A380056 identifies preferred parts which will be used in equipment design wherever possible to achieve standardization of design and simplify procurement and spare parts stocks. In addition to establishing the preferred parts, this list identifies standard drawing representations (e.g. identification of switch deck and terminal numbers for schematic and wiring diagrams), mechanical mounting dimensions, and special use characteristics wherever possible. Standard nomenclature identified by the list shall be used on drawings.

3.5.2 CRITERIA FOR SELECTION

The criteria for selection of parts for the preferred parts list are:

1) Quality and versatility of part
2) History of performance on previous applications in electrical equipment
3) Availability
4) Commercial equivalent of military parts where applicable (e.g. wire, diodes, transistors)

3.5.3 INTERFACE

The major exception to the above paragraphs is that any connector that mates to a prime equipment connector must be of quality compatible with the prime connector. It shall be so selected as to minimize any degradation of prime connector reliability.

3.6 PREFERRED CIRCUITS AND SUB-ASSEMBLIES

3.6.1 GENERAL

The electrical preferred circuits and sub-assembly list (Document 47A380056) identifies preferred circuits and sub-assemblies that will be used in the electrical equipment whenever possible to assure uniformity of design.

3.7 SELECTION AND QUALITY OF MATERIALS

3.7.1 GENERAL

Materials not listed on the preferred parts list (para 3.5) shall be selected on the same criteria identified by para 3.5.2.

3.7.2 INSTRUMENTS

All instruments used shall be subject to General Electric Company inspection code G (send material to I. & M. Lab for inspection to vendor catalog specifications and for calibration).

3.7 SELECTION AND QUALITY OF MATERIALS (continued)

3.7.3 VENDOR CATALOG ITEMS AND MISCELLANEOUS

All other parts used shall be inspected to General Electric Company inspection code M (inspect to characteristics identified by purchase order) unless otherwise noted.

3.8 PROCESSES

3.8.1 FINISHES

Finishes and coating shall be applied to provide for maximum durability and protection.

3.8.2 STANDARD COLORS

Unless specified otherwise by program instruction

A) Enclosure colors shall be FED-STD-595-25102 (blue gloss).

B) Front panel colors shall be FED-STD-595-25550 (blue semi-gloss).

C) Where possible commercial instruments shall be purchased with panel colors that conform to item (B).

D) Panels of test boxes may be of brushed aluminum or FED-STD-595-26492 (grey).

E) Surface preparations shall be compatable with material being finished.

F) Aluminum Chassis shall be finished using Alodine 600.

3.9 IDENTIFICATION AND MARKING

Unless specified otherwise in the following paragraphs, identification and marking materials shall be selected from the preferred parts list (para 3.5).

Figures I, II, III, IV, V, VI, and VII show typical locations for identification and markings.

3.9.1 END ITEM IDENTIFICATION

Each end item shall be identified by an equipment name plate (engraved black/white/black laminated plastic per preferred parts list) and a G.E. signature strip (per preferred parts list). Location of the signature strip for enclosures shall be as shown on the enclosure drawing. The equipment name plate normally shall be located directly below the signature strip.

3.9.2 IDENTIFICATION PLATE

An adhesive backed mylar G.E. identification plate (NP 206417) shall be attached to every end item and all major sub-assemblies. This plate will identify the equipment by:

A) Nomenclature
B) Stock Number
C) Serial Number
D) Model Number
E) Drawing Number
F) Contract Number

3.9.3 REVISION STATUS TAG

Every assembly and major sub-assembly shall have an adhesive backed mylar revision status tag, as defined by the preferred parts list. This tag provides space to identify revisions made to the assembly and wiring of the unit. Space is provided for an inspection stamp. In the event that the number of revision exceeds the tag capacity, an additional tag will be attached adjacent to the original.

3.9.4 ASSEMBLY LOCATION TAGS ("A" Tags)

Adhesive backed mylar assembly location tags as identified by the preferred parts list shall be used on panel/chassis assemblies to show location of the unit in an enclosure housing multiple units. One "A" tag shall be installed on the enclosure tapped rail front face and a tag bearing the corresponding number installed on the rear of the chassis located at that position. Use of the tags shall be specified by the assembly drawing.

TYPICAL PREFERRED IDENTIFICATION LOCATIONS

(Refer to Figures I, II, III, IV, V, VI, AND VII)

1. Identification Plate
2. Revision Status Tag
3. Assembly Location Tag - "A" Tag (located by top assembly)
4. Terminal Board Identification Tag - "TB" Tag
5. Connector Identification Tag - "J" Tag
6. Harness Connector Identification Tag
7. Engraved Panel Markings
8. G.E. Signature Strip
9. Equipment Nameplate
10. Engraved Laminated Plastic Plate Bonded to Panel
11. Engraved Aluminum Plate (painted and filled to match panel) used for rework
12. Connector Identification Tag with "Mates to" Information
13. Cable Assembly Identification Tag (note on long cables locate additional identification tags at both ends)

TYPICAL PREFERRED IDENTIFICATION LOCATIONS

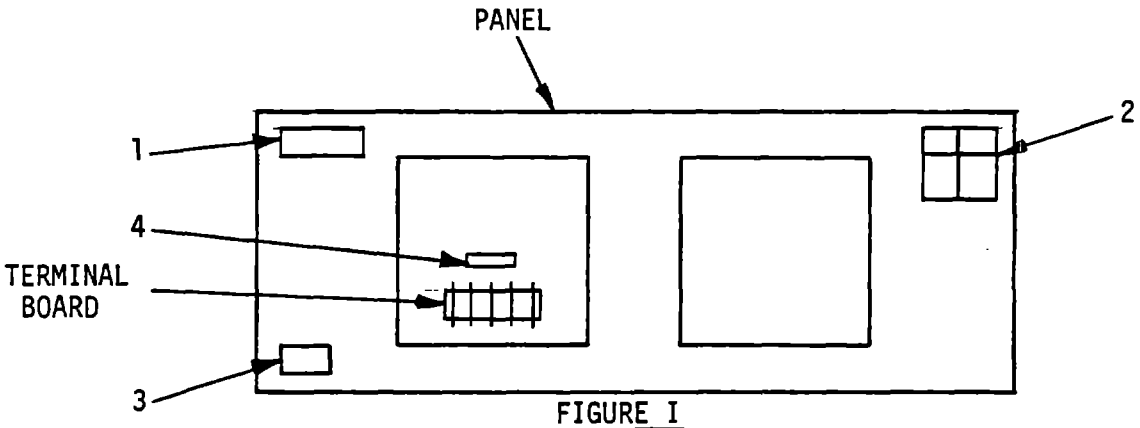

FIGURE I

PANEL ASSEMBLY (REAR VIEW)

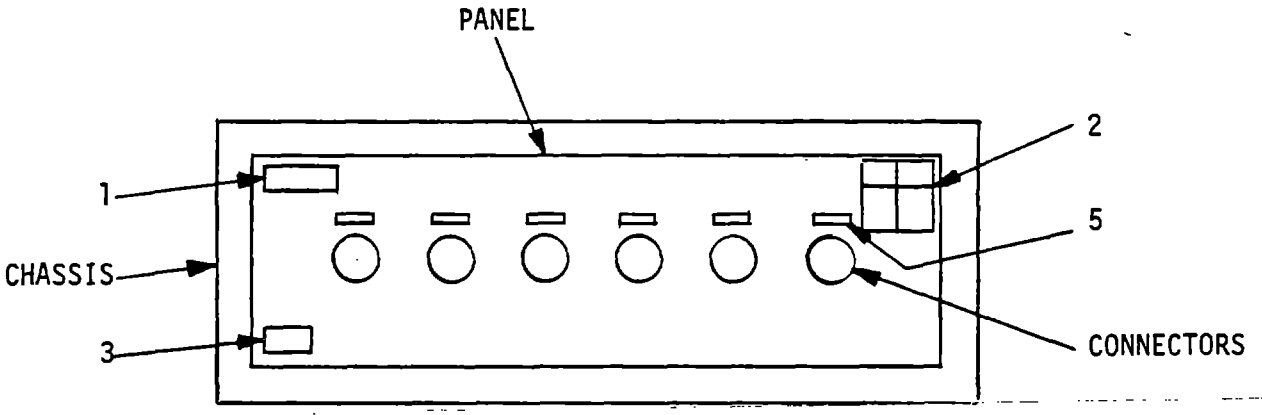

FIGURE II

PANEL & CHASSIS ASSEMBLY (REAR VIEW)

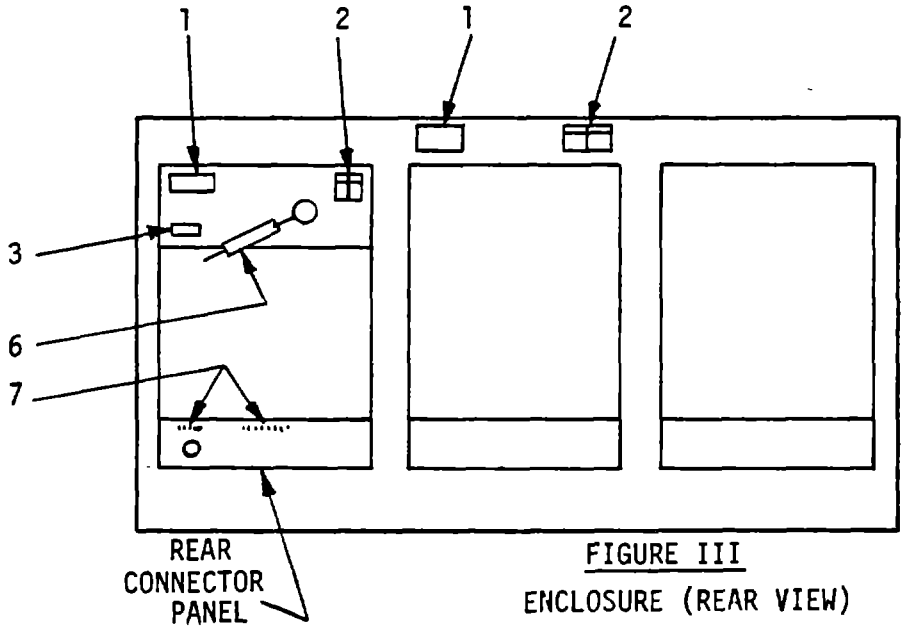

FIGURE III

ENCLOSURE (REAR VIEW)

TYPICAL PREFERRED IDENTIFICATION LOCATIONS

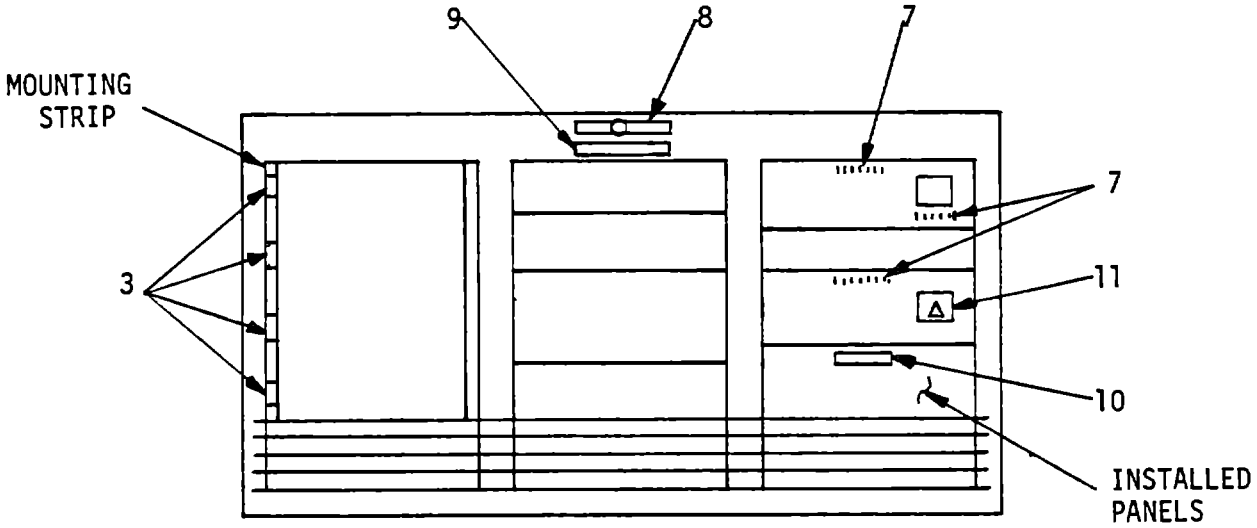

FIGURE IV
ENCLOSURE (FRONT VIEW)

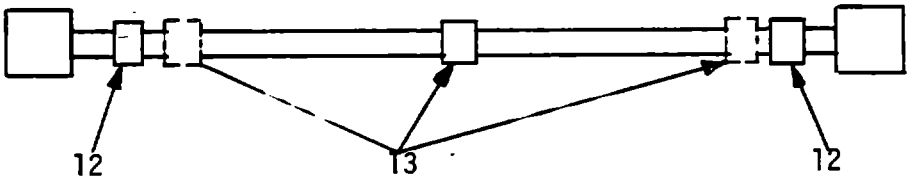

FIGURE V
CABLE

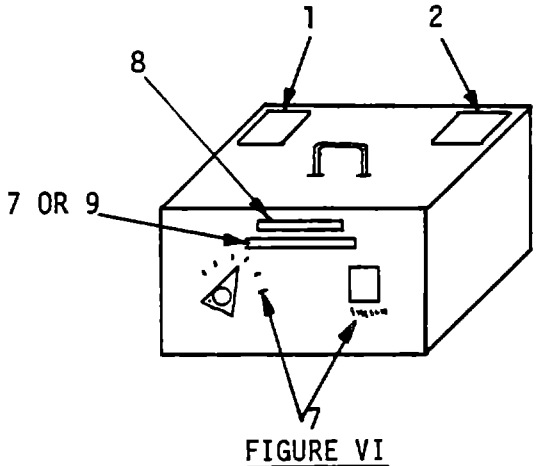

FIGURE VI
PORTABLE UNIT (FRONT VIEW)

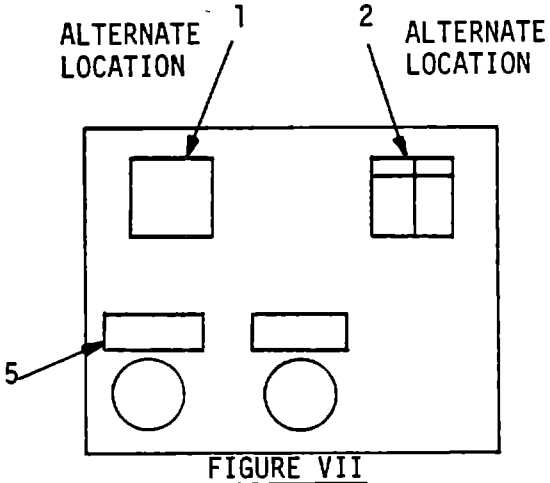

FIGURE VII
PORTABLE UNIT (REAR VIEW)

3.9.5 CONNECTOR AND TERMINAL BOARD IDENTIFICATION TAGS

All rear chassis connectors and terminal boards shall be identified by adhesive backed mylar "J" tags or "TB" tags defined by the preferred parts list.

3.9.6 CONNECTOR MATES TO IDENTIFICATION TAGS

Internal harness connectors within an enclosure shall have identification tags showing the following information: harness connector number and mating chassis sub-assembly number and connector number (e.g. P32 mates to A8J1). The identification tag will be defined by the assembly wiring diagram and selected from the preferred parts list.

3.9.7 CABLE TAGS

External cables and cable connectors will be identified using cable identification tags selected from the preferred parts list. Tags will be located as shown in Figure V. The cable tag will show drawing number, group number, revision status, and job number (an identifying number assigned by production control). The connector tags will identify connector number and mates to information (e.g. P3 mates to J3).

3.9.8 PANEL MARKINGS

Front panels and rear connector panels will normally be identified with panel title and function legends engraved on the panel, filled with a contrasting color wipe in paint. One quarter inch high characters will be used for panel title, 3/16 inch high characters for sub-titles, and 1/8 inch high characters for function legends. Engraved black/white/black laminated plastic plates may be used for special emphasis or to mark special titles on commercially built units (e.g. power supplies, recorders, etc.). These plates will be bonded to

3.9.8 PANEL MARKINGS (continued)

the panel using the adhesive identified by the preferred parts list (RTV 102) if panel rework necessitates changes to panel engraving this will be accomplished by using .020 thick aluminum plates engraved with the proper legends painted and filled to match the panel. These plates will be bonded to the panel using RTV 102.

Special warning tags shall be made from red/white/red plastic laminate (identified by the preferred parts list), engraved and bonded to the panel/unit. These warning tags will be used only where conditions hazardous to personnel or equipment exists.

3.9.9 WIRE IDENTIFICATION

Normally wiring will not be identified by wire stamping or stamped sleeving unless special requirements dictate otherwise.

3.9.10 COMPONENT IDENTIFICATION

Component identification is required for all equipments. The method of component identification shall be in accordance with 47A380052.

3.10 FABRICATION AND WORKMANSHIP

3.10.1 STANDARDS

All electrical wiring and fabrication techniques shall conform to the requirements of electrical standard fabrication, wiring and installation drawing 47A380052. This standard drawing will be referenced by note on all assembly and wiring drawings and may be included in the reference note.

3.10.2 ADVANCE ORDER INFORMATION

Advance order information will be provided to production control whenever possible. Approval of advance order information will conform to program instructions. Inspection codes (see section 4) will be identified by the advance order.

3.10.3 FABRICATION PROCEDURES

The following procedures apply to equipment fabricated in-house.

A) All sheet metal work, chassis, panels, hardware, etc. shall be inspected only for dimensions and notes appearing on the face of the drawing.

   Manufacturing planning (simplified where possible) shall conform to program instruction.

B) All assembly and wiring of units may be done in an approved manufacturing area arranged to fabricate electrical equipment. Assembly and wiring shall be done by qualified wiremen to regular drawings. Detailed formal manufacturing planning will not be used in order to assure flexibility of manufacturing sequence. Design engineering shall provide support to assist in definition of requirements or recommend fabrication sequence.

3.10.4 HANDLING AND PROTECTION OF ITEMS

All electrical items shall be handled with care and respect. During fabrication small items will be stored in protective containers; large items shall be covered with protective covers. Care shall be exercised to maintain cleanliness of all items and to protect units from dust, chips and other foreign matter. All connectors that are not mated on enclosures or cables shall have protective caps installed. These caps shall conform to the applicable drawing.

3.11 ACCEPTANCE TEST REQUIREMENTS

3.11.1 CONTINUITY

All in-house fabricated electrical modules, panels, cables and console wiring shall be subject to electrical continuity tests to verify conformance to the item schematic. For purposes of this test an Ohm meter reading of one (1) Ohm or less is considered an indication of continuity unless specific test requirements are issued to specify otherwise.

3.11.2 DISCONTINUITY AND RESISTANCE TESTS

Discontinuity tests to verify isolation between circuits and resistance test to verify continuity though relay coils, diode polarity, etc. will be performed when identified by the test requirements. Discontinuity for purposes of this test will be considered as 10 Meg Ohms or greater unless specified otherwise.

3.11.3 INSULATION RESISTANCE AND DIELECTRIC STRENGTH

3.11.3.1 Cables

All cables will be subjected to insulation resistance and dielectric strength tests. (Dielectric strength tests normally will be performed only once on a cable).* Tests will be performed between each conductor against all other conductors and connector shells.

* Should it be necessary to repeat the dielectric strength test, it should be done at a lower voltage. Each time it is repeated, the voltage should be 90% of that used in preceding test.

3.11.3.1 Cables (continued)

Insulation resistance shall not be less than 10 Meg Ohms at a DC potential of 500 volts, unless specified otherwise by the test requirements.

Cables shall withstand without degradation a potential of 500 volts AC R.M.S. 60 Hertz for a minimum period of 10 seconds unless specified otherwise by the test requirements. Leakage current shall not exceed 50 microamperes as measured by Micro-ammeter or other suitable means.

3.11.3.2 Console Wiring, Panels, and Modules

Insulation resistance and dielectric strength tests will be performed on console wiring, panels and modules only when specified by the test requirements (dielectric strength tests will be performed only once).* Test levels will be in accordance with those defined in paragraph 3.11.3.1 unless specified otherwise.

3.11.4 PERFORMANCE TESTS

All equipment shall be subjected to performance tests in accordance with the test requirements. Design engineering shall identify test requirements. The minimum requirements specified above shall be referenced plus any additional performance tests required.

* Should it be necessary to repeat the dielectric strength test, it should be done at a lower voltage. Each time it is repeated, the voltage should be 90% of that used in preceding test.

3.11.5 ENVIRONMENTAL TESTS

Environmental tests shall be performed only when specified by the test requirements.

3.11.6 ENCAPSULATED UNITS

All encapsulated units shall be subjected to test prior to encapsulation in addition to post pot tests in accordance with the test requirements.

4.0 QUALITY ASSURANCE PROCEDURES

4.1 INSPECTION OF PURCHASED PARTS

A) All material and component parts will normally be coded with inspection code M (inspect per purchase order). Only those characteristics requiring inspection or test will be delineated on the purchase order. The design engineer will define the characteristics to be inspected. The responsible quality control engineer will obtain the information and transmit it to inspection planning for incorporation on the material request.

B) Standard commercial test equipment will normally be coded as requiring G code inspection (inspection by I. & M. Lab to vendor catalog specifications and calibration).

4.2 CONTROL OF FABRICATED MATERIAL - INSPECTION INSTRUCTIONS

4.2.1 INSTRUCTIONS

Inspection instructions may appear as classified characteristics and notes on the drawing.

4.2.2 INTERMEDIATE INSPECTION

Intermediate inspection will be provided as required.

4.2.3 DETAILED INSPECTION

Detailed inspection instructions may be provided for piece parts if the preceeding methods do not suffice or if specific variable data or other objective evidence is required.

4.2.4 FINAL INSPECTION

Upon completion of a unit it shall have final inspection to the appropriate level.

4.3 TEST PLANNING

Unless specified otherwise by program instruction the following procedure shall be followed:

A) Q. C. shall conduct the continuity, Megger and HI-POT test where applicable.

B) Q. C. will perform in-process and preliminary test in conjunction with design engineering.

C) Q. C. will provide the acceptance test procedures based on requirements established by design engineering. Test instructions will either be documented in the equipment log book or by test requirement. Test data shall be recorded on approved forms.

D) Q. C. shall conduct the acceptance test. Design engineering shall witness all major acceptance tests. Design engineering may at its option perform a general checkout test prior to the formal acceptance test.

4.4 NON-CONFORMING MATERIAL

4.4.1 IN-HOUSE FABRICATED MATERIAL

All descrepancies for in-house fabricated material shall be recorded on the defect report (DR). Disposition of DR's shall be made by the design engineer and QC engineer. When the disposition is to "refer to MRB", a non-conformance report (NR) is written and despositioned by the material review board (MRB).

4.4.2 PURCHASED MATERIAL

Discrepant purchased material shall be recorded on an NR. Disposition shall be by MRB.

4.5 HANDLING, STORAGE AND DELIVERY

Handling, storage and delivery activities shall be in accordance with established procedures.

4.6 INDICATION OF INSPECTION STATUS

The quality control and test section has established and maintains an inspection stamp control system. Quality contol and test stamps are designed to identify that articles are in process, partially inspected, finally inspected and/or tested, and to provide an identity of the specific individual performing the inspection and/or test. Evidence of inspection of miniature items is indicated by applying the appropriate stamp to the accompanying paperwork and to the container.

4.7 QUALITY INFORMATION EQUIPMENT

All inspection standards, gages, measuring and test equipment will be controlled in accordance with established procedures for equipment control and calibration.

5.0 NOTES

5.1 DEFINITIONS

NR - Non-conformance Report

MRB - Materials Review Board

DR - Defect Report

GENERAL WELDING AND SURFACE PREPARATION SPECIFICATION

FOR THE

MOD-5A WIND TURBINE GENERATOR

SEPTEMBER 1982

REV-C
SEPT. 1983

Responsible Engineer DATE: 9/23/82

Systems Engineer DATE: 9/23/82

Engineering Manager DATE: 9/23/82

Quality Assurance DATE: 9-23-82

WTG Integration DATE: 9/24/82

TOTAL NUMBER OF PAGES 17

REVISION

A INCORP AN-1 PER D.C.C-82-024 1/5/83

B INCORP AN-2 PER 6/12/83

C INCORP AN-3 PER DCC-83-067 10/21/83

WTG 500

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REVISION LOG

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	7	5.2		AN-2
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SECTION 1

WELDING REQUIREMENTS

Unless specified otherwise on the drawing, welding shall conform to the following requirements.

1.0 QUALIFICATION OF WELDERS

1.1 WELDERS, WELDING OPERATORS AND TACKERS

All welders, welding operators, and tackers shall be qualified in accordance with the qualification requirements specified in the American Welding Society "Structural Welding Code", ANSI/AWS D1.1-82, Section 5, Parts C, D, and E, or to ASME Section IX, or ANSI/AWS D14.6-81.

1.2 QUALIFICATION AND QUALIFICATION RESPONSIBILITY

The provisions of ANSI/AWS D1.1-82, Section 5, Part 5.3 and 5.4 or ASME Section IX, or ANSI/AWS D14.6-81, Section 5 shall apply with exceptions noted, herein.

SECTION 2

QUALIFICATION OF WELDING INSPECTORS

2.1 WELDING INSPECTION

Welding inspection shall be done only by personnel certified by the AWS Qualification and Certification program (or equivalent).

2.2 NON-DESTRUCTIVE TESTING

Non-destructive testing shall be done by personnel qualified as NDT Level II technicians under ASNT Recommended Practice SNT-TC-1A, while supervised by personnel qualified as NDT Level III.

SECTION 3

WELD PROCEDURE QUALIFICATION

3.1 QUALIFICATION REQUIREMENTS

Welding procedure qualification shall conform in all respects to the provisions of ANSI/AWS D1.1-82, Section 5, or ASME Section IX, (hereinafter referred to as ASME) or ANSI/AWS D14.6-81, with the exceptions noted below.

3.2 JOINT QUALIFICATION AND EXCEPTIONS

All joints, except yoke and rotor adapter, shall be qualified according to procedure qualifications of ANSI/AWS D1.1-82, Section 5, Part B, or ASME specification. No yoke or rotor adapter weld joint shall be considered pre-qualified unless they have been qualified in accordance with ASME, or ANSI/AWS D14.6-81 requirements, using the same materials utilized for construction as specified on the drawing.

3.2.1 JOINT THICKNESS

Weld qualification tests shall be made only on the thickest and thinnest joints of each type to be used. Intermediate thickness joints shall be considered qualified on the basis of the performance of the thickest and thinnest joints.

3.2.2 WELD CONSUMABLES

Any change in weld consumables, such as indicated in ANSI/AWS D1.1-82, Section 5, Part B, 5.5.2.2(1) and (2), 5.5.2.3(1) and (2), 5.5.2.4(1) and (2), is not permitted. All production welds shall be made with the same consumables as the qualification tests. All other provisions of ANSI/AWS D1.1-82, Section 5, Part B, 5.5.2.1 through 5.5.2.4, apply.

3.2.3 DISAPPROVED WELDING METHODS

Electroslag or electrogas welding may not be used.

3.2.4 CHARPY V-NOTCH TEST

Charpy V-notch impact tests as specified hereinafter are mandatory for qualifying the weld procedure. The impact specimens shall be prepared from the weld procedure qualification test plates after straightening and post-weld-heat treatment (PWHT).

3.2.4.1 Test Requirement

The Charpy V-notch impact tests shall be conducted in accordance with the requirements of ASTM E23.

3.2.4.2 Test Specimen Geometry And Orientation

The specimen shall be cut with the longitudinal center line of the test piece transverse to the weld axis. Each V-notch shall be perpendicular to the plate surface and located so as to provide data representative of parent metal, weld-heat-affected metal (HAZ) and weld metal.

3.2.4.3 Test Specimen Location

The weld test specimen shall be taken from the test piece at 1/4 thickness.
The weld test piece shall be constructed such that at the center of the weld length, the welding process was stopped and restarted for at least one half the expected number of weld passes required to complete the test piece. One impact test specimen shall be taken from this stop/start region and its impact result specifically identified in the test data.

3.2.4.4 Test Specimen Preparation And Test Procedure

From each weld test piece, five impact test specimens shall be prepared. After discarding the lowest and highest test values, the average of the three remaining values shall be equal to or greater than 15 ft-lb at 10^{o}F for steels having a yield strength up to 65 KSI. Reduce test temperature 15^{o} for every 10 KSI above 65 KSI. In addition, only one of the three values may be lower than the specified level, but not less than 75% of the specified energy level.

3.2.4.5 Informational Testing

Tests duplicating 3.2.4.4 shall be repeated at -40°F and data reported for the record only, no pass-fail criteria apply.

3.2.5 PREVIOUSLY QUALIFIED PROCEDURES

For weld procedures that have been previously qualified in all respects except for a Charpy V-notch test, only groove weld test pieces, prepared in the position encountered in actual fabrication need be prepared, and only the Charpy V-notch test need be conducted.

SECTION 4

WELDING DESIGN, WORKMANSHIP AND TECHNIQUE REQUIREMENTS

4.1 REQUIREMENTS AND EXCEPTIONS

The welding design, workmanship, and technique shall conform in all respects to ANSI/AWS D1.1-82, Sections 1, 2, 3, and 4 with the following exceptions and additions.

4.1.1 DRAWING DIMENSIONS

Dimensions for detail parts shown on the drawing are basic envelope sizes prior to weld preparations.

4.1.2 EDGE PREPARATION

Edge preparations alternative to those called out on drawings may be used provided that full penetration welds of satisfactory quality result. Where backing strips are used, they shall be removed after welding. Inspect that welds are sound, by grinding smooth, then using penetrant or magnetic particle inspection.

4.1.3 FILLER METALS

Only filler metals as specified in ANSI/AWS D1.1-82, Section 4, Table 4.1.1 shall be used. ASME specification is acceptable when steel processed is not covered by AWS.

4.1.4 PREHEAT AND INTERPASS TEMPERATURE

The minimum preheat and interpass temperature requirements of ANSI/AWS D1.1-82, Section 4, Table 4.2, shall apply when applicable. When a quenched and tempered (Q&T) steel is welded to a non-Q&T steel the pre-heat and interpass temperature requirements stated for the Q&T steel shall be controlling; ASME and/or ANSI-AWS D14.6-81 specifications may be used when AWS D1.1-82 does not cover steels processed.

4.1.5 WELDING CONTINUITY

The welding of any given joint shall be continuous, i.e., the weld joint shall not drop below the interpass temperature until the last pass of the joint is complete unless permitted by a qualified procedure approved by G.E.

4.1.6 DEBURRING REQUIREMENT

Exposed plate edges (after welding) shall be free of burrs and sharp corners that would present a hazard to bare hands.

4.1.7 STRESS RELIEF TEMPERATURE

Post weld stress relief specified on the drawing, shall be performed per ANSI/AWS D1.1-82, Section 4.4, for medium strength steels. (For other materials consult ASME Section IX).

SECTION 5

INSPECTION PROCEDURES

5.1 WELD INSPECTION

Weld inspections shall meet the requirements of ANSI/AWS D1.1-82, Section 6 with the following additions and exceptions.

5.1.1 INSPECTION REQUIREMENT

All welds and weld heat-affected metals shall be inspected for 100% of their length.

5.1.2 INSPECTION TECHNIQUES

All welds shall be inspected by dry powder magnetic particle per Section 6.7.5 of ANSI/AWS D1.1-82. In addition, all full penetration welds, except as noted otherwise on the drawing, shall be inspected radiographically or ultrasonically, per ANSI/AWS D1.1-82, Part B or Part C of Section 6.

5.2 WELD QUALITY

Quality of welds, except category E, shall conform to the requirements of ANSI/AWS D1.1-82, Section 9.25 with the following additions or exceptions.

5.2.1 CLARIFICATION OF DISCONTINUITY DEFINITION

Replace subsection 9.25.2.1 with: If any or all of the following requirements are exceeded:

(1) Individual discontinuities have a greatest dimension of 3/32 inch or greater.

(2) The discontinuity is closer than three times its greatest dimension to the end of a groove weld.

(3) A group of such discontinuities is in a line such that:

(a) The sum of the greatest dimensions of all discontinuities is larger than the effective throat or weld size in any weld length six times the effective throat or weld size. When the length of the weld being examined is less than six times the effective throat or weld size, the permissible sum of the greatest dimensions shall be proportionally less.

(b) The space between two such discontinuities which are adjacent is not greater than three times the greatest dimensions of the larger of the discontinuities.

5.2.2 MODIFICATION OF DISCONTINUITY DEFINITION

Replace subsection 9.25.2.3 with: Independent of the requirements of 9.25.2.1 (as modified by 5.2.1), discontinuities having a greatest dimension of less than 3/32 inch if the sum of their greatest dimension exceeds 1/4 inch in any linear inch of weld.

5.2.3 ULTRASONIC INSPECTION

Ultrasonic inspection criteria shall be in accordance with ANSI/AWS D1.1-82, Section 9.25.3 for tension welds, Table 9.25.3. Non fatigue critical welds may be inspected in accordance with ANSI/AWS D1.1-82 Section 8.15.3 (Buildings) if specifically allowed on the drawing.

SECTION 6

WELD REPAIR

6.1 WELD REPAIR PROVISIONS

Weld repair shall be performed according to the provisions of ANSI/AWS D1.1-82, Section 3.7 with the following additions and exceptions.

6.1.1 PROCEDURE QUALIFICATION

Procedure qualification is mandatory for any type of weld repair covered in subsections 3.7.2.3 and 3.7.2.4 applied to groove welds. Repairs of any weld shall be made with an approved welding procedure.

6.1.2 DIMENSIONS OF PROCEDURE QUALIFICATION

The width of the procedure qualification test weldment shall be six (6) times the plate thickness, t, (3t on either side of the groove weld) or twelve (12) inches, whichever is the greater dimension. The length of the weldment shall be at least twelve (12) inches. The test weldment shall be prepared using the same consumables, shielding, preheat, interpass temperature, and midrange current, voltage and arc-travel speed to be used on the joint in need of repair. The plate material used in making the test weldment shall be of the same type and grade as used in the structure.

6.1.3 TEST WELDMENT

The repair weld qualification test weldment shall meet all of the requirements, including stress relief, of the original weld with the exception noted in 6.1.5 below.

6.1.4 PRIOR QUALIFICATION

If prior qualification of the repair procedure is to be performed, only the thickest joints of each type need to be qualified. Other thickness joints shall be considered qualified on the basis of the performance of the thickest joint.

6.1.5 GROOVE WELDED JOINTS

For groove welded joints in which all plate thicknesses are less than one inch or the length of repair is less than one inch, impact tests are not required. For groove welded joints in which any plate thickness exceeds one inch, the repair weld area of the qualification test weldment shall be large enough to permit Charpy impact test specimens to be removed.

6.1.5.1 Test Specimens

Charpy impact test specimens in the repaired area may be removed from any location with respect to plate thickness. Notch orientation and position shall be such that the repair weld area is tested as if it were the original weld.

6.1.6 REPAIR OF DEFECTS

Repair of defects of the type covered in subsection 3.7.2.1 and 3.7.2.2 of ANSI/AWS D1.1-82 shall be made using the preheat and interpass requirements specified for the original weld. Repair welds less than two (2) inches in length are not permitted.

6.1.7 DOCUMENTATION

Documentation shall be provided for all weld repairs performed.

6.1.8 PEENING

Repair of defects performed after stress relieving shall be peened in accordance with a procedure, submitted by the fabricator and approved by GE.

6.1.9 REVIEW REQUIREMENTS

Repair of surface defects whose greatest dimension is less than 3/32 inch shall be subject to review.

SECTION 7

REFERENCES

7.0 REFERENCES

(a) American Welding Society "Structural Welding Code" ANSI/AWS D1.1-82

(b) American Welding Society "Specification for Welding of Rotating Elements of Equipment", ANSI/AWS D1.1-81

(c) American Society of Mechanical Engineers" ASME Boiler and Pressure Vessel Code", Section IX (latest revision)

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A INCORP. AN-1 PER DCC-83-063 10/21/83

MATERIAL CONTROL DATA SPECIFICATION

FOR THE

MOD-5A WIND TURBINE GENERATOR

REV "A"
SEPT 83

JANUARY 1983

Responsible Engineer	DATE:	1/5/83
Responsible Engineer	DATE:	1/5/83
Subsystem Engineer	DATE:	1/5/83
Quality Assurance	DATE:	1-6-83
WTG Integration	DATE:	1/5/83
Manager of Engineering	DATE:	

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A	5	1.1.8	10/3/83	
A	6	1.2.2	10/3/83	
A	7	1.2.2.1	10/3/83	
A	8	1.2.2.2	10/3/83	

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1.0 MATERIAL SELECTION

Unless otherwise specified, structural steels on MOD-5A shall conform to one of the following grades shown below.

1.1 STRUCTURAL SHAPES AND PLATES

1.1.1 ASTM A516

Steel plate per ASTM A516 Grade 70 (added supplement S5 per ASTM A20 and ASTM A370) must be certified to 15 ft-lb minimum standard Charpy V-Notch impact strength at a +10°F test temperature. The orientation of test bars shall be transverse to the direction of final rolling. The supplier shall submit actual test data and certificate of conformance with the material. The maximum phosphorus and sulfur content in the product analysis shall be less than 0.01 per cent. The steel shall be fully killed and treated for inclusion shape control. The material shall be ultrasonically tested per ASTM A578, Level I.

1.1.2 ASTM A333

Steel pipe for low temperature service ASTM 333 Grade 6 (added supplements per ASTM A530, A370, and E23) must be certified to 15 ft-lb minimum standard Charpy V-Notch impact strength at a +10°F test temperature. The supplier shall submit actual test data and certificate of conformance with the material.

1.1.3 ASTM A36

Rolled steel shapes ASTM A36 (added supplements ASTM A6, ASTM A370), must be certified to 15 ft-lb minimum standard Charpy V-Notch impact strength at a +10°F test temperature. The orientation of test bars shall be transverse to the direction of final rolling for plates only. As per ASTM A673 section 5, frequency of testing shall be as designated (H) for both plates and rolled shapes. The supplier shall submit actual test data and certificate of conformance with the material.

1.1.4 ASTM A572

Structural steel per ASTM A572 Grade 42 or 50, Type 1 as specified on the pertinent drawing. The steel shall be made to a fine grain practice and normalized by heating to a suitable temperature which produces an austeritic structure, but not exceeding 1700°F (925°C), holding a sufficient time to attain uniform heat throughout the material and cooling in air. The steel shall be fully killed and treated for inclusion shape control. The maximum phosphorus and sulfur content in the product analysis shall be less than 0.01 per cent. Impact testing shall be piece testing in both the longitudinal and transverse directions at +10°F with a required minimum energy of 15 ft. lb. on the normalized material per ASTM A673. Impact tests at -40°F shall be performed and the results reported for information only. Tensile and impact tests shall be performed at 70°F on coupons heat treated at 1150°F for 12 hours and the results reported for information purposes only. The plate shall be ultrasonically inspected per ASTM A578 (including S2). The acceptance standard shall be that defined in Section S2.1 except the acceptable circle diameter is 1 inch. Test reports and data are required for all testing conducted. Note that Section 1.3 of this Specification applies to plate repair welding.

1.1.5 ASTM A678

Steel plate per ASTM A678 Grade B. The steel shall be fully killed and treated for inclusion shape control. The maximum phosphorus and sulfur content in the product analysis shall be less than 0.01 per cent. Impact testing shall be piece testing in both the longitudinal and transverse directions at -25°F with a required minimum energy of 25 ft. lb. on the quenched and tempered material per ASTM A673. Sufficient impact tests shall be made from the plate test material to establish a temperature absorbed energy curve. The test temperature range shall be wide enough to establish the upper and lower shelf foot-pound energies, with sufficient testing at intermediate temperatures to permit plotting a reasonably smooth curve. The plate shall be ultrasonically inspected per ASTM A578 (including S2). The acceptance standard shall be Level I. Test reports and data are required for all testing conducted. Note that Section 1.3 of this Specification applies to plate repair welding. The tempering temperature for all delivered material shall be reported.

1.1.6 ASTM A543 TYPE B CLASS 2

Steel plate per ASTM A543 Type B Class 2 must be certified to 25 ft-lb minimum standard Charpy V-notch impact strength at a -30°F test temperature per ASTM A20 S5. The orientation of test bars shall be both longitudinal and transverse to the direction of final rolling. The supplier shall submit actual test data and certificate of conformance with the material. The maximum phosphorus and sulfur content in the product analysis shall be less than 0.01 per cent. The steel shall be fully killed and treated for inclusion shape control. The material shall be ultrasonically tested per ASTM A578, Level I .

1.1.7 ASTM A633

Structural steel per ASTM A633, Grade C as specified on the pertinent drawing. The steel shall be fully killed, fine grain per Section 8.1 of ASTM A633, and treated for inclusion shape control. The maximum phosphorus and sulfur content in the product analysis shall each be less than 0.01 per cent. Impact testing shall be piece testing in both the longitudinal and transverse directions at +40°F with a required minimum energy of 35 ft lb. on the normalized material per ASTM A673. Sufficient impact tests shall be made from the plate test material to establish a temperature absorbed energy curve. The test temperature range shall be wide enough to establish the upper and lower shelf foot-pound energies, with sufficient testing at intermediate temperatures to permit plotting a reasonably smooth curve. The plate shall be ultrasonically inspected per ASTM A578 (including S2). The acceptance standard shall be that defined in Section S2.1 except the acceptable circle diameter is 1 inch. Test reports are required for all testing conducted. Note that Section 1.3 of this Specification applies to plate repair welding.

1.1.8 ASTM A533

Steel plate per ASTM A533, Type B, Class 1. The steel shall be fully killed and treated for inclusion shape control. The maximum phosphorus and sulfur content in the product analysis shall each be less than 0.01 per cent. Impact testing shall be piece testing in both the longitudinal and transverse directions at + 40°F with a required minimum energy of 35 ft. lb. on the quenched and tempered material per ASTM A673. Sufficient impact tests shall be made from the plate test material to establish a temperature absorbed energy curve. The test temperature range shall be wide enough to establish the upper and lower shelf foot-pound energies, with sufficient testing at intermediate temperatures to permit plotting a reasonably smooth curve. Tensile and impact tests shall also be performed at 70°F on coupons heat treated at 1150°F for 12 hours and the results reported for information purposes only. The plate shall be ultrasonically inspected per ASTM A578 (including S2). The acceptance standard shall be that defined in Section S2.1 except the acceptance circle diameter is 1 inch. Test reports and data are required for all testing conducted. Note that Section 1.3 of this specification applies to plate repair welding. The tempering temperature for all delivered material shall be reported.

1.2 FORGINGS

1.2.1 ASTM A266

Carbon steel forgings shall meet the requirements of Class 2 except that the minimum tensile yield point shall be 38,000 psi. In addition, the material must be certified to 15 ft-lb minimum standard Charpy V-Notch impact strength at a $+10^{o}F$ test temperature. The reduction ratio of drum and head shaped forgings shall be as specified in ASTM A266. Forgings of other shapes shall be reduced by a ratio of at least 3:1 from the cross-sectional area of the ingot. Test specimens shall be taken in the principal direction of elongation during forging. The supplier shall submit actual test data and certificate of conformance with the material.

Forgings shall have 100% ultrasonic examination in accordance with ASTM A388. Calibration and examination shall be appropriate to the configuration of the forging. Reference blocks shall be of forged block of the same chemical composition. Indication greater than that from .125 inch diameter flat bottom holes for straight beam examination shall be cause for rejection. Using angle beam examination, indications greater than from a notch 3 percent of the nominal thickness or .125 inch, whichever is less, shall be cause for rejection.

1.2.2 ASTM A508

Steel forging per ASTM A508, Class 2 or 4b (including Supplemental Requirements S1, S2, S3, and S5), as specified on the applicable drawing. The steel shall be treated for inclusion shape control. Per S1, the heat treatment of the samples

shall be that specified as postweld heat treatment on the drawing for the final structure. The forging shall be inspected according to Sections 1.2.2.1 and 1.2.2.2 of this specification. Per S5, the Charpy V-notch minimum requirements are 35 ft. lb. at -30°F for Class 4b and 35 ft. lb. at +40°F for Class 2. Multiple specimens shall be prepared coinciding with the longitudinal, tangential, and radial directions of the forging in accordance with paragraphs 6.1.2 and 6.1.4 of ASTM A508. The maximum sulfur and phosphorus content are both restricted to 0.012 per cent in the product analysis. Test reports and data are required for all testing conducted. A508 class 2 may not be suitable for use in AASHTO zone 3 temperature environs.

1.2.2.1 Ultrasonic Inspection

Forging shall be 100% straight beam ultrasonically inspected per ASTM A508 Finished part shall be 100% straight and angle beam inspected per ASTM A508. Any indications greater than that produced by the criteria stated in Table 1.2.2-1 shall be cause for rejection. Zones A or B (Table 1.2.2-1) are to be applied as stated on applicable drawing. Per S2, the test block shall be in accordance with S2.1.1.

Indications which have a signal amplitude of 50% of reference signal amplitude are relevant. Relevant indications must be separated by at least three times the rejection criteria. No more than ten (10) relevant indications are permitted in any six (6) square inch area with major dimension not to exceed six (6) inches. No more than four (4) relevant indications are permitted in any one (1) square inch area with major dimension not to exceed one (1) inch. Non conformance with above requirement shall be cause for rejection.

1.2.2.2 Magnetic Particle Inspection

Finished part to be 100% magnetic particle inspected on surfaces indicated on applicable drawings per ASTM A-275. Any indications greater than that produced by the criteria stated in Table 1.2.2-1 shall be cause for rejection. Zones A or B (Table 1.2.2-1) are to be applied as stated on applicable drawing. Indications one half the rejection criteria or greater are relevant. Relevant indications must be separated by at least three times the inspection criteria. No more than ten (10) relevant indications are permitted in any six (6) square inch area with major dimension not to exceed six (6) inches. No more than four (4) relevant indications are permitted in any one (1) square inch area with major dimension not to exceed one (1) inch. Non conformance with above requirements shall be cause for rejection.

TABLE 1.2.2-1

INSPECTION CRITERIA
(Inches)

	Ultrasonic Criteria		
	Flat Bottom Hole Size	60° V-Notch Size	Magnetic Particle Criteria
Zone A	.060	.060	.040
Zone B	.100	.100	.080

1.3 WELDING REPAIR

Welding repair shall be in accordance with GE specification 47A380054.

GENERAL ELECTRIC

47A380067
CONT ON SHEET ii SH NO i

REV NO. A

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TITLE

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FOR THE
MOD-5A WIND TURBINE GENERATOR

DECEMBER 1982

Keith E. Ekland DATE: 12-8-82
Responsible Engineer

G.P. Schongenbach DATE: 12-8-82
Subsystems Engineer

[signature] DATE: 12-10-82
Systems Engineering

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A	5	3.4.3	"	"
A	8	3.4.6, 3.4.7	"	"

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SECTION 1.0

SCOPE

This specification establishes the performance, design and test requirements for an Uninterruptible Power System, hereafter referred to as the UPS, intended for use on the MOD-5A Wind Turbine Generator (WTG) System. The requirements are for either an indoor or outdoor unit. The outdoor unit requirements are indicated on pages where they apply.

1.1 INTRODUCTION

The UPS will provide AC power to the Control Subsystem and aircraft warning devices during normal operation, and using a battery reservoir, during a utility power failure.

SECTION 2.0

APPLICABLE DOCUMENTS

The following documents of the date of this issue, or as indicated below, form a part of this specification to the extent referenced herein. In the event of conflict between this specification and the documents referenced herein, the contents of this specification shall be considered as superceding requirements.

2.1 GENERAL ELECTRIC

47E387001	Electrical System One-Line Diagram
47A380048	Specification For Material Finishes, MOD-5A
(Later)	Specification Control Drawing

SECTION 3.0

REQUIREMENTS

3.1 GENERAL

The UPS will provide AC power to the Control Subsystem and other loads during normal operation and, using a battery reservoir, during a utility power failure. The UPS shall provide 3 KVA of continuous power at 120 VAC, 1Ø, and 60 Hz.

3.2 CONFIGURATION

The UPS will include a Rectifier/Battery Charger, Battery Reservoir and Rack, Inverter and a Transfer Switch. The outdoor unit will be housed in a cabinet providing front and rear access suitable for outdoor use with the environments specified in Paragraph 3.3. Maintenance must be easily accomplished via hinged front panel.

3.2.1 WEIGHT

The maximum weight of the UPS shall not exceed 2000 pounds.

3.2.2 SIZE

The maximum size of the UPS shall not exceed 75 inches high, 36 inches wide and 28 inches deep.

3.2.3 INTERFACE

The UPS shall be mounted on a poured concrete foundation pad. Electrical connections shall be made to terminal boards located within the UPS cabinet for the outdoor unit or within the inverter cabinet for the indoor unit.

3.3 ENVIRONMENTAL (Outdoor Unit Only)

The UPS cabinet shall supply all necessary heating and ventilating required for operation within the environmental limits specified in Table 1. For certain seacost applications, unusual service conditions of high humidity and salt atmopshere may be encountered and will be called out as the "salt atmosphere" option on the procurement document in addition to the requirements of Table 1. For this case, suitable air filtration, coatings and additional corrosion protection shall be provided.

TABLE 1

ENVIRONMENTAL CONDITIONS

Shipping Shock	2 g's 100 ms lateral 5 g's 100 ms vertical and horizontal 20 g's 100 ms horizontal (uncushioned rail, only if so shipped)
Temperature	-40 degrees C to 50 degrees C ambient (survival) -30 degrees C to 40 degrees C ambient (operational - outdoor unit) 0 degree C to 50 degrees C ambient (operational-indoor unit)
Wind	120 mph (outdoor unit)
Altitude	0 - 7000 feet above sea level
Snow Loading	30 pounds/sq foot (outdoor unit)

3.4 ELECTRICAL

The UPS shall be a basic non-redundant system configured as shown in Figure 1.

3.4.1 INPUT

The UPS input voltage will be 120 VAC, 1Ø, 60 Hertz.

3.4.2 OUTPUT

The UPS output shall provide 3 KVA of continuous power at 120 VAC, 1Ø, 60 Hz.

3.4.2.1 Voltage Regulation

The voltage regulation shall be ±3% over worst-case combinations of temperature, input voltage, load current and power factor.

3.4.2.2 Waveshape

The UPS output shall be a sine wave with a maximum harmonic distortion of 5%.

3.4.2.3 Power Factor

The UPS output shall accept loads of up to .8 lagging or .8 leading.

3.4.2.4 Frequency

The output frequency shall be 60 ±1 Hertz.

3.4.2.5 Current Overload

The output of the UPS shall be capable of 125% of normal load for fifteen (15) minutes while maintaining a ±3% voltage regulation.

3.4.2.6 Current Limiting

The UPS shall have inherent current-limiting and short-circuit capability - it shall survive a dead short at the output terminals indefinitely and return to normal operation immediately upon its removal.

3.4.3 BATTERY RESERVOIR

The battery reservoir shall be sufficient for thirty (30) minutes backup at 3 KVA and rechargeable within eight (8) hours.

3.4.3.1 Battery Life

The battery service life shall not be less than fifteen (15) years under normal operation with routine maintenance.

3.4.4 STATIC TRANSFER SWITCH

The static transfer switch shall sense the loss of normal inverter output and switch to the auxiliary bypass power in a total of less than four (4) milliseconds. A manual switch over shall be required to restore the load to the converter.

3.4.5 FAULT DETECTION

The following items shall be monitored for an out-of-limits condition and the specified response shall occur.

3.4.5.1 AC Input Power

The UPS Control System shall provide an open set of relay contacts (contacts held closed during normal operation) to indicate loss of AC power. Contacts shall be accessible for user wiring.

3.4.5.2 Battery Status

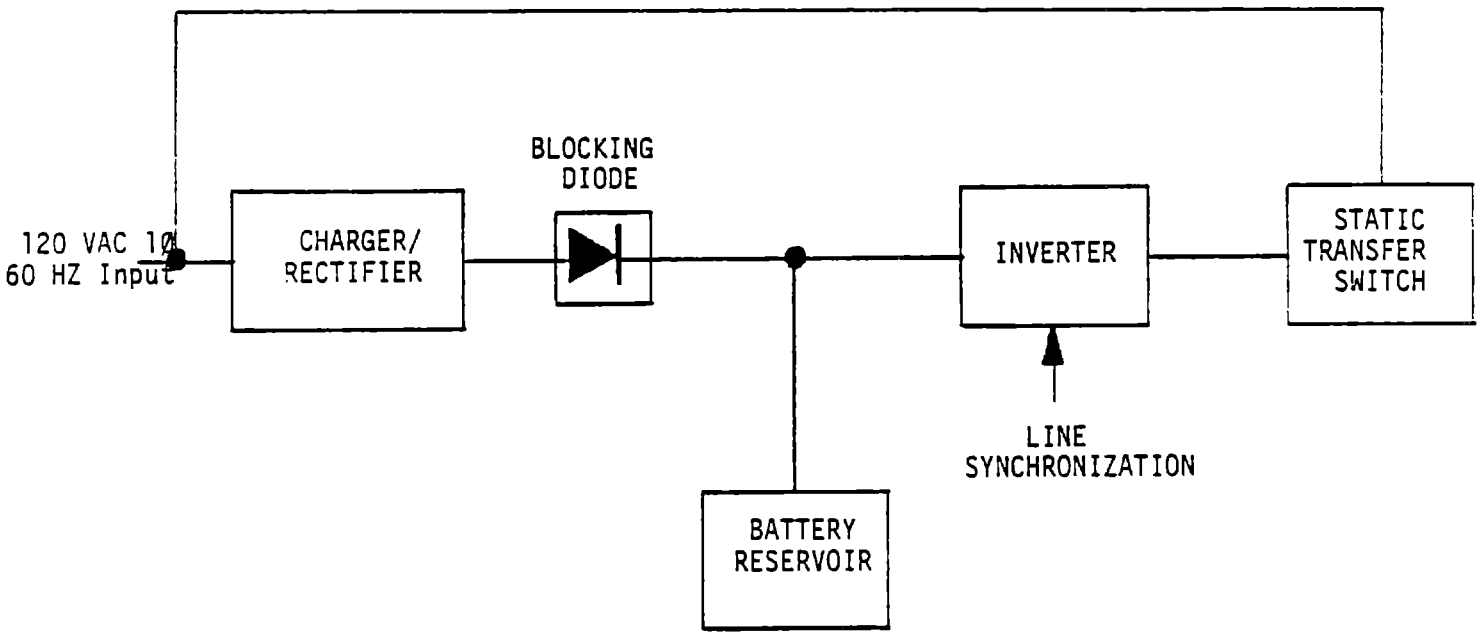
The UPS Control System shall provide an open set of relay contacts (contacts held closed during normal operation) to indicate a battery reservoir low voltage condition. Relay contacts shall be accessible for user wiring.

3.4.5.3 Transfer Status

In the event of a static transfer switchover an alarm light shall be illuminated and an open set of relay contacts (contacts held closed during normal operation) shall indicate the transfer.

FIGURE 1

UNINTERRUPTIBLE POWER SYSTEM (UPS)



3.4.6 STATUS

Analog panel meters with ±3% accuracy shall be provided within the UPS cabinet, for the outdoor unit, or on the front panel of the inverter cabinet for the indoor unit, to monitor the following:

- o AC Output Voltage
- o AC Output Current
- o Output Frequency
- o DC Battery Voltage

3.4.7 FINISH (Outdoor Unit)

The UPS Cabinet shall be painted in accordance with GE Specification 47A380048 (semi-gloss blue/ Fed-Std-595, Color 25177).

3.4.8 RELIABILITY

The expected lifetime of the UPS System shall be 30 years, with routine maintenance. Batteries shall be as specified in Paragraph 3.4.3.1.

3.4.9 MAINTAINABILITY

Routine maintenance shall be able to be performed on site. Interval between routine maintenance cycles shall be not less than one (1) year.

SECTION 4.0

VERIFICATION

4.1 GENERAL REQUIREMENTS

4.1.1 TEST SITE

All inspections, examinations and tests of the UPS shall be made at the vendor's plant unless otherwise specified.

4.1.2 TEST CONDITIONS

All tests shall be performed at room ambient conditions of temperature, humidity and atmospheric pressure unless otherwise specified.

4.1.3 TEST PROCEDURE

All tests shall be conducted using documented test procedures approved by GE. All test procedures shall contain data sheets on which the results of the individual tests may be recorded.

4.1.4 TEST REPORTS

A test report containing the test procedure, test results and test conclusions snall be provided with each UPS presented for delivery when specified.

4.1.5 ACCEPTANCE TESTS

The following acceptance tests shall be performed on each UPS Assembly presented for delivery. The tests may be performed in any sequence unless otherwise specified.

4.2.1 Visual Examination

4.2.2 Dimensional Inspection

4.2.3 Insulation Resistance Test

4.2.4 Dielectric Strength Test

4.2.5 Circuit Continuity Test

4.2.6 Operational Verification

4.2 SPECIFIC TEST REQUIREMENTS

4.2.1 VISUAL EXAMINATION

The assembly shall be visually examined to assure that it is free from all defects that could adversely affect its life or make it unsuitable for its intended use.

4.2.2 DIMENSIONAL INSPECTION

The assembly shall be measured to verify that it fits within the space enveloped defined.

4.2.3 INSULATION RESISTANCE TEST

The insulation resistance between each circuit and all other circuits and ground shall be measured at 500 ±10% volts DC. The insulation resistance shall not be less than 10 meg ohms.

4.2.4 DIELECTRIC STRENGTH TEST

The dielectric strength test voltage, 500 volts AC R.M.S, 60 Hz, shall be applied for a minimum of ten (10) seconds between each circuit and all other circuits and ground. The leakage current shall not exceed 50 microamperes as measured by a micro-ammeter or other suitable means.

4.2.5 CIRCUIT CONTINUITY TEST

The end-to-end continuity of each circuit shall be verified.

4.2.6 OPERATIONAL VERIFICATION

The UPS System performance shall be checked and that the following functions are within specification.

- o Output voltage per paragraph 3.4.2
- o Output voltage regulation per paragraph 3.4.2.1
- o Output waveshape per paragraph 3.4.2.2
- o Power factor per paragraph 3.4.2.3
- o Frequency per paragraph 3.4.2.4
- o Current overload per paragraph 3.4.2.5
- o Current limiting per paragraph 3.4.2.6
- o Static transfer switch per paragraph 3.4.4
- o Fault detection per paragraph 3.4.5.1, 3.4.5.2 and 3.4.5.3
- o Status per paragraph 3.4.5

4.2.7 APPROVAL

Review and approval of all test results by a General Electric Quality Assurance representative is required prior to shipment of the UPS.

SECTION 5.0

PREPARATION FOR DELIVERY

The manufacturer shall submit a statement detailing the normal practice of packaging and method of delivery for approval by:

General Electric Company
Advanced Energy Programs Department
P.O. Box 527
King of Prussia, PA 19406

5.1 DOCUMENTS

o Certified detailed outline drawing	a, b
o Connection diagrams	a, b
o Complete instructions with parts list	b
o Detailed summary or equipment list	b
o Three (3) certified copies of test data	b
o Recommended Spare Parts List	b

5.1.1 DOCUMENT SUBMITTAL

Documents marked "a" shall be submitted for examination or approval within six (6) weeks of order by sending two (2) copies to General Electric Company, Advanced Energy Programs Department, MOD-5A Engineering, P.O. Box 527, King of Prussia, PA 19406. Approval or comments will be returned within two (2) weeks of receipt.

Documents marked "b" shall be supplied with shipment. One (1) mylar reproducible and ten (10) copies of each drawing shall be supplied. Twelve (12) copies of instruction books shall be supplied. In addition, one copy of all documents shall be enclosed with shipment.

Documents marked "a, b" shall meet submittal requirements of both "a" and "b".

AUXILIARY POWER TRANSFORMER, 300 KVA SPECIFICATION

FOR THE

MOD-5A WIND TURBINE GENERATOR

DECEMBER 1982

Responsible Engineer — DATE: 12-6-82

Subsystems Engineer — DATE: 12-6-82

Systems Engineering — DATE: JAN-3-1983

Quality Assurance — DATE: 12-6-82

WTG Integration — DATE:

TOTAL NUMBER OF PAGES 12

WTG 512

PRINTS TO

REVISION LOG

This log identifies those portions of this document which have been revised since original issue. Revised portions of each page, for the current revision only, are identified by marginal striping.

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SECTION 1.0

SCOPE

This specification covers the electrical and mechanical requirements of a three phase, 60 Hertz, mineral-oil immersed, self-cooled, pad mounted compartmental-type distribution transformer rated at 300 KVA.

1.1 INTRODUCTION

The 300 KVA transformer hereafter referred to as the transformer assembly is intended for use on the MOD-5A Wind Turbine Generator System to step-down 4160 Volt site power to 480V for auxiliary power distribution.

SECTION 2.0

APPLICABLE DOCUMENTS

The following documents of the date of issue of this specification or as indicated below form a part of this specification to the extent referenced herein. In the event of conflict between this specification and the documents referenced herein, the contents of this specification shall be considered a superceding requirement.

2.1 GENERAL ELECTRIC

47A380048 Specification for Material Finishes, MOD-5A

2.2 INDUSTRY STANDARDS

ANSI

C57.12.00 Requirements, Terminology and Test Codes for Transformers

C57.12.22 Requirements for Pad-mounted Compartmental-type, Self-cooled, Three-phase Distribution Transformers

C57.12.70 Terminal Markings and Connections

C47.12.90 Test Code

C57.12.80 Terminology

SECTION 3.0

REQUIREMENTS

3.1 ELECTRICAL

3.1.1 GENERAL

Unless otherwise specified herein the requirements of ANSI Standard C57.12.22 Sections 2, 3 and 4 shall apply.

3.1.2 DESCRIPTION

The transformer shall have a continuous 3 Phase Kilovolt-ampere rating of 300 at 60 Hertz with a primary input voltage of 4160 and a secondary voltage of 480Y/277.

The primary/secondary windings shall be delta/wye connected.

3.1.3 IMPEDANCE

The impedance shall be 4.5%.

3.2 CONSTRUCTION

3.2.1 GENERAL

Unless otherwise specified herein the requirements of ANSI Standard C57.12.22 Section Six (6) shall apply.

3.2.2 BUSHINGS AND TERMINALS

3.2.2.1 Primary Connections

The primary connections shall be made using deadbreak connectors.

3.2.2.2 Secondary Connections

The secondary connections shall be made to blade type low voltage bushings. The blade shall accommodate and support two (2) each per phase, 3/0 copper cables.

3.2.3 ENVELOPE

The transformer assembly shall be within an envelope of 71 inches in height, 81 inches in width and 92 inches in depth.

3.2.4 WEIGHT

The maximum weight of the transformer assembly shall not exceed 5000 pounds.

3.2.5 FINISH

Transformer assembly shall be painted in accordance with GE Specification 47A380048 (semi-gloss blue/Fed - Std - 595, Color 25177).

3.2.6 WIRING INTERFACE

All wiring shall enter and leave the compartment sections from the bottom.

3.3 ACCESSORY EQUIPMENT

In addition to the accessory equipment listed in Table 5 of ANSI Standard C57.12.22 the following shall also be supplied.

- o Dial type thermometer to indicate the top-liquid temperature
- o Liquid-level gauge
- o Mecnanical, resealing, pressure relief device

3.4 ENVIRONMENTAL

The transformer assembly must be able to survive, without damage, the conditions listed in Table 3-1. Transformer operation at altitudes in excess of 3300 feet will be subject to customer derating per manufacturer's instructions.

TABLE 3-1

ENVIRONMENTAL CONDITIONS

Shipping Shock	2 g's 100 ms lateral 5 g's 100 ms vertical and horizontal 20 g's 100 ms horizontal (uncushioned rail, only if so shipped)
Temperature	-40 degrees C to 50 degrees C ambient (survival) -30 degrees C to 40 degrees C ambient (operational)
Wind	120 mph
Altitude	0 - 7000 feet above sea level
Humidity	0 - 100%

3.5 RELIABILITY

The expected lifetime of the transformer assembly shall be thirty (30) years.

3.6 MAINTAINABILITY

Routine maintenance shall be able to be performed on site. Interval between routine maintenance cycles shall be not less than one (1) year.

SECTION 4.0

VERIFICATION

4.1 STANDARD TEST

The following tests will be made as a minimum by the vendor. The numbers shown do not necessarily indicate the sequence in which the tests shall be performed. All tests shall be performed in accordance with the latest revision of ANSI Standard Test Code for Transformers C57.12.90 - 1968.

4.1.1 TEST SITE

All inspections, examinations and tests of the Transformer Assembly shall be made at the vendor's plant unless otherwise specified.

4.1.2 TEST CONDITIONS

All tests shall be performed at room ambient conditions of temperature, humidity and atmospheric pressure unless otherwise specified.

4.1.3 TEST PROCEDURE

All tests shall be conducted using documented test procedures approved by GE. All test procedures shall contain data sheets on which the results of the individual tests may be recorded.

4.1.4 TEST REPORTS

A test report containing the test procedure, test results and test conclusions shall be provided with each Transformer Assembly presented for delivery when specified.

4.1.5 ACCEPTANCE TESTS

The following acceptance tests shall be performed on each Transformer Assembly presented for delivery. The tests may be performed in any sequence unless otherwise specified.

4.2.1 Visual Examination

4.2.2 Dimensional Inspection

4.2.3 Insulation Resistance Test

4.2.4 Dielectric Strength Test

4.2 SPECIFIC TEST REQUIREMENTS

4.2.1 VISUAL EXAMINATION

The assembly shall be visually examined to assure that it is free from all defects that could adversely affect its life or make it unsuitable for its intended use.

4.2.2 DIMENSIONAL INSPECTION

The assembly shall be measured to verify that it fits within the space enveloped defined.

4.2.3 INSULATION RESISTANCE TEST

The insulation resistance between each winding and all other windings and ground shall be measured at 500 ±10% volts DC. The insulation resistance shall not be less than 10 meg ohms.

4.2.4 DIELECTRIC STRENGTH TEST

A dielectric strength test shall be performed on the primary and the secondary of each transformer. The test voltage, see Table 4-1, AC R.M.S., 60 Hz, shall be applied for a minimum of one (1) minute between each circuit and all other circuits and ground. The leakage current shall not exceed, see Table 4-1, milliamperes as measured by a milliammeter or other suitable means.

Table 4-1

DIELECTRIC STRENGTH TEST

	Test Voltage	Leakage Current
Secondary	10 KV	1 ma
Primary	19 KV	2 ma

SECTION 5.0

PREPARATION FOR DELIVERY

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P.O. Box 527
King of Prussia, PA 19406

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o	Certified detailed outline drawing	a, b
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Documents marked "a, b" shall meet submittal requirements of both "a" and "b".

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16. Abstract

This report documents the design, development and analysis of the 7.3MW MOD-5A wind turbine generator covering work performed between July 1980 and June 1984. The report is divided into four volumes: Volume I summarizes the entire MOD-5A program, Volume II discusses the conceptual and preliminary design phases, Volume III describes the final design of the MOD-5A, and Volume IV contains the drawings and specifications developed for the final design.

Volume IV contains the drawings and specifications that were developed in preparation for building the MOD-5A wind turbine generator.

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