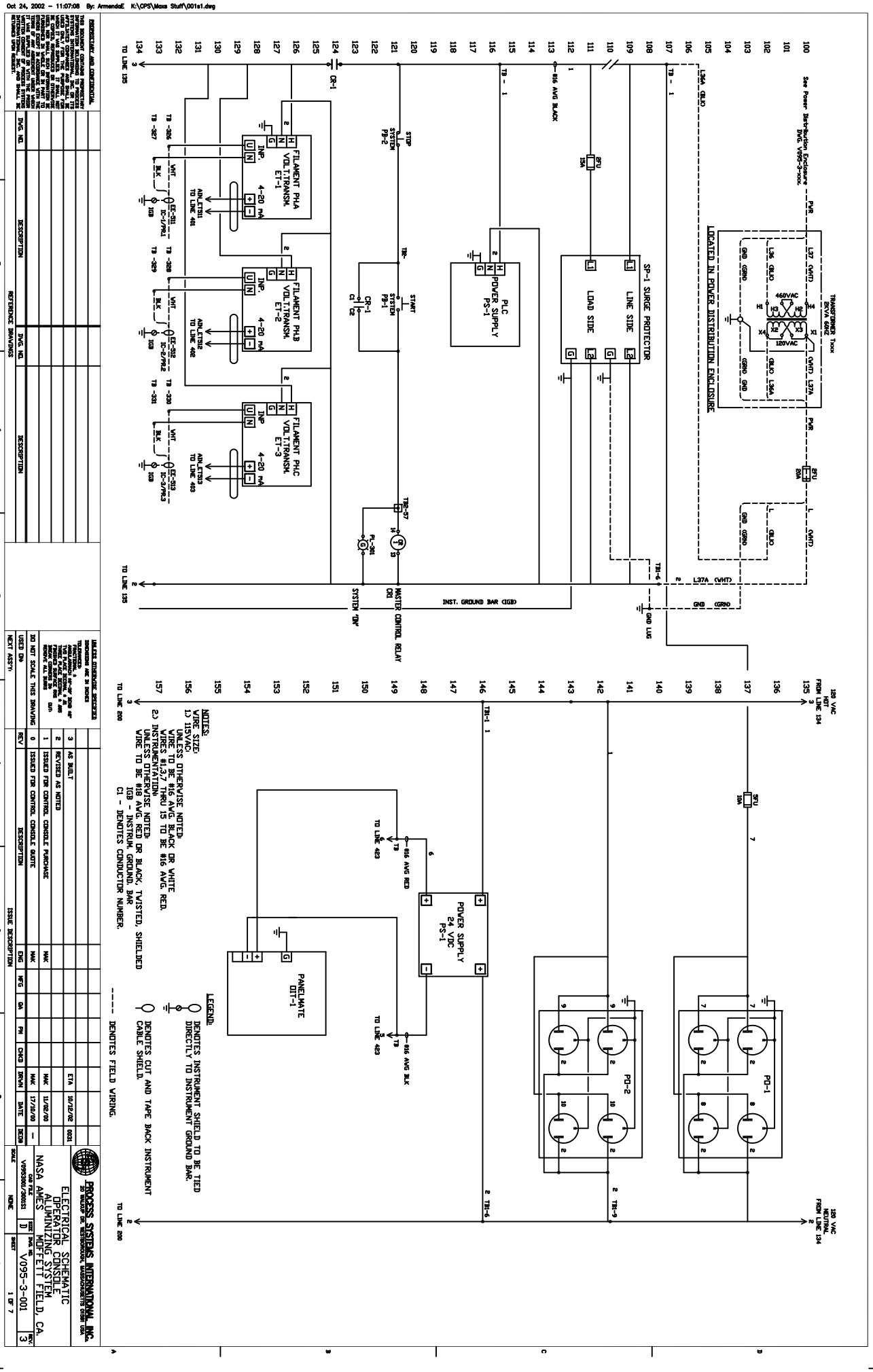
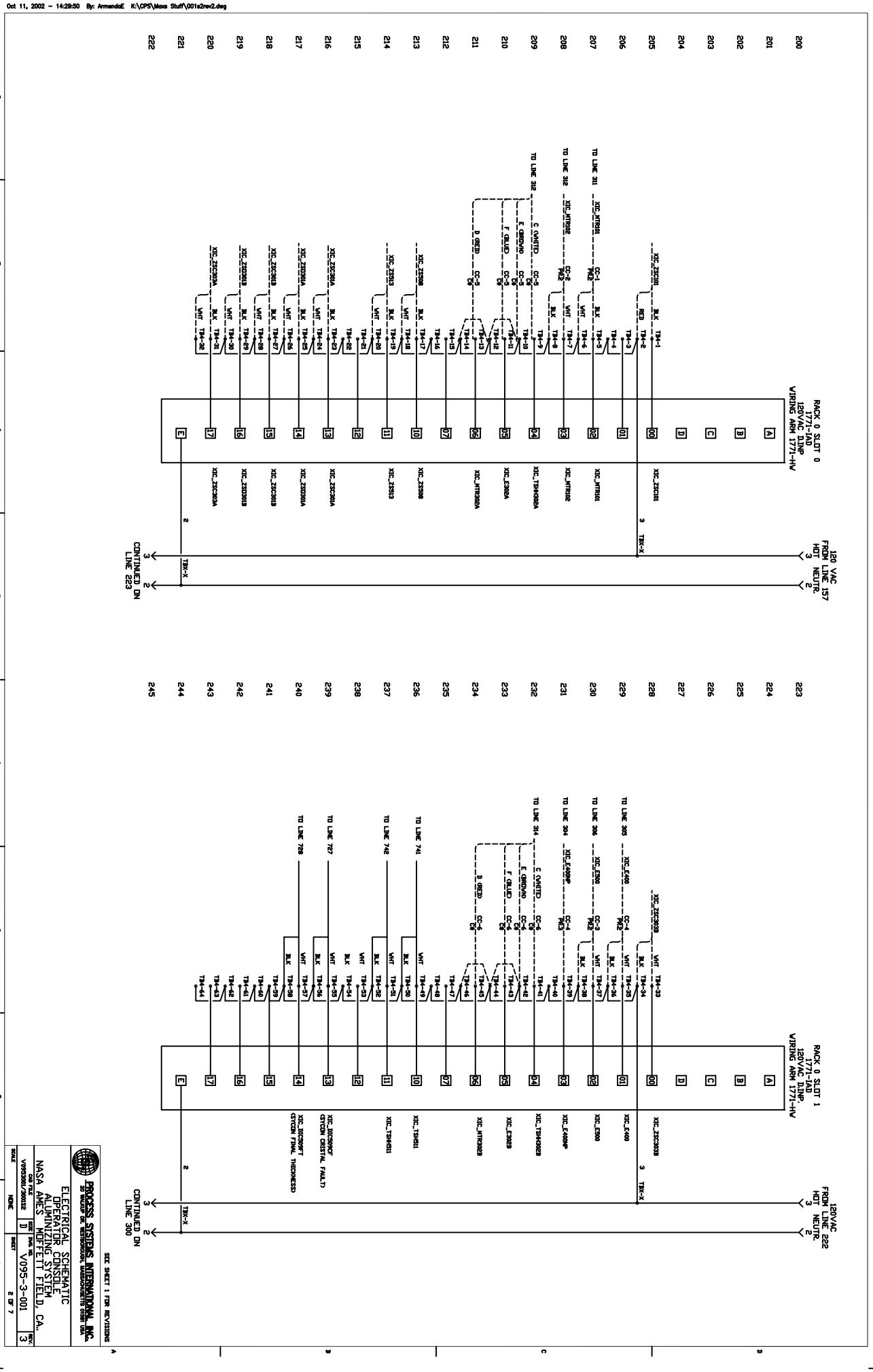
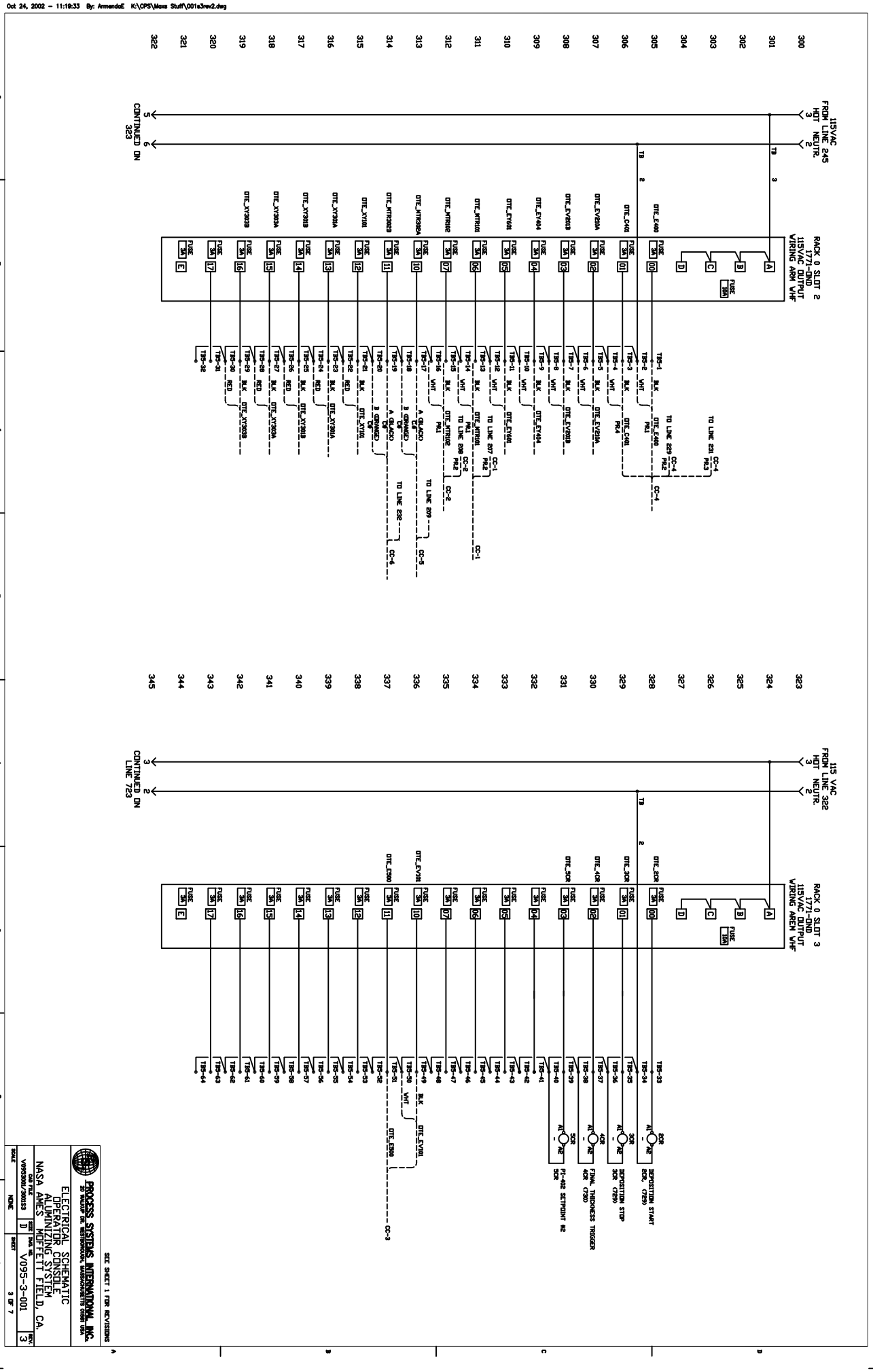
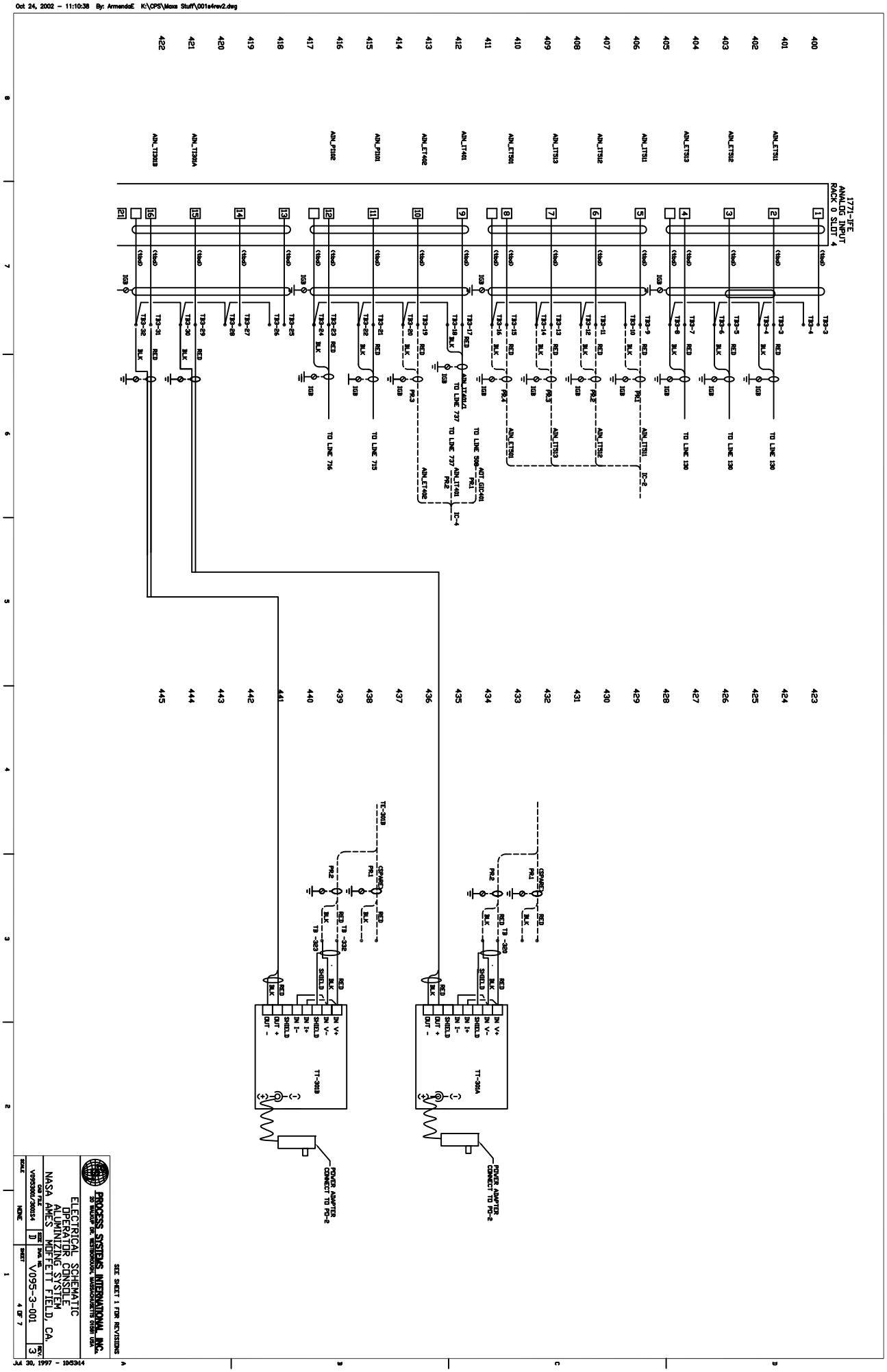
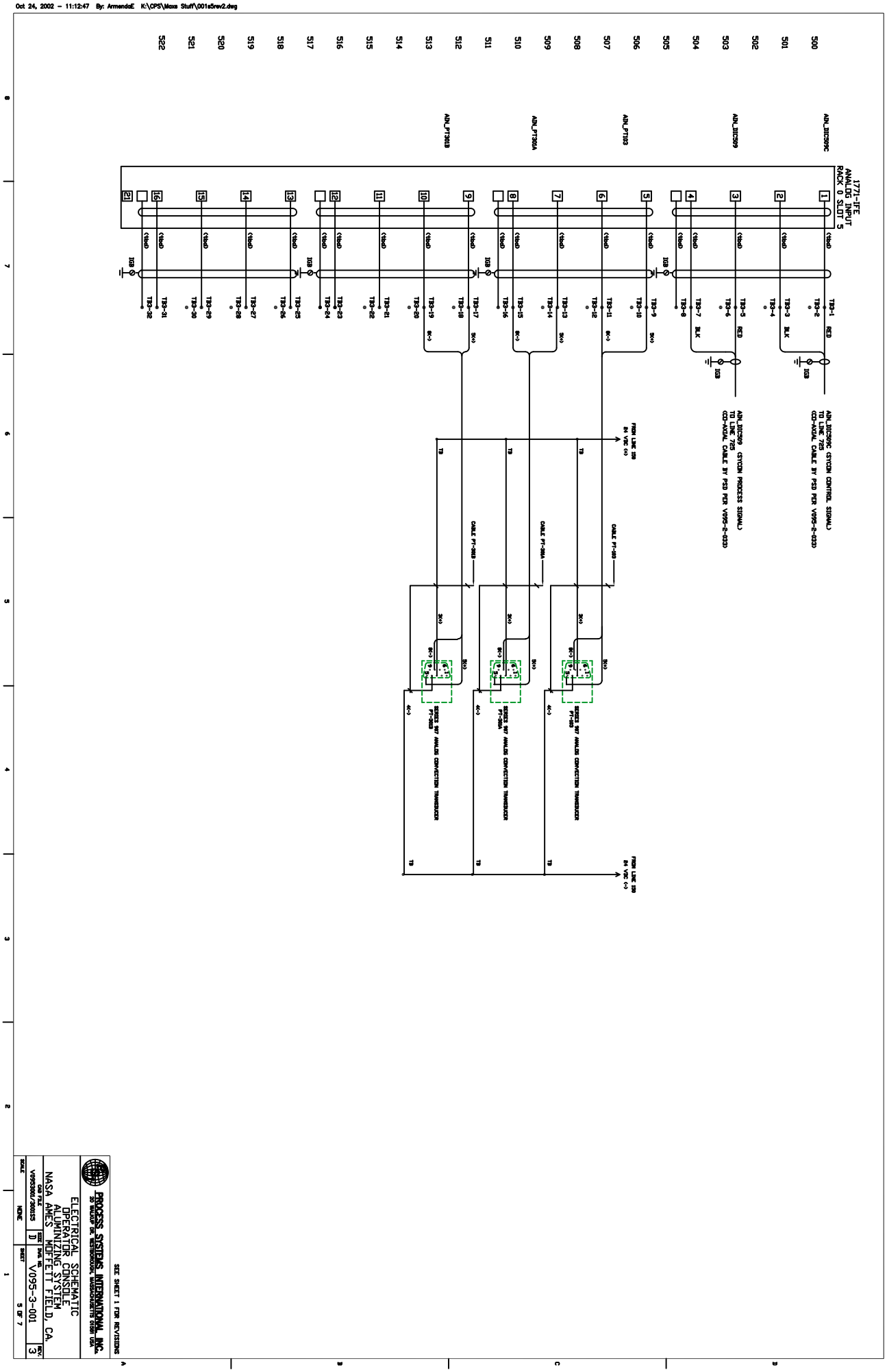
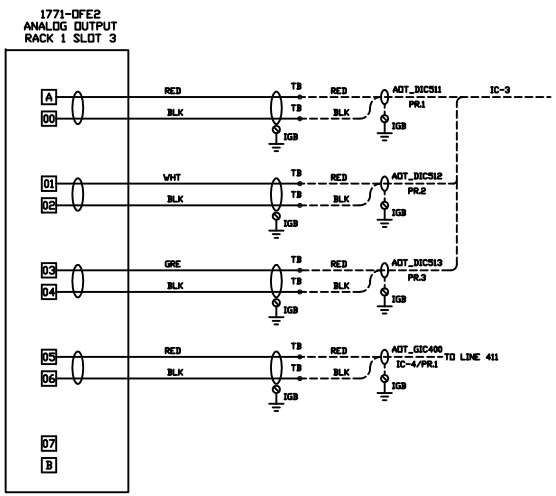

Oct 24, 2002 - 11:07:08 By: ArmandoE K:\CPS\Moxa Stuff\001s1.dwg
TRANSFORMER 3KVA 60HZ
460VAC
120VAC
LOCATED IN POWER DISTRIBUTION ENCLOSURE
SP-1 SURGE PROTECTOR
LINE SIDE
LOAD SIDE
PLC POWER SUPPLY PS-1
FILAMENT PH.A VOLT.TRANSM. ET-1
FILAMENT PH.B VOLT.TRANSM. ET-2
FILAMENT PH.C VOLT.TRANSM. ET-3
4-20 mA
MASTER CONTROL RELAY CR1
INST. GROUND BAR (IGB)
GND LUG
PD-1
PD-2
POWER SUPPLY 24 VDC PS-1
PANELMATE DIT-1
TO LINE 135
FROM LINE 134
TO LINE 200
NOTES:
WIRE SIZE:
1.) 115VAC:
UNLESS OTHERWISE NOTED:
WIRE TO BE #16 AWG. BLACK OR WHITE
WIRES #1-37 THRU 15 TO BE #16 AWG. RED.
2.) INSTRUMENTATION:
UNLESS OTHERWISE NOTED:
WIRE TO BE #18 AWG. RED OR BLACK, TWISTED, SHIELDED
IGB - INSTRUM. GROUND BAR
CI - DENOTES CONDUCTOR NUMBER.
LEGEND:
DENOTES INSTRUMENT SHIELD TO BE TIED DIRECTLY TO INSTRUMENT GROUND BAR.
DENOTES CUT AND TAPE BACK INSTRUMENT CABLE SHIELD.
---- DENOTES FIELD WIRING.
PROCESS SYSTEMS INTERNATIONAL INC.
ELECTRICAL SCHEMATIC
OPERATOR CONSOLE
ALUMINIZING SYSTEM
NASA AMES
MOFFETT FIELD, CA.
V095-3-001
SCALE: NONE
SHEET 1 OF 7
REV 3

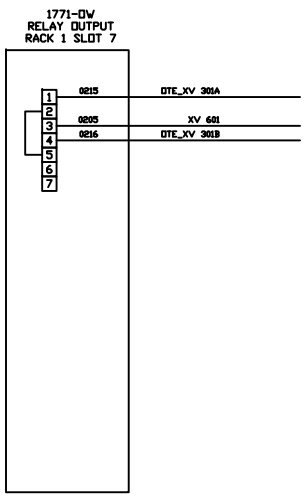

Oct 11, 2002 - 14:29:50 By: ArmandoE K:\CPS\Mdxx Stuff\001s2rev2.dwg
RACK 0 SLOT 0
1771-IAD
120VAC D.INP.
WIRING ARM 1771-HV
120 VAC
FROM LINE 157
HOT
NEUTR.
CONTINUED ON
LINE 223
RACK 0 SLOT 1
1771-IAD
120VAC D.INP.
WIRING ARM 1771-HV
120VAC
FROM LINE 222
HOT
NEUTR.
CONTINUED ON
LINE 300
PROCESS SYSTEMS INTERNATIONAL INC.
ELECTRICAL SCHEMATIC
OPERATOR CONSOLE
ALUMINIZING SYSTEM
NASA AMES MOFFETT FIELD, CA.
V095-3-001
REV 3
SEE SHEET 1 FOR REVISIONS


Oct 24, 2002 - 11:19:33 By: ArmandoE K:\CPS\Mova Stuff\001a3rev2.dwg
115VAC FROM LINE 245 HOT 3 NEUTR. 2
RACK 0 SLOT 2 1771-DND 115VAC OUTPUT WIRING ARM VHF
CONTINUED ON 323
DTE_E400
DTE_C401
DTE_EV201A
DTE_EV201B
DTE_EV401
DTE_EV404
DTE_XTR201A
DTE_XTR202
DTE_XTR203A
DTE_XTR203B
DTE_XY201A
DTE_XY201B
DTE_XY203A
DTE_XY203B
DTE_XY101
TO LINE 231 PR3
TO LINE 229 PR2
TO LINE 227 PR2
TO LINE 225 PR1
TO LINE 209
TO LINE 228
115 VAC FROM LINE 322 HOT 3 NEUTR. 2
RACK 0 SLOT 3 1771-DND 115VAC OUTPUT WIRING AREM VHF
CONTINUED ON LINE 723
DTE_SCR
DTE_3CR
DTE_4CR
DTE_SCR
DTE_EV101
DTE_E300
SCR AI 2 DEPOSITION START SCR, C729
SCR AI 2 DEPOSITION STOP 3CR (729)
4CR AI 2 FINAL THICKNESS TRIGGER 4CR C730
SCR AI 2 P1-402 SETPOINT #2 SCR
TO LINE 209
SEE SHEET 1 FOR REVISIONS
PROCESS SYSTEMS INTERNATIONAL INC.
ELECTRICAL SCHEMATIC
OPERATOR CONSOLE
ALUMINIZING SYSTEM
NASA AMES MOFFETT FIELD, CA.
V095-3-001
REV 3
SIZE D
SHEET 3 OF 7
SCALE NONE


Oct 24, 2002 - 11:10:38 By: ArmandoE K:\CPS\Mona Stuff\001s4rev2.dwg
1771-IFE
ANALOG INPUT
RACK 0 SLOT 4
ADN_LT501
ADN_LT502
ADN_LT503
ADN_LT504
ADN_LT401
ADN_LT402
ADN_TI001
ADN_PI002
ADN_TI003B
ADN_TI003A
TO LINE 130
TO LINE 716
TO LINE 715
TO LINE 737
TO LINE 506
ADT_GUC401
TE-3019
TT-3019
TT-300A
POWER ADAPTER
CONNECT TO PD-2
PROCESS SYSTEMS INTERNATIONAL INC.
ELECTRICAL SCHEMATIC
OPERATOR CONSOLE
ALUMINIZING SYSTEM
NASA AMES MOFFETT FIELD, CA.
V095-3-001
SEE SHEET 1 FOR REVISIONS
Jul 30, 1997 - 105344


Oct 24, 2002 - 11:12:47 By: ArmandaE K:\CPS\Moxa Stuff\001s5rev2.dwg
1771-IFE
ANALOG INPUT
RACK 0 SLOT 5
ADN_BIC309C
ADN_BIC309
ADN_FT303A
ADN_FT303
ADN_FT303B
ANALOG CONVECTION TRANSDUCER
CABLE PT-303
CABLE PT-303A
CABLE PT-303B
FROM LINE 209
TO LINE 725
PROCESS SYSTEMS INTERNATIONAL INC.
ELECTRICAL SCHEMATIC
OPERATOR CONSOLE
ALUMINIZING SYSTEM
NASA AMES MOFFETT FIELD, CA.
V095-3-001
SEE SHEET 1 FOR REVISIONS





SEE SHEET 1 FOR REVISIONS

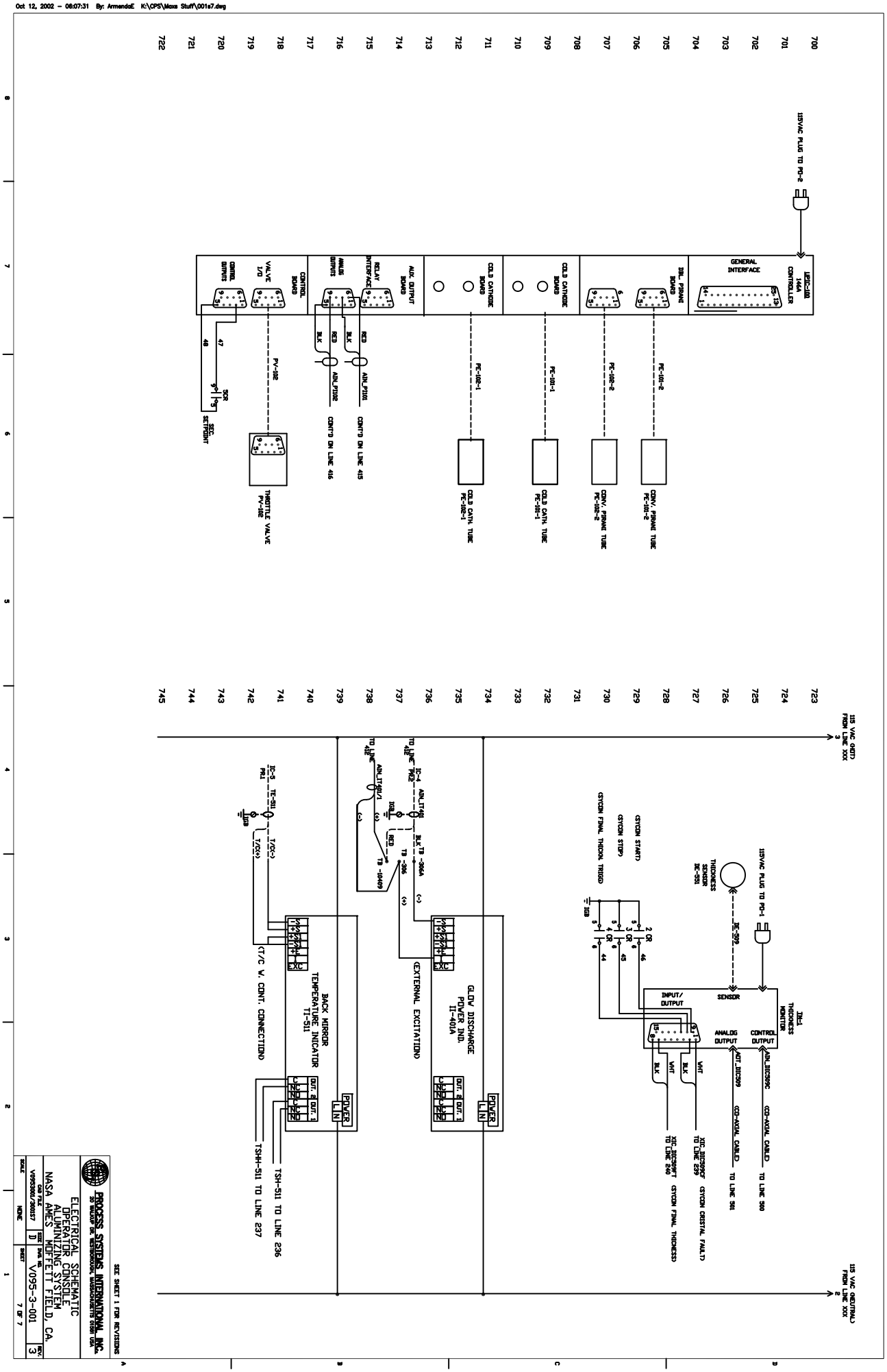
PROCESS SYSTEMS INTERNATIONAL INC.
20 WALKUP DR. WESTBOROUGH, MASSACHUSETTS 01581 USA

ELECTRICAL SCHEMATIC
OPERATOR CONSOLE
ALUMINIZING SYSTEM
NASA AMES MOFFETT FIELD, CA.

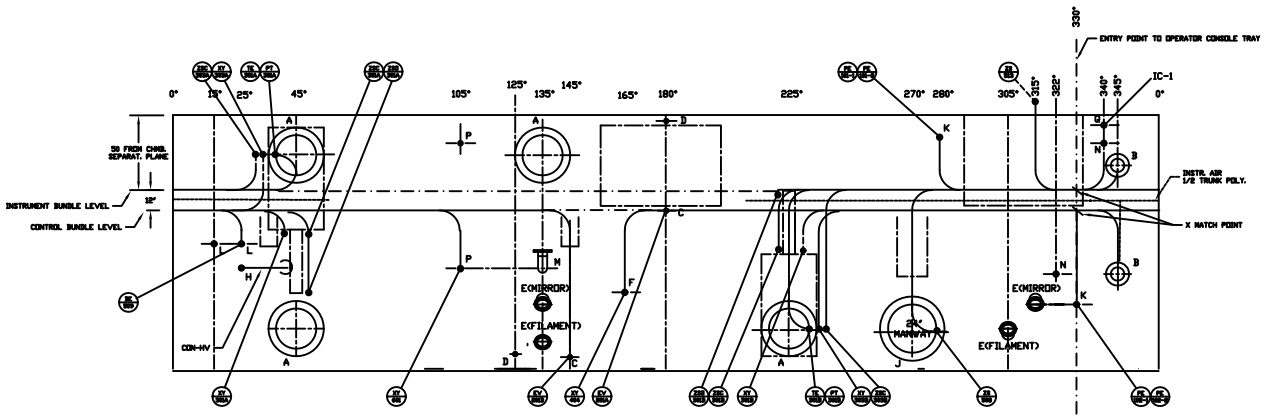
CAD FILE	SIZE	DWG. NO.	REV.
V095300L/3001S6	D	V095-3-001	3
SCALE NONE		SHEET 6 OF 7	

J.11.1

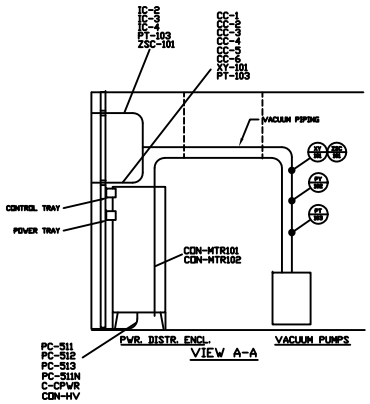
Oct 24, 2002 - 11:14:00 By: AmmenE K:\CPS\Ames Stuff\001s6.dwg


Oct 12, 2002 - 08:07:31 By: ArmandaE K:\CPS\Mdxa Stuff\001a7.dwg
115VAC PLUG TO PD-2
GENERAL INTERFACE
MDC-101 MASS CONTROLLER
DBL. P/RANI BOARD
COLD CATHODE BOARD
COLD CATHODE BOARD
AUX. OUTPUT BOARD
RELAY INTERFACE
ANALOG OUTPUTS
CONTROL BOARD
VALVE I/O
CONTROL OUTPUTS
PC-102-2
PC-101-2
PC-102-1
PC-101-1
CDRV. P/RANI TUBE PC-102-2
CDRV. P/RANI TUBE PC-101-2
COLD CATH. TUBE PC-102-1
COLD CATH. TUBE PC-101-1
PV-102
THROTTLE VALVE PV-102
SCR
SETPOINT
ANN_P102
ANN_P101
CONT'D ON LINE 416
CONT'D ON LINE 415
115 VAC (HOT) FROM LINE XXX
115VAC PLUG TO PD-1
THICKNESS SENSOR TE-501
TE-509
SENSOR
INPUT/ OUTPUT
ANALOG OUTPUT
CONTROL OUTPUT
TH-1 THICKNESS MONITOR
GLOW DISCHARGE POWER IND. TI-401A
BACK MIRROR TEMPERATURE INDICATOR TI-511
(EXTERNAL EXCITATION)
(T/C W. CONT. CONNECTION)
TSH-511 TO LINE 236
TSHH-511 TO LINE 237
CDI-AXIAL CABLE
TO LINE 500
TO LINE 501
TO LINE 239
TO LINE 240
(GYCON CRYSTAL FAULT)
(GYCON FINAL THICKNESS)
(GYCON START)
(GYCON STOP)
(GYCON FINAL THICK. TRIGG)
115 VAC (NEUTRAL) FROM LINE XXX
SEE SHEET 1 FOR REVISIONS
PROCESS SYSTEMS INTERNATIONAL INC.
ELECTRICAL SCHEMATIC
OPERATOR CONSOLE
ALUMINIZING SYSTEM
NASA AMES MOFFETT FIELD, CA.
V095-3-001
REV. 3
SCALE NONE
SHEET 7 OF 7

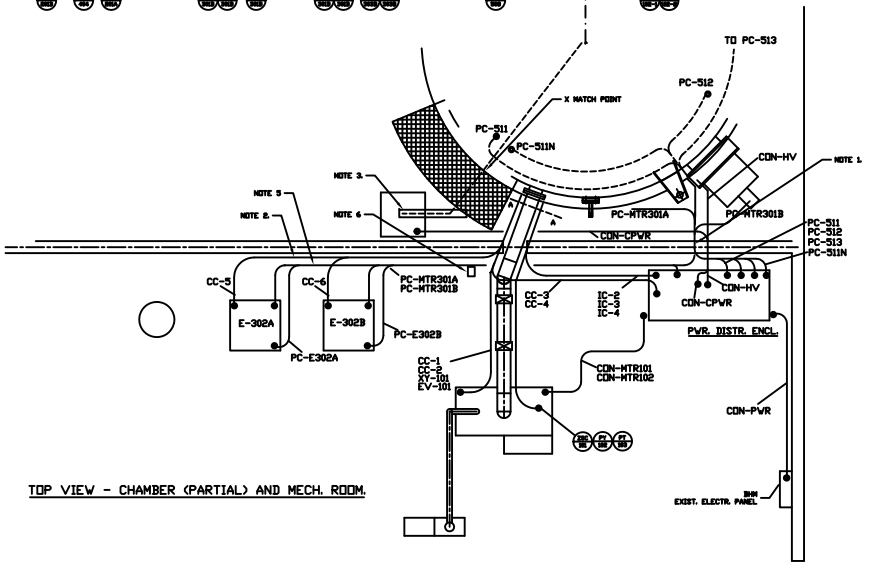
J.11.2



VIEW - CHAMBER SIDE WALL UNFOLDED.



VIEW A-A



TOP VIEW - CHAMBER (PARTIAL) AND MECH. ROOM.

NOTES:
1. POWER CABLES TO PASS ROUND OPENING APP. 4 INCH DIA AT BOTTOM OF THE WALL.
2. CABLE TRAY TO BE 4 INCH WIDE, 24 FT LONG, ELEV.5 FT. TO HOLD CONTROL CABLES.
3. TWO CABLE TRAYS 4 INCH WIDE, 5 FT LONG EACH, TO BE STAGGERED 12 INCHES APART.
4. CABLE MARKED AS N/A IN 'LP' COLUMN REFERS ITEM PROVIDED BY CHART PSD.
5. CABLE TRAY 4 IN WIDE, 24 FT LONG, ELEV. 4 FT TO HOLDD POWER CABLES.
6. INSTRUMENT AIR REGULATOR , WALL MOUNTED.
7. PROVIDE EXTRA LENGTH FOR FILAMENT ARRAY WIRING PER V095-3-010.

DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION

REFERENCE DRAWINGS

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONAL ±
ANGULAR:MACH ±0°-30' BEND ±0°
TWO PLACE DECIMAL ± .01
THREE PLACE DECIMAL ± .005
FINISHED SURFACE RMS
BREAK CORNERS ON .015 MAX
REMOVE ALL BURRS

DO NOT SCALE THIS DRAWING
USED ON
NEXT ASS'Y

REV	DESCRIPTION	CHKD	DRWN	DATE	DED#
1	ISSUED FOR DESIGN		MAK	10-23-00	0025

ISSUE DESCRIPTION

Chart Industries, Inc.
Process Systems Division
20 Walkup Dr., Westborough Ma 01581 USA

INSTR.& POWER CABLE SCHEDULE
SOFIA PRIM. MIRROR COATING CENTER
NASA AMES RESEARCH CENTER
MOFFETT FIELD, CA.

CAD FILE	SIZE	DWG NO.	REV.
3003sht1	D	V095-3-003	1

SCALE | SHEET 1 OF 3

Oct 27, 1999 - 11:47:01

NOTE 4.

CABLE SCHEDULE							LG	PRODUCT	COMMENTS
VALVE OR INSTRUMENT TAG	CABLE TAG	PAIR/ COND.	PAIR OR COND. TAG	CABLE DESCRIPTION	FROM	TO			
INSTRUMENT CABLES									
DE-509	DE-509			V095-2-033	OPERATOR CONSOLE	CHAMBER	N/A		
PE-101-1	PE-101-1			V095-2-032	OPERATOR CONSOLE	CHAMBER	N/A		
PE-101-2	PE-101-2			V095-2-032	OPERATOR CONSOLE	CHAMBER	N/A		
PE-102-1	PE-102-1			V095-2-032	OPERATOR CONSOLE	CHAMBER	N/A		
PE-102-2	PE-102-2			V095-2-032	OPERATOR CONSOLE	CHAMBER	N/A		
PT-301A	PT-301A			V095-2-032	OPERATOR CONSOLE	CRYOPUMP E-301A	N/A		
PT-301B	PT-301B			V095-2-032	OPERATOR CONSOLE	CRYOPUMP E-301B	N/A		
PT-103	PT-103			V095-2-032	OPERATOR CONSOLE	VACUUM PIPING	N/A		
TE-301A	TE-301A			V095-2-003	OPERATOR CONSOLE	CRYOPUMP E-301A	N/A		
TE-301B	TE-301B			V095-2-003	OPERATOR CONSOLE	CRYOPUMP E-301B	N/A		
LIMIT SWITCHES									
ZS-513	XIC_ZS513			1 PR #18	OPERATOR CONSOLE	CHAMBER	17'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
ZS-508	XIC_ZS508			1 PR #18	OPERATOR CONSOLE	CHAMBER	24'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
ZSC-101	XIC_ZSC101			1 PR #18	OPERATOR CONSOLE	VACUUM PIPING	27'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
ZSC-303A	XIC_ZSC303A			1 PR #18	OPERATOR CONSOLE	VACUUM PIPING	24'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
ZSC-303B	XIC_ZSC303B			1 PR #18	OPERATOR CONSOLE	VACUUM PIPING	32'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
ZSO-301A	XIC-ZSO301A			1 PR #18	OPERATOR CONSOLE	GATE VLV. 301A	24'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
ZSC-301A	XIC_ZSC301A			1 PR #18	OPERATOR CONSOLE	GATE VLV. 301A	22'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
ZSO-301B	XIC_ZSO301B			1 PR #18	OPERATOR CONSOLE	GATE VLV. 301B	28'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
ZSC-301B	XIC_ZSC301B			1 PR #18	OPERATOR CONSOLE	GATE VLV. 301B	30'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
SOLENOIDS OR VALVES									
XY-404	OTE_XY404			1 PR #18	OPERATOR CONSOLE	CHAMBER	30'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
XY-303A	OTE_XY303A			1 PR #18	OPERATOR CONSOLE	VACUUM PIPING	24'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
XY_303B	OTE_XY303B			1 PR #18	OPERATOR CONSOLE	VACUUM PIPING	32'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
XY-101	OTE_XY101			1 PR #18	OPERATOR CONSOLE	VACUUM PIPING	27'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
XY-601	OTE_XY601			1 PR #18	OPERATOR CONSOLE	VACUUM PIPING	30'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
XY-301A	OTE_XY301A			1 PR #18	OPERATOR CONSOLE		22'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
XY-301B	OTE_XY301B			1 PR #18	OPERATOR CONSOLE		30'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
EV-201A	OTE_EV201A			1 PR #18	OPERATOR CONSOLE	SOLENOID	24'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
EV-201B	OTE_EV201B			1 PR #18	OPERATOR CONSOLE	SOLENOID	37	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
EV-101	OTE_EV101			1 PR #18	OPERATOR CONSOLE	VACUUM PIPING	27'	ALPHA PN#5600B1801 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
PV-102	PV102			V095-2-023	OPERATOR CONSOLE	VACUUM PIPING	N/A		
CONTROL CABLES									
	CC-1	1	OTE_MTR101	4 PR #18	OPERATOR CONSOLE	PWR. DISTR. ENCL.	36'	ALPHA PN#5610B1804 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
		2	XIC_MTR101						
		3							
		4							
	CC-2	1	OTE_MTR102	4 PR #18	OPERATOR CONSOLE	PWR. DISTR. ENCL.	36'	ALPHA PN#5610B1804 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
		2	XIC_MTR102						
		3							
		4							
	IC-5	1	TE-511	V095-2-039	OPERATOR CONSOLE	CHAMBER	N/A		
	IC-6	1	EE-511						
		2	EE-512						
		3	EE-513						
	IC-2	1	AIN_IT511	4 PR #24, T/SH.	OPERATOR CONSOLE	FILAMENT P/S	36'	ALPHA PN#6318 OR EQIV.	INST. TRAY, 300V, TIN. COP.,7 STR. OV.& IND. SH. GRAY J.
		2	AIN_IT512						
		3	AIN_IT513						
		4	AIN_ET501						
	IC-3	1	AOT_DIC511	4 PR #24, T/SH.	OPERATOR CONSOLE	FILAMENT P/S	36'	ALPHA PN#6318 OR EQIV.	INST. TRAY, 300V, TIN. COP.,7 STR. OV.& IND. SH. GRAY J.
		2	AOT_DIC512						
		3	AOT_DIC513						
		4							
	CC-3	1	OTE_E500	4 PR #18	OPERATOR CONSOLE	FILAMENT P/S	36'	ALPHA PN#5610B1804 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
		2	XIC_E500						
		3							
		4							
	IC-4	1	AOT_GIC401	4 PR #24, T/SH.	OPERATOR CONSOLE	GLOW DISCH. P/S	36'	ALPHA PN#6318 OR EQIV.	INST. TRAY, 300V, TIN. COP.,7 STR. OV.& IND. SH. GRAY J.
		2	AIN_IT401						
		3	AIN_ET402						
		4							
	CC-4	1	OTE_E400	4 PR #18	OPERATOR CONSOLE	GLOW DISCH. P/S	36'	ALPHA PN#5610B1804 OR EQ.	CNTR. TRAY, 300V, BARE COPPER, 7 STR., BLACK JACK.
		2	XIC_E400						
		3							
		4							

NOTE: THIS TABLE CONTINUES ON THE NEXT SHEET

CABLE COLOR CODE NOTES:
CONTROL 1 PAIR IS BLK & WHT
CONTROL 4 PAIR IS BLK & WHT, NUMBERED PAIRS

INSTR 4 PAIRS ARE:
PAIR 1: BLK & RED
PAIR 2: BLK & WHT
PAIR 3: BLK & GREEN
PAIR 1: BLK & BLUE

SEE SHEET 1 FOR REVISIONS

CHART Chart Industries, Inc.
Process Systems Division
20 Walkup Dr., Westborough Ma 01581 USA

INSTR.& POWER CABLE SCHEDULE
SOFIA PRIMARY MIRROR COATING SYS.
NASA AMES RESEARCH CENTER
MOFFETT FIELD, CA.

CAD FILE	SIZE	DWG NO.	REV.
3003sht2	D	V095-3-003	1
SCALE		SHEET 2 OF 3	

Oct 26, 1999 - 164704

J.11.2

J.11.2

CABLE SCHEDULE							LG	PRODUCT	COMMENTS
VALVE OR INSTRUMENT TAG	CABLE TAG	PAIR/ COND.	PAIR OR COND. TAG	CABLE DESCRIPTION	FROM	TO			
	CC-5	1	A/BLACK	V095-2-003	OPERATOR CONSOLE	CRYOPUMP E-301A	N/A		
		2	B/ORANGE						
		3	C/WHITE						
		4	D/RED						
		5	E/BROWN						
		6	F/BLUE						
		7	GREEN						NO CONNECTION
	CC-6	1	A/BLACK	V095-2-003	OPERATOR CONSOLE	CRYOPUMP E-301B	N/A		
		2	B/ORANGE						
		3	C/WHITE						
		4	D/RED						
		5	E/BROWN						
		6	F/BLUE						
		7	GREEN						NO CONNECTION
POWER CABLES									
PC-511	PC-511			1 COND #750 KCMIL	CHAMBER	POW. DISTR. ENCL.	16'	ANIXTER 5L-7771	FIL. A POWER
PC-512	PC-512			1 COND #750 KCMIL	CHAMBER	POW. DISTR. ENCL.	16'	ANIXTER 5L-7771	FIL. B POWER
PC-513	PC-513			1 COND #750 KCMIL	CHAMBER	POW. DISTR. ENCL	12'	ANIXTER 5L-7771	FIL. C POWER
PC-511N	PC-511N			1 COND #250 KCMIL	CHAMBER	POW. DISTR. ENCL	20'	ANIXTER 5L-4041	FIL. NEUTRAL
PC-E302A	PC-E302A			V095-2-003	CRYOPUMP COMPR.	PWR. DISTR. ENCL	N/A		COMPRESSOR POWER
PC-E302B	PC-E302B			V095-2-003	CRYOPUMP COMPR.	POW. DISTR. ENCL	N/A		COMPRESSOR POWER
PC-MTR301A	PC-MTR301A			V095-2-003	CRYOPUMP COMPR.	CRYOPUMP MOTOR	N/A		CONTROL SOLENOID
PC-MTR301B	PC-MTR301B			V095-2-003	CRYOPUMP COMPR.	CRYOPUMP MOTOR	N/A		
CONDUITS									
CON-PWR				3X #2+#8G	PWR. DISTR. ENCL	BHM PANEL	1 1/4"	HOOK-UP WIRE	EMT, 10 FT LONG.
CON-CPWR				2X #12+#8G	PWR. DISTR. ENCL	OPERATOR CONS.	1/2"	HOOK-UP WIRE	EMT, 12 FT LONG.
CON-MTR101				3X #12+G	VACUUM PUMP	PWR. DISTR. ENCL	1/2"	HOOK-UP WIRE	EMT, 25 FT LONG.
CON-MTR102				3X #12+G	VACUUM PUMP	PWR. DISTR. ENCL	1/2"	HOOK-UP WIRE	EMT, 25 FT LONG.
CON-HV				V095-2-041	CHAMBER	PWR. DISTR. ENCL	1/2"		EMT, 25 FT LONG.

NOTE 7

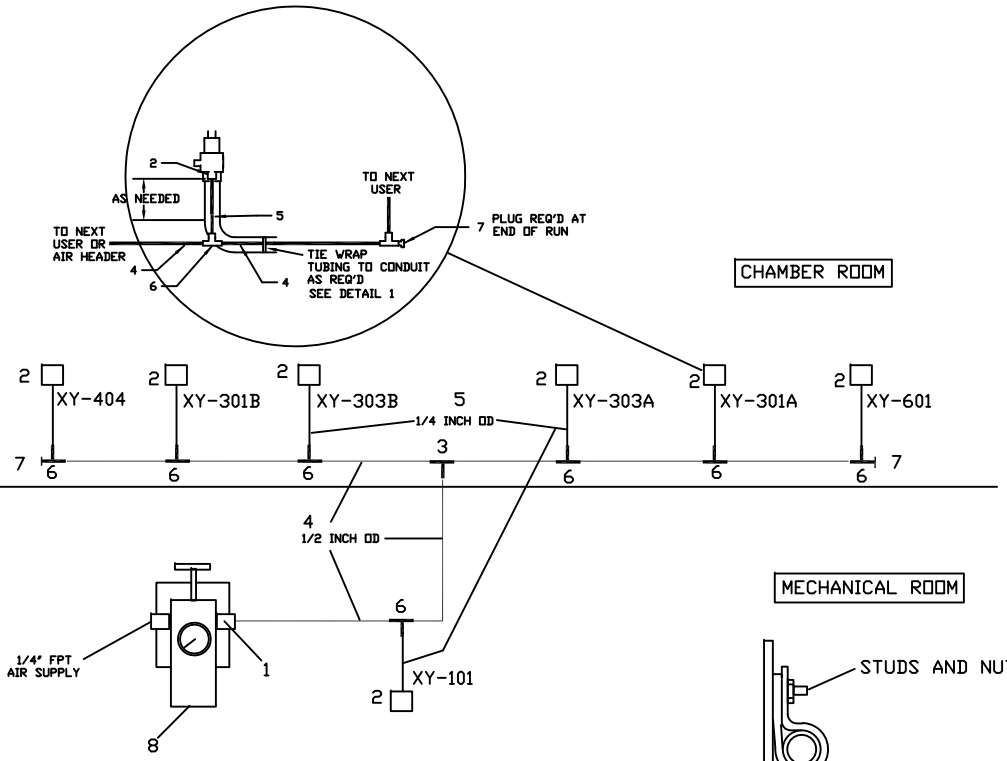
SEE SHEET 1 FOR REVISIONS

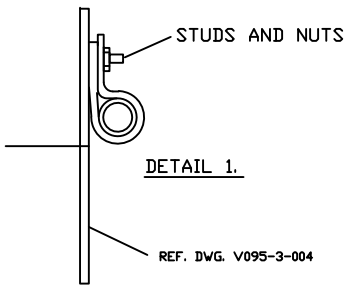
CHART Chart Industries, Inc.
Process Systems Division
20 Walkup Dr., Westborough Ma 01581 USA

INSTR.& POWER CABLE SCHEDULE
SOFIA PRIMARY MIRROR COATING SYS.
NASA AMES RESEARCH CENTER
MOFFETT FIELD, CA.

CAD FILE	SIZE	DWG NO.	REV.
3003shts3	D	V095-3-003	1
SCALE		SHEET 3 OF 3	

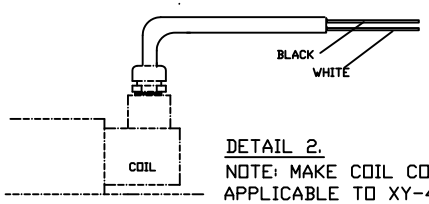
Oct 26, 1999 - 164704



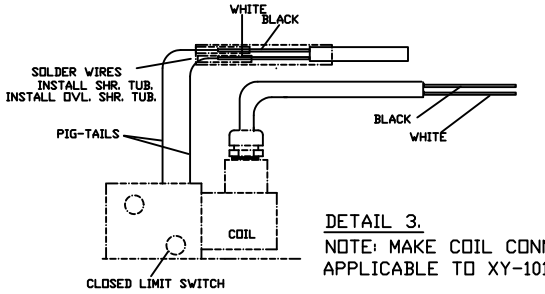


QTY.	DESCRIPTION	ESTIMATE QTY.
1	MALE CONNECTOR 1/2"T x 1/4MPT, SWAGELOCK #B-810-1-4KN	1
2	MALE CONNECTOR 1/4"T x 1/4MPT, SWAGELOCK #B-400-1-4KN	7
3	UNION TEE 1/2"T SWAGELOK #B-810-3KN	1
4	TUBING, POLYETHYLENE, 1/2"O.D. MCMASTER CARR #5180K14	75 FT
5	TUBING, POLYETHYLENE, 1/4"O.D. MCMASTER CARR #5180K14	50 FT
6	REDUCING TEE 1/2"T X 1/4"T SWAGELOK #B-810-3-8-4KN	7
7	PLUG 1/2" SWAGELOK #B-810-P	2
8	REGULATOR, 0-100 PSI, 20SCFM, "BELLOFRAM" #51FR-960-177-210 (TO INCLUDE: KNOB, 5 MICR FILTER, MOUNT. BRACKET, PRESS. GAUGE)	1

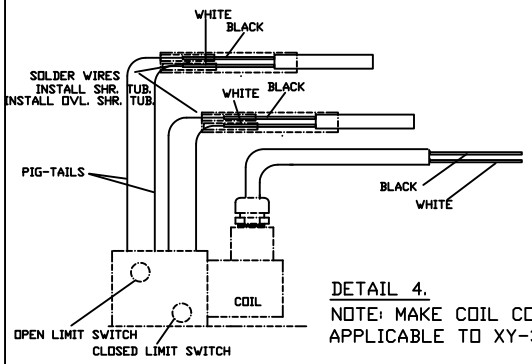
SUPPLIED BY CONTRACTOR



DETAIL 2.
NOTE: MAKE COIL CONNECTION INSIDE JUNCTION BOX. APPLICABLE TO XY-404, XY-601.



DETAIL 3.
NOTE: MAKE COIL CONNECTION INSIDE JUNCTION BOX. APPLICABLE TO XY-101, XY-303A, XY-303B.



DETAIL 4.
NOTE: MAKE COIL CONNECTION INSIDE JUNCTION BOX. APPLICABLE TO XY-301A, XY-301B.

DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION
REFERENCE DRAWINGS			

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONAL ±
ANGULAR: ±0° ±30' BEND ±0°
TWO PLACE DECIMAL ± .01
THREE PLACE DECIMAL ± .005
FINISHED SURFACE RMS
BREAK CORNERS ON EDGES
REMOVE ALL BURRS

REV	DESCRIPTION	APPD	CHKD	DRWN	DATE	ECO#
DO NOT SCALE THIS DRAWING	0	ISSUED FOR FABRICATION		MAF	MAK	10-26-00	0025
USED ON:							
NEXT ASS'Y:		ISSUE DESCRIPTION					

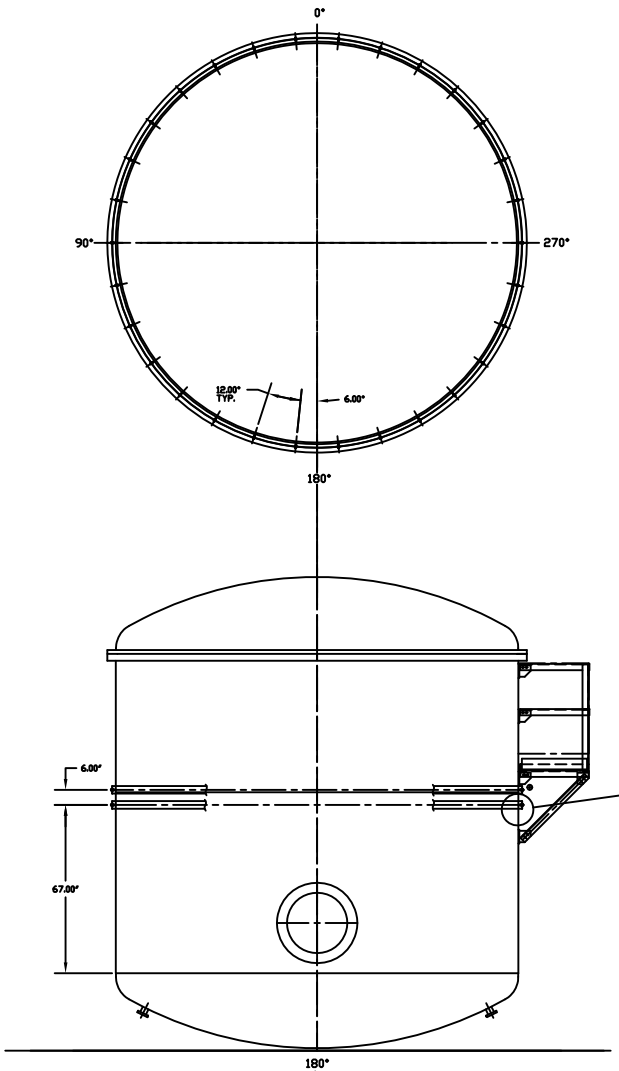
Chart Industries, Inc.
Process Systems Division
20 Walkup Dr., Westborough Ma 01581 USA

INSTRUMENT AIR INSTALLATION
SOFIA PRIMARY MIRROR COATING SYS.
NASA AMES RESEARCH CENTER
MOFFETT FIELD, CA.

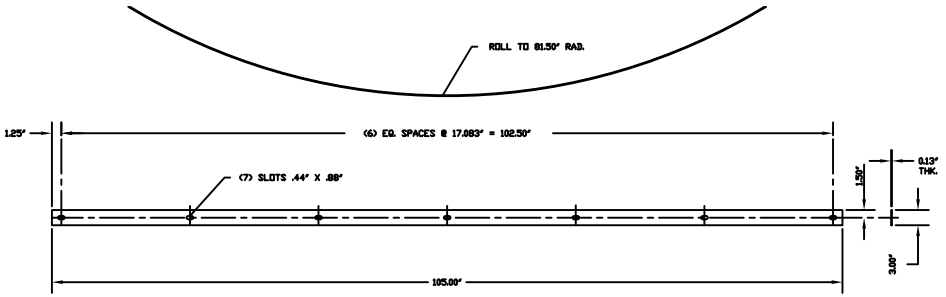
CAD FILE	SIZE	DWG NO.	REV.
V0953002	D	V095-3-002	0
SCALE		SHEET 1 OF 1	

Jan 31, 2001 - 11:50:43

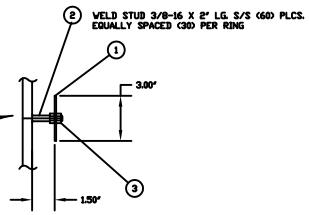
J.11.2



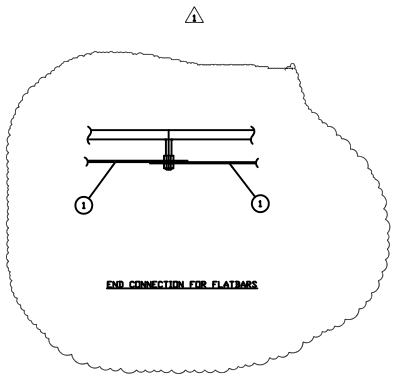
NOTE: SUPPORT LEGS NOT SHOWN



① WIRE SUPPORT STRIP (10) REQ'D MAT'L .125" X 3.00" FLATBAR T304 ST.ST.



WIRE SUPPORT DETAIL



END CONNECTION FOR FLATBARS

PROPRIETARY AND CONFIDENTIAL
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION BELONGING TO PROCESS SYSTEMS, DIVISION OF CHART INDUSTRIES, INC. OR ITS AFFILIATED COMPANIES AND SHALL BE USED ONLY FOR THE PURPOSE FOR WHICH IT WAS SUPPLIED. IT SHALL NOT BE COPIED, REPRODUCED, OR OTHERWISE USED, NOR SHALL SUCH INFORMATION BE FURNISHED IN WHOLE OR IN PART TO OTHERS EXCEPT IN ACCORDANCE WITH THE TERMS OF ANY AGREEMENT UNDER WHICH IT WAS SUPPLIED OR WITH THE PRIOR WRITTEN CONSENT OF PROCESS SYSTEMS, DIVISION OF CHART INDUSTRIES, INC. AND SHALL BE RETURNED UPON REQUEST.

DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION
REFERENCE DRAWINGS			

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONAL ±
ANGULARITY 60°-90° BEND 45°
TWO PLACE DECIMAL ± .01
THREE PLACE DECIMAL ± .005
FINISHED SURFACE RMS
BREAK CORNERS ON
REMOVE ALL BURRS

DO NOT SCALE THIS DRAWING
USED ON
NEXT ASS'Y

REV	DESCRIPTION	APP'D	CHKD	DRWN	DATE	ECO#
1	REVISED	MAF		WEB	1-29-01	0025
0	RELEASE FOR FABRICATION	MAF		WEB	12-21-00	0024
ISSUE DESCRIPTION						

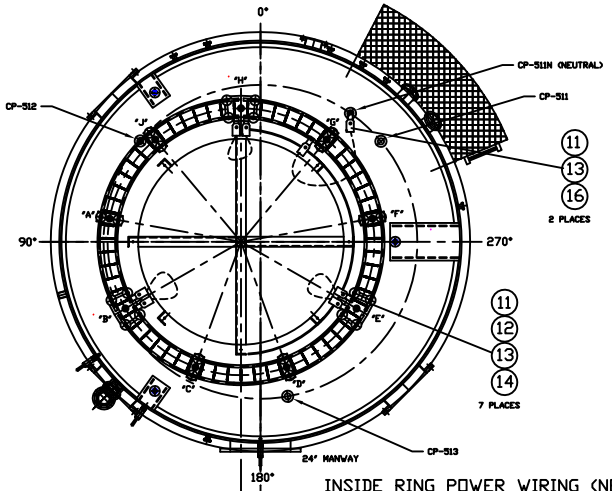
CHART Chart Industries, Inc.
Process Systems Division
20 Walkup Dr. Westborough Ma 01581 USA

VESSEL WIRE SUPPORT BRKT
SOFIA PRIM. MIRROR COATING SYSTEM
NASA AMES RESEARCH CENTER
MOFFETT FIELD, CA.

CAD FILE	SIZE	DWG NO.	REV.
V0953004	D	V095-3-004	1
SCALE		SHEET	

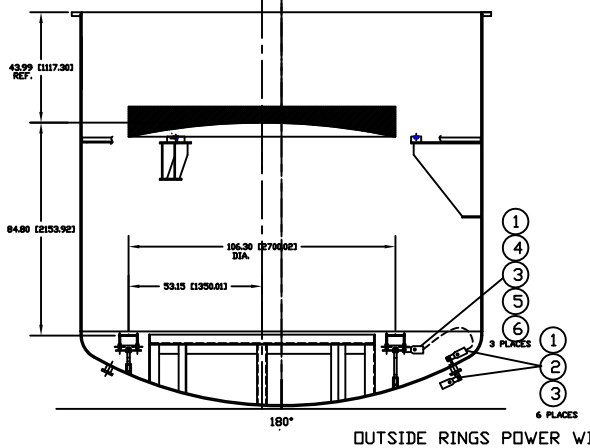
Dec 21, 2000 - 103427

J.11.2



INSIDE RING POWER WIRING (NEUTRAL).
(USE 250 KCMIL CABLE W. OUTER JACKET REMOVED).

ITEM	DESCRIPTION		QTY.
1	LUG, 1000KCMIL CAP. COPPER, THOMAS&BETTS PN#31019		9
2	BOLT, 5/8-11X1 3/4" LONG, SS, MASTER MCCARR PN#92198A800	OR EQUAL	PACK OF 25
3	LOCKWASHER, 5/8", SS, MASTER MCCARR PN#92147A035	OR EQUAL	PACK OF 100
4	BOLT, 5/8-11X2 1/2" LONG, SS, MASTER MCCARR PN#92198A804	OR EQUAL	PACK OF 25
5	FLAT WASHER, 5/8", MASTER MCCAR PN#92141A035	OR EQUAL	PACK OF 100
6	HEX NUT 5/8-11 MASTER MCCARR PN#91845A305	OR EQUAL	PACK OF 100
11	LUG, 250KCMIL CAP. COPPER, THOMAS&BETTS PN#31013		9
12	BOLT, 1/2-13X2" LONG, 18-8 SS, MASTER MCCARR PN#92198A720	OR EQUAL	PACK OF 50
13	LOCKWASHER, 1/2", 18-8 SS, MASTER MCCARR PN#92147A033	OR EQUAL	PACK OF 100
14	FLAT WASHER, 1/2", SS, MASTER MCCAR PN#92141A033	OR EQUAL	PACK OF 100
15	HEX NUT 1/2-13 18-8 SS, MASTER MCCARR PN#91845A033	OR EQUAL	PACK OF 100
16	BOLT, 1/2-13X1 1/4" LONG, 18-8 SS, MASTER MCCARR PN#92198A714	OR EQUAL	PACK OF 50



OUTSIDE RINGS POWER WIRIRNG (PHASE 1OF3).
(USE 1000 KCMIL CABLE W. OUTER JACKET REMOVED).

DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION

REFERENCE DRAWINGS

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONAL ±
ANGULAR ±0°-30' BEND ±0°
TWO PLACE DECIMAL ± .01
THREE PLACE DECIMAL ± .005
FINISHED SURFACE RMS
BREAK CORNERS ON OUT
REMOVE ALL BURRS

DO NOT SCALE THIS DRAWING
USED ON
NEXT ASS'Y

REV	DESCRIPTION	APP'D	CHKD	DRWN	DATE	DED#
0	RELEASE			MAK	11-09-00	0026

ISSUE DESCRIPTION

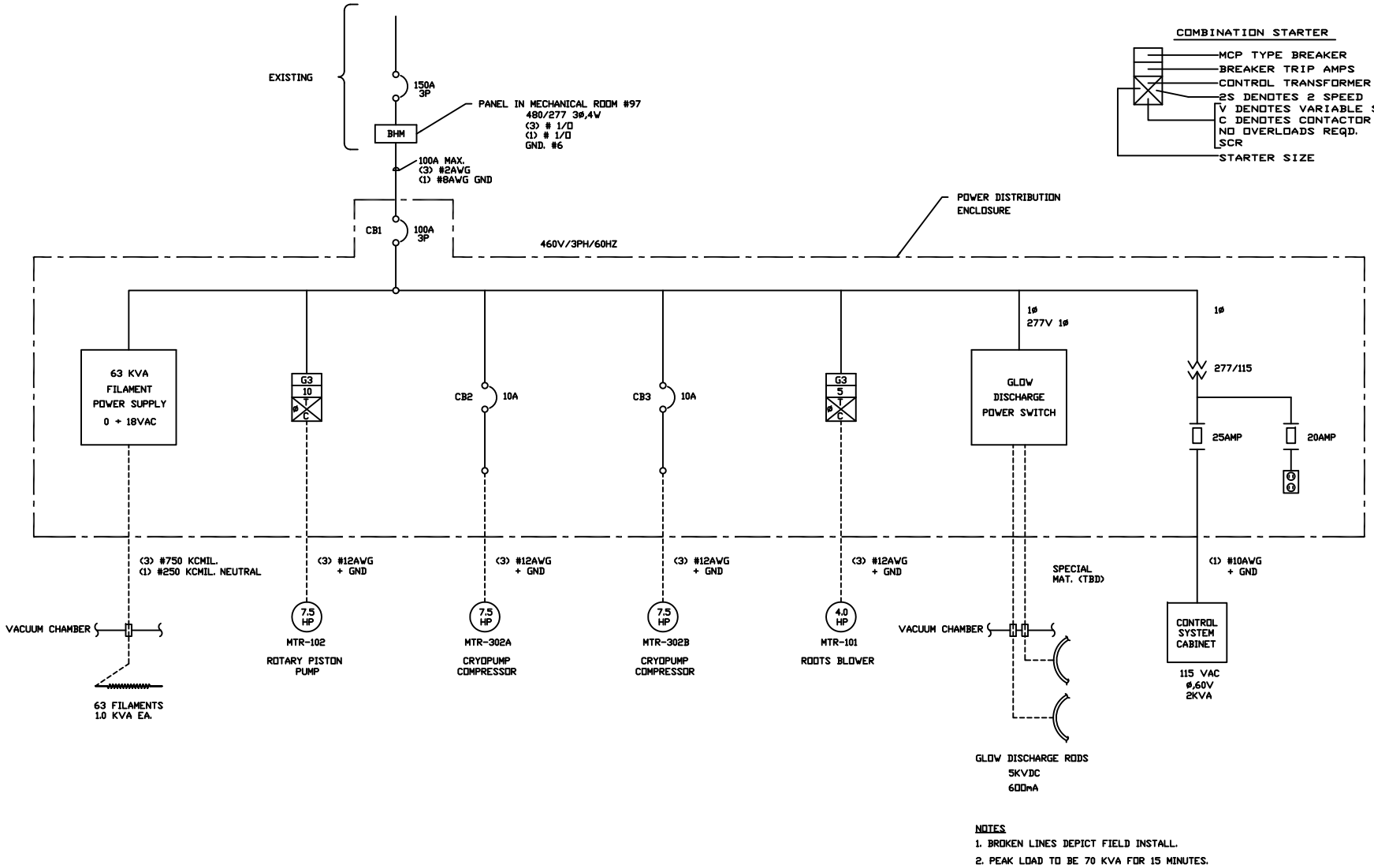
Chart Industries, Inc.
Process Systems Division
20 Walkup Dr., Westborough Ma 01581 USA

FILAMENT ARRAY, ASS'Y AND WIRING
SOFIA PRIMARY MIRROR COATING SYS.
NASA AMES RESEARCH CENTER
MOFFETT FIELD, CA.

CAD FILE	SIZE	DWG NO.	REV.
V0953010	D	V095-3-010	0

SCALE | SHEET SHT 1 OF 1

Feb 13, 2001 - 10:30:03



J.11.2

NOTES

1. BROKEN LINES DEPICT FIELD INSTALL.
2. PEAK LOAD TO BE 70 KVA FOR 15 MINUTES.

DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION

REFERENCE DRAWINGS

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONAL ±
ANGULAR/MACH 45°-30° BEND 45°
TWO PLACE DECIMAL ± .01
THREE PLACE DECIMAL ± .005
FINISHED SURFACE RMS
BREAK CORNERS ON OUT/
REMOVE ALL BURRS

DO NOT SCALE THIS DRAWING
USED ON
NEXT ASS'Y

REV	DESCRIPTION	CHKD	DRWN	DATE	DES'D
0	RELEASE FOR CDR		WEB	5-8-00	

ISSUE DESCRIPTION

CHART Chart Industries, Inc.
Process Systems Division
20 Walkup Dr., Westborough Ma 01581 USA

ONE LINE DIAGRAM

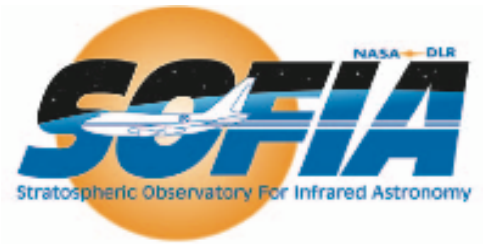
SOFIA PRIMARY MIRROR COATING SYS.
NASA AMES RES., MOFFETT FIELD, CA.

CAD FILE	SIZE	DWG NO.	REV.
V0953030	D	V095-3-030	0

SCALE NONE SHEET

May 18, 2000 - 14:50:40

8 7 6 5 4 3 2 1



Mirror Aluminizing Procedure
SSMOC-MCF-PRO-2001C

SCI-US-PRO-OP02-2009

Date: October 30, 2008
Revision: A

DFRC
Dryden Flight Research Center
Edwards, CA 93523

ARC
Ames Research Center
Moffett Field, CA 94035

German Space Agency, DLR
Deutsches Zentrum für Luft und Raumfahrt

REVISION HISTORY

REV	DATE	DESCRIPTION
	080328	Released as USRA-DAL-SSMOC-MCF-PRO-2001
	080506	Updated to include QA (John Monkvic) comments and added part numbers for all items as needed
	080515	Set up in standard format for MCF documents.
	080516	Added DR number SCI-US-PRO-SV02-2014 and re-released
	080528	Updated to include comments from IRB Board Member Ray Schuler. Added circuit breaker tables to appendix, data sheets to appendix B. Removed chemical list from appendix and verified existence of chemical list in Section 5.
-	080530	Added new DR number, SCI-US-PRO-OP02-2009 and re-released.
A	081030	Updated after internal and NASA redline review

Mirror Aluminizing Procedure
SSMOC-MCF-PRO-2001C
SCI-US-PRO-OP02-2009, Revision A

Table of Contents

Acronyms

A/R	As Required
CSO	Chief System Safety and Mission Assurance Officer
CODE Q	Quality and Environmental Health
DLOG	Discrepancy Log
FILA	Filament Sequence
FPS	Filament Power Supply
GDPS	Glow Discharge Power Supply
GLOW	Glow discharge sequence
HVAC	High Vacuum
LN_2	Liquid Nitrogen
MCC	Mirror Coating Chamber
MCF	Mirror Coating Facility
MST	Metering Structure
O_2	Oxygen
PLC	Programmable Logic Controller
PLD	PMA Lifting Device
PMA	Primary Mirror Assembly
PPE	Personal protective equipment
PSIG	Pounds per Square Inch Gauge
QA	NASA SSP CSO or SSMA Representative
RGEN	Regeneration Sequence
RGN1	Regeneration Sequence for cryopump A
RGN2	Regeneration Sequence for cryopump B
RVAC	Rough Vacuum Sequence
SLS	Secondary Load Path Structure

SOFIA	Stratospheric Observatory for Infrared Astronomy
SSMA	System Safety and Mission Assurance
SSP	SOFIA Science Project
TA	Telescope Assembly
TD	Test Director
TMA	Tertiary Mirror Assembly
TMP	Tertiary Mirror Pedestal
VENT	Vent Sequence
VCP	Video Control Panel
VIS	Vibration Isolation System

Mirror Aluminizing Procedure
SSMOC-MCF-PRO-2001C
SCI-US-PRO-OP02-2009, Revision A

1. PURPOSE

This procedure provides detailed work instructions and describes the preparation of the coating tank for the aluminizing of the mirror as well as the deposition process after the PMA has been installed.

2. PERSONNEL

2.1.Test Director

The Test Director is responsible for the performance of this procedure. The Test Director must have a detailed understanding of all procedures and facility operations. The performance of this procedure requires a minimum complement of personnel as determined by the Test Director. The Test Director may stop any work as deemed appropriate.

2.2.Procedure Performer(s)

The Procedure Performer(s) is (are) responsible for conducting the work steps of the procedure. These personnel must have a detailed understanding of all tasks they are performing and the knowledge of the facility around them. Procedure Performers should only perform work they have been properly trained to perform safely. During the performance of this procedure, they should take direction from the Test Director. The Procedure Performer(s) should stop work deemed unsafe to personnel or flight hardware/software.

2.3. NASA SOFIA Science Project (SSP), Chief System Safety and Mission Assurance Officer (CSO)

The SSP CSO is responsible for System Safety and Mission Assurance (SSMA) functions while performing this procedure. The SSP CSO may delegate specific authority to a SSMA Representative during this procedure. The SSP CSO also coordinates all Code Q activities in the facility. The SSP CSO may stop any work deemed unsafe to personnel, flight hardware/software, or in violation of this procedure.

2.4.SSMA Representative

The SSMA Representative is responsible for a variety of SSMA functions including, but not limited to witnessing operations, signing-off steps requiring SSMA involvement, approving red-lines, approving minor discrepancies, and reviewing the facility/operation for system safety. The SSMA Representative may stop any work

deemed unsafe to personnel or flight hardware/software. Issues that cannot be resolved directly with the Test Director or Procedure Performers should be referred to the SSP CSO for resolution.

2.5. Occupational Safety (OS) Representative

The OS Representative is responsible for ensuring the personnel are conducting this procedure in safe manner and the facility is safe for the operations needed. The OS ensures personnel are properly trained, assesses the facilities safety, and monitors the safety of the personnel performing the procedure. The OS Representative may stop any work deemed unsafe to personnel or flight hardware/software. Issues that cannot be resolved directly with the Test Director or Procedure Performers should be referred to the SSP CSO, or the OS Representative's supervisor as the OS Representative deems necessary, for resolution.

2.6. Qualified Personnel

Test Director	***Procedure Performers*** Additional as appointed by TD	
Ken Bower William Brown Nancy McKown Karen Savage Patrick Waddell	Ken Bower William Brown Dave Black Karen Savage Olyvia Han Paul Keas	
SSP CSO	***SSMA Representative***	***OS Representative***
Edward Ingraham	Edward Ingraham Rich Junnila Additional as appointed by CSO	Ramsey Razik

At the start of this procedure the names of the individuals performing this procedure (by role) should be initialed next to their names in the qualified personnel section.

3. SAFETY

3.1. General

The following is a list of Potential Hazards that will be present during SOFIA Sample Coating Operations:

- Liquid Nitrogen (LN2) and pressurized LN2 Cryogenic burns can be caused by contact with the cold liquid or gas, high pressures can result if boiling liquid or cold gas is confined without a vent path, and asphyxiation can result if the vent gas is allowed to accumulate.
- Working with Hazardous Chemicals
- Working within a Confined Space, the Mirror Coating Chamber (MCC)

- Working near the MCC windows when under high-vacuum.
- Working at heights above 30 inches

3.2. Mitigation of Hazards

- Fall hazard training is required for any individual performing operations that pose a fall hazard
- Only authorized and trained personnel are allowed in the MCF Cleaning and Coating Laboratories without escort.
- When appropriate, tools or other items used with the potential to damage the SOFIA Primary Mirror shall be tethered.

3.3. Safety Training Requirements

Any participants engaging in restricted activity must have training in the applicable areas according to NASA ARC Standards for Health and Safety -

- Fall Protection
- Confined Space
- LockOut– Tag Out
- Chemical Hygiene
- Hazardous Materials
- Cryogens/Compressed Gases
- Overhead Crane/Lifting Operations

3.4. Mishap Notification

Mishap Notification - Injury

- In case of any injury obtain medical treatment by calling 911 (from NASA/ARC phone only) or 650-604-5555. Refer to Appendix Z for further instruction.

Hardware Mishap

- In case of an accident, incident, or mishap, notification is to proceed per the procedures outlined in NASA ARC APR 1700.1 Chapter 4, "Ames Health & Safety Procedural Requirements - Mishap Reporting and Investigating."

4. QUALITY ASSURANCE

4.1. Configuration Control

The Test Director is responsible to ensure the procedure and any other support documents used in performing this procedure are the most current version and approved per the projects configuration management plan. The NASA SSP CSO or his/her designated SSMA Representative should review this.

4.2.Red-Line Authority

Authority to red-line this procedure (e.g. making minor changes during procedure execution) is given solely to the Test Director or his/her designate and shall be approved by the NASA SSP CSO or his/her designated SSMA representative. Red-lines must be in red and initialed/stamped (to the right of the red-line) by these two individuals in a hardcopy of the document prior to use. Issues that cannot be resolved by these two individuals should be flowed up the management chain for resolution.

4.3.Discrepancies

All discrepancies will be recorded in a D-log located in Appendix C. The performer of the procedure should immediately notify the NASA SSP CSO or his/her designated SSMA Representative for review of any discrepancy noted during this procedure. Resolution and approval of D-Log items shall be made by the Test Director and NASA SSP CSO or his/her designated SSMA Representative.

During the review of this D-log, the NASA SSP CSO or his/designated SSMA Representative will assess if the D-log item requires the creation of a Discrepancy Report. All discrepancies that effect flight hardware fit or functions, shall be documented in a Discrepancy Report. The NASA SSP CSO using information from the Test Director will open all Discrepancy Reports.

4.4.Documentation

- Unless stated otherwise within this procedure, the performance of each step of this procedure should be performed in sequence. Once a step is completed, it is the responsibility of the person performing the step or the Test Director who is witnessing the completion of the step, to initial to the right of the step. Steps requiring additional witness initial or stamp (i.e NASA SSP CSO, SSMA representative, OS representative, etc.) will specifically indicate this.
- During a fabrication or test phase, all completed procedures should be contained in a binder located with the hardware in the order they were performed. A copy of the complete procedure will be provided to the NASA SSP CSO.
- When recording data during the As-Run, record the value and the units used to describe the value.
- The AS-RUN procedure, paper copy, shall be printed in Color to maintain color coding of VCP work steps.
- The completed AS-RUN Procedure will be sent for archival through the USRA Configuration Management process.
- Use of Discrepancy Log, Appendix C. This log is used to document, other than trivial, deviation from the procedure. Each deviation shall be evaluated by QA to determine whether a Non-Conformance Report should be initiated or not.

5. TEST REQUIREMENTS

5.1. Training Required – Certified by Test Director

1. PLC Engineer shall have the following required experience:
   - Rockwell Automation Software packages maintenance.
   - Experience in SOFIA MCF software downloads/uploads to the PLC.
   - Experience in configuration and monitoring for Data Acquisition System using RSTrend.
   - Experience in RS-232 communication using Rockwell Software package RSLinx.
   - Experience in the use of MCC PanelMate GUI 1700.

2. MCC Engineer shall have the following experience:
   - Thorough review and understanding of the MCC electrical and mechanical schematic diagrams.
   - Ability to diagnose vacuum gauge failures and vacuum system failures.
   - Thorough understanding and experience with Vacuum Systems.
   - Panel Mate GUI use on the PLC cabinet.
   - Sycon Crystal and controller experience including the ability to program the Sycon Controller for specific thicknesses as requested by the SOFIA Science Program.
   - Experience in the use of the MKS 146 Vacuum gauge controller.

5.2. Test Personnel

The successful performance of these procedures requires a minimum complement of personnel as determined by the Test Director. A Test Director shall be designated for each test and is required to sign all test sheets or logbooks, and is the only person with the authority to red-line the test procedure. Approval of redlines required from QA Engineer.

5.3. Tools, Utilities, Materials, and Consumables Required

Accumulate the following equipment/material and consumables. Store items in appropriate area.

Description	Quantity	Part number
Halogen lamps	3	Standing
Allen Wrenches	2	Sz=5/32”
Tungsten Filaments – preloaded with Aluminum	63	Part Number=1450H-2
Gaseous Argon	200 cu ft	Spec: MIL-PRF-27415A
LN_2 w/100 psi relief valve	1000 liters/day	Airgas–265 Liter dewars x 4
Electrical Power	Verify functional	NA
Instrument air -	1	CA22 – cutoff valve for

• Adjust/confirm air regulator = 80-100 psig • Check Filter		instrument air in room 97
Vacuum Grease	1 Tube	Sec=NSF61 FC-976
O_2 sensor	1	Record Calibration date:
Commercial Voltmeter and connectors	1	As Available
Cleaning Materials - Isopropanol Squeeze Bottle	2	Cole Parmer K-62300-36
Particle Counter	1	MetOne Particle Counter
Lock/Key (LN_2)	1	A/R
Lock/Key (Argon)	1	A/R
Lock/Key (Electrical)	1	A/R
RS-232 Cable	1	A/R
Magnets	4	Used for View port shutters
LN_2 PPE	Face Mask, Apron, Gloves	1 ea/operator as needed
Timing devices	1	Wristwatch OK
Vacuum Grade Aluminum Foil	A/R	All Foils Inc., Aluminum Foil, UHV, .0015X24"X500'
Commercial Grade HEPA Vacuum	1	Festool CT 22E
Long hoses for vacuum cleaner	A/R	Festool CT 22E
Tyvec coverall suits	A/R	Fisher Scientific, #'s 19-088-1121B (Med), 19-088-1121C (Lrg) and 19-088-1121D (XLrg)
Tyvec Clean room hoods	A/R	M Lrg
Tyvec Clean room booties	A/R	Fisher Scientific 19-039-410B (Med.) and # 19-149-246 (X-large)
Face Masks with ear loops	A/R	Fisher Scientific #18-960B
Nitrile Gloves	A/R	Fisher Scientific #19-130-1565B (Med) and #19-130-1565C (Large)
Hazardous Waste Containers	2	McMaster-Carr 4070T64: 1 Red, 1 Yellow
Sycon thickness monitor crystals	2	Sycon Instruments OSC-100
Ionized N2 Blower	1	Simco Cobra with G165 Power Supply
Nitrogen, Grade C, Regulator 3000/ 150 psig gauges	1	McMaster-Carr, 7897A16

Technicloth II Cleanroom wipes	A/R	Fisher Scientific #18-330A
2-Propanol	1 liter	Fisher Scientific #A451-1.
Acetone	4 liters	Fisher Scientific #A40-4
Ethyl Alcohol, 200 proof	1 liter	(Fisher Scientific #AC615090010)
Distilled Water	20 gallons	NC9223074
1 mm plastic feeler gauges to install mirror gap seal	1 Package	McMaster-Carr: 9513K42
Sample Holder	1	Accessory to Secondary Load Path Structure (SLS)
Digital Camera	1	As Available
Laptop	1	Windows XP w/Rockwell Automation software RSLogix5, RStrend, RSlinx
Plastic Boxes to hold Samples	5	Spawr – PSH-502
Zerodur samples	5	2” diameter x 1/4” width round
Scotch Tape	1	MIL-M-13508C

6. REFERENCE DOCUMENTS

Drawings and Schematics

Drawing No.	**Title**
V095-0-001 Rev5	MCC Schematic (Appendix D)

Supporting Documentation

Document Author	**Document No.**	**Title**
Chart	V095-2-058	Acceptance Test Plan
NASA Safety / QUALITY DOCS	SSMOC-MCF-PRO-2110	Confined Space Entry Procedures
USRA	SSMOC-MCF-PRO-0400	MCF Cleanroom Access Protocols
NASA Safety / QUALITY DOCS	SSMOC-MCF-PRO-2111	Lockout/Tagout Procedure
USRA	SSMOC-MCF-PRO-2009	Critical Lift

Reference Documentation

Document No.	**Title**
V095-2-012	Control System Operation
V095-1-013	Instrument List

V095-1-014	PLC Database
V095-1-015	Control System Overview
V095-1-016	Video Control Panel
V095-1-017	Valve List
V095-1-018	Line List
V095-1-019	Equipment List
V095-1-021	Requirements Verification Matrix
V095-1-025	Cleaning Procedures for Tungsten Filaments and Aluminum Clip -
SSMOC-MCF-TN-2120	Filament mounting Procedures
V095-2-054	System Handling and Operations for Primary Mirror Coating System.
SOF-1701	Standards for Health and Safety.
NA	Sycon Owners Manual
NA	MKS 146 Gauge controller Manual

7. OPERATIONS

7.1.Pre-Operational Work Steps

The SSMA Representative shall be notified 24 hours prior to the start of this procedure.

QA Notified _____ (Date & Time)

Test Director: _____ (Date & Time)

Prior to starting this section, perform particulate measurement:

Date	Measurement Type	Location	Value
	Particulate count: 0.5 micron/ft^3	Coating Room	
	Particulate count: 0.5 micron/ft^3	Cleaning Room	
	Particulate count: 0.5 micron/ft^3	Equipment Room	
	Pressure/Magnahelic	Cleaning Room to Hanger	Pa
	Pressure/Magnahelic	Coating Room to Cleaning Room	Pa

Read and record RTD temperature sensor upon startup.

TI_511_____deg C

TIME_____

Note: When this temperature is above 50 degC we cannot start Glow or Filament Sequences. Above 60 degC the PLC automatically shuts down these sequences

.

WARNING:
FOLLOWING WORK STEPS ARE HAZARDOUS DUE TO ENTRY INTO A CONFINED SPACE – NO PERMIT REQUIRED.

7.2.MCC Preparation for Mirror Installation

Initial Conditions:

System is in Locked Out/Tagged Out condition
Chamber is at atmospheric pressure
Chamber lid is on

Remove coating chamber lid as per document number SSMOC-MCF-PRO-2009

List all personnel performing operational work steps and Test Director

_____

_____

Step	Description
1	Don clean-room smocks, shoes, face masks, hoods, gloves and PPE in gowning area inside Room 95
2	Fill out Confined Space Entry Forms and contact x45416 to inform emergency Services of details for entry
3	With coating chamber lid removed enter chamber
4	Remove (as needed) the 63 used filaments using appropriate Allen wrenches Record all items and people entering the chamber. Tech 1 _____ Tech 2 _____ Wrenches _____ O2 Sensor _____ Lights _____ New filaments _____ (63)
5	Inspect chamber surfaces for large particles of aluminum, tungsten or other materials from previous depositions and manually remove with HEPA vacuum or by hand as appropriate
6	Remove vacuum grade aluminum foil, if used, from covered surfaces and recycle

WARNING:
THE FOLLOWING STEPS WORK WITH HAZARDOUS CHEMICALS
REFER TO PERSONAL PROTECTIVE EQUIPMENT PROTOCOL DOCUMENT

NOTE:
Pay special attention to the cleaning of Meissner trap surfaces, as they collect contaminates during chamber operation

Step	Description
7	Using 2-Propanol in marked squeeze bottles and clean-room wipes, clean accessible interior chamber surfaces, examining wipes to see if any material has been collected and/or any color on the wipes.
8	Dispose of wipes outside the MCC in approved waste container labeled with Hazardous Material sticker
9	Continue cleaning until no more contamination, as indicated by particles or color on wipes, is removed. Test Director to have final

	decision as to pass/fail criteria
10	Clean internal surfaces of viewports using clean-room wipes and 2-propanol. Dispose of wipes outside in approved labeled waste container as above. (Note: HCL can be used as well to clean the viewports more thoroughly)
11	Close magnetically activated shutters over each viewport using magnets slid along top edge of viewport housing
12	Install 63 new tungsten filaments that are pre-loaded with aluminum
13	Reexamine after installation to verify filament clamp screws are tight and that aluminum helixes are positioned at bottom of each filament loop.
14	Record current life span of both Sycon crystals 1: % 2 % Replace as necessary. (Note: Functioning crystals with long life spans are preferred to new)
15	Examine electrical cable, gas lines, metal shields, etc. for visible damage, record findings in D-Log as needed.
16	Verify mirror temperature sensor is installed and cables connected.
17	Verify mirror gap seals are retracted to outermost position and tighten thumb screws
18	Exit chamber and remove all tools and supplies used in this operation
19	TD to verify all personnel have exited the MCC. Record all items and people exiting the chamber. Tech 1 _____ Tech 2 _____ Wrenches _____ O2 Sensor _____ Lights _____ Bare/Used filaments _____(63)
20	Close manway cover, install 4 C-Clamps symmetrically around cover and secure.
21	Contact Emergency Services at x45416 at completion of all confined space entry procedures Note: If the next step, 7.3, is being performed immediately this step may be skipped since another Confined Space Entry occurs at that time as well.
22	Label manway cover “DO NOT ENTER Without Permission Of Test Director.”
23	Connect Laptop to PLC, Configure RSTrend for Data Acquisition Record trend Configuration file name:
24	Complete Set Point Table in Appendix B.2.
25	Complete Initial Conditions Checklist App B.1.

Section complete.

TD: _____

QA: _____

7.3.Mirror Installation and Inspection

Perform Critical Lift procedure, per document number SSMOC-MCF-PRO-2009 to lift the PMA into the Chamber.
Reinstall MCC Lid per document number SSMOC-MCF-PRO-2009.

Initial Conditions:

- System is in Locked Out/Tagged Out condition
- Chamber is at atmospheric pressure
- Chamber lid is on
- PMA Installed

7.3.1. Mirror Gap Seal Adjustment and Mirror Inspection

WARNING:
FOLLOWING WORK STEPS ARE HAZARDOUS DUE TO ENTRY INTO A CONFINED SPACE – PERMIT REQUIRED.

CAUTION:
WORKING NEAR THE MIRROR REQUIRES PPE AND TRAINING FOR SENSITIVE EQUIPMENT, NON-HAZARDOUS CHEMICAL ENVIRONMENT. REFER TO PERSONAL PROTECTIVE EQUIPMENT PROTOCOL DOCUMENT.

Step	Description
1	Don Cleanroom Attire
2	Open manway door. Using an Oxygen Sensor Record O_2 level in the room and inside the tank. %
3	Fill out confined space entry forms and contact emergency services with entry details. (Note: Can be skipped if emergency services already contacted during operations in 7.2 above - Ames: x45416)
4	Record equipment entering chamber for use by entrants • Worklights • Technicloth II wipes • Antistatic nitrogen blow off gun inside chamber. • 2-Propanol in glass bottle
5	Adjust mirror gap seal to within 1 mm of mirror edge using a 1 mm plastic feeler gauge and tighten thumbscrews finger tight to hold gap seal in position.
6	Positioning work lights as needed, inspect mirror for smudges, dust, etc. acquired from installing the PMA into the MCC.

CAUTION:

WORKING NEAR THE MIRROR WITH LIGHTS – NEVER GET WITHIN 3 INCHES FROM THE MIRROR WITH THE LIGHTS

Record results of inspection for step 6 above:

_____

_____

_____

_____

TD: _____

If contaminated areas are found that require wet cleaning, proceed as follows. Using Technicloth II Cleanroom wipes and 2-Propanol (Appendix A, #1) clean contaminated areas of the primary mirror using the following technique:

CAUTION:
DO NOT LET THE 2-PROPANOL AIR DRY ON THE MIRROR, or streaking will result. Be very careful not to allow gloved hands to contact the front surface of the mirror, or smudges might result.

Step	Description
7	Fold two Technicloth II wipes into quarters. One will be used for wet wiping, and the other for drying.
8	Have an assistant apply 2-Propanol to one of the wipes, replacing the lid on the bottle immediately to minimize water absorption into the 2-Propanol
9	Using light pressure, with one hand, wipe wet cloth over small section of mirror following immediately with the dry cloth in the other hand.
10	Wipes should be replaced often and disposed of into a controlled disposal container outside the MCC, labeled with Hazardous Material.
11	Visually inspect the mirror with bright work lights positioned to see reflections and observe if any sections of the mirror still have contaminated areas.

Record results of the inspection of Step 11 above:

_____

_____

Repeat Steps 1-4 for dirty areas.

TD: _____

QA: _____
N P: _____

7.3.2. Sample Installation

Verify that the sample holder, SLS, is installed in the center of the mirror. In the event that it is not installed follow the steps below to complete the installation.

Step	Description
1	Install sample holder that contains five pre-cleaned 2-inch diameter Zerodur witness samples into SLS and check for contaminated areas as above
2	When all contaminated areas have been removed as above, use ionized nitrogen blow off gun connected to UHP nitrogen tank with regulator set to 20 psig, to remove any remaining visible dust particles.
	Exit chamber and remove all tools and supplies used in this operation. Verify all equipment and personnel exiting chamber • Personnel • Work lights • Technicloth II wipes • Antistatic nitrogen blow off gun inside chamber. • 2-Propanol in glass bottle
4	Close manway door and secure using 4 C-Clamps.
5	Contact Emergency Services at completion of all confined space entry operations (Ames: x45416)
6	Label manway door “DO NOT ENTER Without Permission Of Test Director.”

Section complete.
TD: _____
QA: _____

7.4. Aluminizing Sequence

Review Initial Conditions checklist (Appendix B) and record information as needed.

- Expected Run Time 12Hrs
- Personnel required
  - MCF/PLC Engineer
  - Test Director
  - Safety Personnel

Prior to starting this section, perform particulate measurement and record results using the Particulate Monitor.

Date	Measurement Type	Location	Value
	Particulate count: 0.5 micron/ft^3	Chamber Room	
	Particulate Count	Cleaning Room	
	Particulate Count	Equipment Room	
	Pressure/Magnahelic	Cleaning Room to hanger	
	Pressure/Magnahelic	Coating Room to cleaning room	

Note: Initial Pump down of the chamber may need to be conducted over several days due to excess water and possible contaminants off-gassing from the Primary Mirror Assembly.

7.4.1. Rough Vacuum in PLC Off mode

For the first day run an RVAC Sequence in off mode to determine if a sufficient vacuum level can be reached to continue to 7.4.2. Minimum chamber vacuum level to continue to next step is 15-50 mTorr. Otherwise execute this section until the desired level of vacuum is achieved.

Step	Description
1	Verify the PLC is in OFF Mode
2	Press RVAC button from PLC Main Panel
3	Manually start Roughing pump: E-102
4	Manually start Roots Blower: E-101
5	Record starting pressure of the chamber inlet line: • PI-103
6	Record Chamber Starting Pressures as indicated on the following instruments: • PI-101 • PI-102 • PI-111 • PI-112
7	When PI-103 is at or below 5mTorr stop the pumps in the following order:

	E-102(Roughing Pump) E-101 (Roots Blower) Using RSTrend from MCF laptop start recording data
8	Start E-102 (roughing pump)
9	Start E-101 (roots blower)
10	Observe the pressure gauge PI-101 and PI-102. When PI-103 < PI-101 and PI-102 Open XV-101 (Chamber Isolation Valve)
11	Record time when 15 mTorr is reached (RVAC should automatically halt at this pressure) Time:

TD: _____

QA: _____

Note: The following step, 7.4.1, is performed from the PLC while in PLC Off mode.

7.4.2. Cryopump Regeneration and Cooldown

7.4.2.1. Cryo-pump Regeneration Sequence

Note: Regeneration **MUST** be performed before cool down can start.

Summary:
Execute regeneration sequence for Cryo pumps using the RGEN sequence from the PLC. Note: A successful regeneration sequence will result in a pressure between 75 mTorr and 90 mTorr in the Cryopump being held for one minute.

Step	Description
1	Record Start Time:
2	From the PLC main panel press RGEN
3	Press RGN1□Start from the right side of the RGEN Panel
4	Verify Permissives for RGN1 • 301A OK, CLSD • 303A OK, CLSD • TI-301A OK > 100K
5	Wait for RGN1 to complete before starting RGN2
6	Press RGN2□Start from the right side of the RGEN
7	Verify Permissives for RGN2 • 301B OK, CLSD, • 303B OK, CLSD • TI-301B OK > 100K
8	Record final value of PI-301A and PI-301B • PI-301A _____

	• PI-301B

Section complete.

TD: _____

QA: _____

7.4.2.2. Cryopump Cooldown

When the regeneration sequence is completed, the cryopumps can be cooled.

Step	Description
1	Record Start Time:
2	Record cryopump helium gas pressure Start Time:_____Date: _____ PI-302A1: PI-302A2: PI-302B1: PI-302B2:
3	From the PLC main panel press HVAC
4	Press CLDN from the right side of the HVAC Panel
5	Verify Permissives for CLDN • 301A OK, CLSD • PI-301A < 90mTorr • PI-301B < 90mTorr
6	Press CLDN→CLDN Seq. Start from right side of HVAC Panel
7	Record temperatures from TI-301A TI-301B/Time on data sheet provided in Appendix B.
8	When the cryo-pump temperature sensors, TI-301A TI-301 B read less than 20K record pressure on gauges PI-302 A1-A2 and PI-302B1-B2. Note: The gauge indicator will bounce around due to the pulsing. RECORD the midpoint reading of the bouncing gauge indicator. Log data for cryopump sensors below: TI-301A: _____ PI-302A1:_____ PI-302A2:_____ TI-301B: _____ PI-302B1:_____ PI-302B2:_____

Section complete.

TD: _____

QA: _____

Note: The following steps, 7.4.2-7.4.8, are performed from the PLC while in PLC Aluminizing mode.

7.4.3. Rough Vacuum

Step	Description
1	Press SYSTEM ALUM MODE from PLC Main Panel. (See Fig 1)
2	Verify Aluminization permissives have been met. • No sequence active • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK
3	Press Start/Stop button on right hand side of Panel and press ALUM MD START
4	Verify Step Arrow is pointing to RVAC and RVAC is ready
5	Press RVAC from PLC Main panel to get to the RVAC panel. Record time and beginning values PI-101_____ PI-102 _____ Time _____
6	Press RVAC button on the right hand side of the RVAC panel
7	Verify permissives have been met. • Step Pointer OK • PALL-102R OK • MTR-101, OK Roots blower • MTR-102 OK • XV-101 OK
8	To activate: RVAC Start from the right hand side of the RVAC panel
9	Observe the pressure gauge PI-101 and PI-102.
10	Record time when 15 mTorr is reached (RVAC should automatically halt at this pressure) Time

Section complete.

TD: _____

QA: _____

7.4.4. Meissner

Step	Description
1	Enable LN_2 supply to the Chamber
2	OPEN Dewar Liquid Outlet
3	Turn on room O_2 sensor. Record reading _____$\%O_2$
4	Observe and record Dewar LN_2 level in the LN_2 Usage Log posted

	above dewars.
5	Open valves between LN2 Supply, HV-208, HV-210, HV-209, and chamber
6	Verify MEIS Ready and press Step Advance to Activate MEIS sequence
7	Press MEIS button to get to the MEIS panel. Record Start Time _____
8	Press MEIS button on right hand side of MEIS Panel
9	Verify permissives have been met. • Step Pointer OK • PI-102 <50mTorr • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK.
10	MEIS->MEIS Seq. Start from the right hand side of the MEIS panel
11	When cold gas vents and frost forms meissner sequence has stabilized. Verify pressure drop in PI-101 and PI-102 PI-101: PI-102:
12	Verify Cold Cathode Gauges state: (1) At 10mT verify channels 3 and 4 come on automatically and register a pressure, (These channels correspond to the cold cathode gauges) (2) If 3mTorr pressure is reached verify Cold Cathode gauges and Pirani gauge values indicate averaging taking place. This will be indicated from the values displayed on the PLC Panel. Channels 3 and 4 outputs on the MKS should be equal to the values indicated on PI-102 and PI-102 displayed on the PLC (3) Record pressures at handoff • PI-101_2 • PI-102_2 • PI-101_1 • PI-102_1
13	Return to MAIN Panel once MEIS sequence Completed. (Do not halt sequence, it runs until venting starts.)

Section complete.

TD: _____

QA: _____

7.4.5. High Vacuum

Step	Description
1	Verify temperature sensors TI-301A, TI-301B are < 20K
2	Verify HVAC Ready condition and press Step Advance to HVAC button
3	Press HVAC from PLC Main Panel to activate HVAC panel
4	Press HVAC button on right side of from HVAC panel
5	Verify permissives have been met. • Step Pointer OK • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK. • PI-301A, Gate Valve OK • PI-301B, Gate Valve OK • PI-303A, Regen Valve OK • PI-303B, Regen Valve OK • E-301A, E-302B Cryopumps ready
6	Press HVAC -> HVAC Seq. Start
7	Audibly Verify gate valves opened XV-301A XV-301B
8	Record Starting pressure on PI-101 and PI-102 PI-101: PI-102:
9	If 3mT pressure was not reached during Meissner sequence, Verify Cold Cathode gauges take over at 1mT. Channels 3 and 4 outputs on the MKS should be equal to the values indicated on PI-102 and PI-102 displayed on the PLC
10	Record pressure/time on HIGH VACUUM PUMPDOWN DATA SHEET in Appendix B. until a maximum of 8μTorr is reached at PI-102 Record Pressure:

Section complete.

TD: _____

QA: _____

7.4.6. Glow Discharge

Step	Description
1	Verify Argon supply at 1psig available to HV-404
2	Set the gas calibration factor of 1.76 for argon on channels 3 and 4 of the MKS controller. Use the MKS controller manual as reference.
3	Set the gas calibration for argon from the list of gas options (N2, Ar, He) on channels 1 and 2 of the MKS controller
4	Verify GLOW step ready condition and press Step Advance from PLC Main Panel to GLOW button
5	Press GLOW from PLC Main Panel to activate GLOW Panel
6	Press GLOW button on right side of from GLOW panel
7	Verify permissives have been met. • Step Pointer OK • XV-301A, Gate Valve Closed, OK • XV-301B, Gate Valve Closed OK • XV-101, Isolation Valve Closed OK • TSH-511, Mirror temp OK
8	Press GLOW ->GLOW Seq. Start • Record Start Time:
9	Verify XV-404 opens and observe pressure rise on PI-102
10	Verify Purple Glow record Power level and Time • Power: • Time:
11	Verify pressure rise in PI-101 and PI-102 • PI-101: • PI-102:
12	Verify Pirani Gauges take over as primary sensors writing to the PLC at 3mTorr. Record pressure at handoff: • PI-101_2 • PI-102_2 • PI-101_1 • PI-102_1
13	Verify RVAC starts at 15mTorr Verify XV-101 opens at 18mTorr.
14	Verify glow sequence automatically terminates after 15 minutes
15	Return to PLC Main Panel

Section complete.

TD: _____

QA: _____

7.4.7. High Vacuum – Sequence 2

After glow discharge cleaning, the chamber is re-pumped under high vacuum mode until the system has reached vacuum where filament activation is allowed.

Step	Description
1	Verify TI-301A and TI-301B < 20K
2	Verify HVAC 2 ready and press STEP ADVANCE to step to HVAC 2 button
3	Press HVAC button on right side of HVAC Panel
4	Verify Permissives • HVAC 2, Step Pointer OK • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK. • PI-301A, Gate Valve OK • PI-301B, Gate Valve OK • PI-303A, Regen Valve OK • PI-303B, Regen Valve OK • E-301A, E-302B Cryopumps ready
5	Press HVAC-> HVAC SEQ START from HVAC Panel. Record Starting Pressures. PI-101 PI-102
6 .	Record Start Time
7	Verify cold cathode gauges assume control at 3mTorr Record pressure at handoff: • PI-101_2 • PI-102_2 • PI-101_1 • PI-102_1
8	Verify a minimum pressure of 8μTorr has been reached Record Time
9	Return to PLC Main Panel

Section complete.

TD: _____

QA: _____

7.4.8. Filament Activation

When a pressure of less then 8μTorr has been reached it is time to activate the filaments.

Step	Description
1.	Record Time: _
2.	Verify FILA ready from PLC Main panel and press Step Advance to FILA button
3.	Press FILA button from PLC Main Panel
4.	Verify Sycon Controller is powered on Select Film on Sycon Controller and Record Film #_____ Record Settings for film **Sycon Parameter** **Value** Soak Power Value 1 Ramp up Timing Hold Power value timespan Soak Power Value 2 Ramp up timing Set Point 2 Hold Timespace Soak Power Value 3 Ramp down timing
5.	Press FILA button on right side of FILA Panel
6.	Verify Permissives have been met • Step Pointer OK • PALL-102H, OK • TSH-511, Mirror Temp, OK
7.	Press FILA->FILA SEQ START
8.	At the view port, observe wicking of aluminum onto filaments. Note Power level on Sycon for wicking: Close view ports once wicking of the aluminum off filaments begins.
9.	Monitor TI-511, Stop sequence if temperature rises above 40 deg C. • Press Process Stop button on VCP • Press Stop button on Sycon control panel. NP: _____ TD has discretion to Not Perform (NP)
10.	Verify termination of the deposition sequence and record thickness value displayed on Sycon Controller and PLC • Note value on Sycon controller: • Note value on PLC DIC-509:
11.	Halt Filament Sequence

Section complete.
TD: _____
QA: _____
NP: _____

7.4.9. Vent Chamber

- Expected Run Time 7 Hrs
- Personnel required
  - MCC/PLC Engineer
  - Test Director

Note: Filaments should have been shutdown in previous step (Shutdown filaments – terminate Sycon).

Step	Description
1	Record Time:
2	Change gas calibration factors back to N_2 on the MKS controller and any backup gauges and/or controllers
3	Halt HVAC as needed
4	Halt cool down as needed
5	Turn off meissner LN_2 Supply by closing EV-201A and EV-201B • Verify from MEIS panel on PLC • EV-201A _____ • EV-201B _____
6	Wait four hours for Meissner Traps to warm up. Record start of wait time:
7	Record O_2 level in MCC $\%O_2$
8	Open Vent valve HV-602 to 0 turns to start
9	Verify VENT ready and press Step Advance to VENT button
10	Press VENT from PLC Main Panel
11	Press VENT button on right side of VENT Panel
12	Verify Permissives have been met • Step Pointer OK • XV-101, OK • XV-301A, Gate Valve Clsd, OK • XV-301B, Gate Valve Clsd, OK
13	From PLC main panel Enter VENT Mode • Record Start Time: _____ • PI-101: _____ • PI-102: _____
14	Press VENT->VENT SEQ START Open HV-602 to 1 Turn from closed for venting to begin at 20 T/hour Audibly verify XV-601 opens and venting begins
15	Verify chamber is venting by observing pressure rise at PI-101 and/or PI-102 and log PI_101 and PI_102 vs time on venting log datasheet in Appendix B Record End Time:_____

Section complete.
TD: _____
QA: _____
NP: _____

7.5.Shutdown Procedures

1. At the LN2 Dewar – CLOSE the Liquid Outlet Valve – CLOSE Dewar High Pressure Valve.
   Delay a minimum of 30 minutes to allow time for LN_2 valves to warm up.(permissible to perform below work steps) continue LN_2 shutdown at step 8.
2. At the Argon Bottle: Close K-Bottle Isolation Valve – LEAVE HV-403 alone.
3. Return PLC to SYSTEM OFF Mode
4. Power down PLC
5. Turn Off System from MCF Power Cabinet
6. Perform Lockout/Tagout on MCF Power Cabinet and record state of Circuit Breakers at Shutdown

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB6	Operator Console		
CB7	Glow Discharge		
K6	FPS Relay		

7. CLOSE HV-210 leaving 150 psig of LN_2 in line.
8. Don FULL LN2 PPE, Facemask, Apron, Eye protection, Gloves
9. Ensure no nonessential personnel are nearby

WARNING:
Disconnect of LN2 Line Flexhose from LN2 Dewar –
Possible Temporary Spray of LN2

10. Using Wrench, Slowly remove Flexhose B-Nut from LN2 Dewar Liquid Outlet Interface

TD: _____
QA: _____

7.6.Post Operations

Date	Measurement Type	Location	Value
	Particulate count: 0.5 micron/ft^3	Coating Room	
	Particulate count: 0.5 micron/ft^3	Cleaning Room	
	Particulate count: 0.5 micron/ft^3	Equipment Room	
	Pressure/Magnahelic	Cleaning Room to hanger	Pa
	Pressure/Magnahelic	Coating Room to cleaning room	Pa

TD: _____
QA: _____

WARNING:
FOLLOWING WORK STEPS ARE HAZARDOUS DUE TO ENTRY INTO A CONFINED SPACE – PERMIT REQUIRED.

1. At conclusion of coating chamber operation, open man door in chamber, and following procedure for confined space entry, enter chamber Perform Lockout/Tagout procedures for de-energizing system for electrical, Argon and Liquid Nitrogen.
   1.1. Fill out confined Space Entry forms and follow Confined Space Entry Procedures as per SSMOC-MCF-PRO-2110 and contact emergency services at x45416 to inform them of the planned entry details.
   1.2. Perform one air change prior to entry using VENT sequence.
   1.3. Verify O_2 sensor is within Calibration

   Record Due Date _____
   Hook up O_2 sensor inside chamber door and record initial reading (required above 19.5% for entering)
   Record initial O2 reading _____

2. Gown with following equipment: Face mask, Hood, Coverall, Booties, Gloves.
3. Inspect chamber and mirror and record findings on Mirror Inspection sheet in Appendix B and Record with Digital Camera, Filaments and Samples.
   3.1. Move work light(s) into chamber as needed.
   3.2. Inspect filaments for defects and remnant aluminum and log on Filament Inspection Log in Appendix B
   3.3. Using bright work lights, visually inspect PMA Aluminum coating for defects and contamination. Record / map results and photograph.

_____

_____

_____

3.4. Remove sample holder that contains five 2-inch diameter Zerodur witness samples from SLS and remove from chamber

3.4.1. Remove Kapton tape from one sample and visually verify that the taped area is not contaminated and is suitable for thickness measurement. Record with digital camera.

3.4.2. Relabel in order while removing samples from the sample holder with lead pencil and store in Spawr Substrate holder (1/per container.)

3.4.3. Perform adhesion tests on two of the five witness samples. Place adhesion samples to the right of sample 1 and 2 below

Location	Sample #	Result
Sample 1		
Sample 2		

3.4.4. Perform four adhesion tests on mirror, one each in four quadrants in outer 10 inch radius from the mirror edge. Place adhesion samples on mirror inspection sheet, Appendix B.11.

3.4.5. Package samples and send out for thickness and reflectivity measurements. Record sample numbers being sent _____

3.4.6. Ship to qualified laboratory, example:
Optical Data Associates
5237 E 7th St
Tucson, AZ 85711-2350

3.4.7. Once results are returned append to As-Run procedures and archive.

3.4.8. Completed as-run procedure shall be reviewed for buy offs, data recording (appendices) and discrepancy log closure by Test Director and Quality Assurance

3.4.9. Send completed AS-RUN to USRA Configuration Management for Archival.

3.5. Remove work light and camera from chamber and exit.
Verify all personnel have exited the chamber

3.6. Close manway door and secure.

3.7. From top of chamber, disconnect cables and remove temperature sensor. Use Fall Protection as required.

3.8. PMA is now ready for removal from Coating Chamber.

TD: _____
QA: _____

8. PROCEDURE COMPLETION

Review As-Run procedure for completeness, data sheets filled properly, units are correct and any and all deviations / redlines have been initialed and dated. All identified Work steps have been signed by appropriate signatories.

Send the completed AS-RUN to USRA Configuration Management for Archival.

Final Review of Procedure: Procedure complete and ready for archival:

TD: _____

QA: _____

APPENDIX A: Startup, Shutdown And Energy Isolation Procedures

A.1 PLC Energy Isolation

Startup Procedure:

1. Verify 100A breaker in supply panel in MCF equipment room is off.
2. Remove lock from power supply cabinet in MCF equipment room, following Ames LOTO procedures.
3. Unlock and open power supply cabinet. Verify no voltage is present at 115 VAC duplex box.
4. Remove relay K6 (disables filament power supplies).
5. Turn off circuit breakers CB2, CB3 (Cryopumps), CB4, CB5 (Vacuum pump and roots blower), and CB7 (Glow Discharge power supply). Record Circuit Breaker positions

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB7	Glow Discharge		
K6	FPS Relay		

6. Close and lock cabinet.
7. Close and lock control cabinet in coating room.
8. Verify no personnel present inside coating chamber.
9. Energize 100A circuit breaker in supply panel in MCF equipment room.
10. Energize control switch on power supply panel; verify 'power' light is on.
11. Energize control switch on control chassis. Push 'reset' button, and verify 'power' light is on.
12. Observe startup of PLC controller.

A.2 Shutdown Procedure:

a. Push stop button on control chassis.
b. Switch off control switch on control chassis.
c. Switch off control switch on power supply chassis.
d. De-energize 100A circuit breaker in supply panel.
e. Apply lock to power supply chassis control switch, per Ames LOTO procedures.

A.3.) FULL SYSTEM Energizing procedures

Power-up test of mirror coating tank control chassis

Purpose: To power on all systems to the MCC.
Reference Documents: Operations & Maintenance Document; Warner Power power supply schematic D65-001673-2, -2A, -3
Chart Documents Package, Book 2; One Line Diagram, V095-3-030

Startup Procedure:

1. Verify 100A breaker in supply panel in MCF equipment room is off.
2. Remove lock from power supply cabinet in MCF equipment room, following Ames LOTO procedures.
3. Unlock and open power supply cabinet. Verify no voltage is present at 115 VAC duplex box.
4. Install relay K6 (enables filament power supplies).
5. Turn on circuit breakers CB2, CB3 (Cryopumps), CB4, CB5, CB6, (Vacuum pump and roots blower), and CB7 (Glow Discharge power supply). Record Circuit Breaker positions.

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB7	Glow Discharge		
K6	FPS Relay		

6. Close and lock cabinet.
7. Close and lock control cabinet in coating room.
8. Verify no personnel present inside coating chamber.
9. Energize 100A circuit breaker in supply panel in MCF equipment room.
10. Energize control switch on power supply panel; verify 'power' light is on.
11. Energize control switch on control chassis. Push 'reset' button, and verify 'power' light is on.
12. Observe startup of PLC controller.

APPENDIX B: Forms And Checklists

B.1 Initial Conditions Operator Checklist

Test Director_____Operator_____

Date:__ /__ / __ Time: _:__:__

Step	item	Value	Op	TD
1	Confined Space entry forms and work as needed			
2	All supplies necessary are in place as defined			
3	View Ports covers installed			
4	Remove Administrative Lock (see appendix A.2)			
5	All breakers plugged in and powered on			
6	Main Power breaker On			
7	Vacuum chamber lid in position			
8	Inspect chamber for personnel and unwanted items			
9	Manway door closed			
	i. Swing door close and secure by hand tightening			
10	Chamber under ambient pressure Record PI-101			
	Gauge: PI-101			
11	Argon available to gas valve XV404			
	Attach delivered Argon spec sheet, Verify Purity of Argon	99.999%		
	Fully reduce regulator (calibrated downstream gauge)			
	Connect regulator to tank, Tighten Wrench Tight			
	Connect facility line to regulator outlet			
	Open Argon Isolation valve			
	Increase reg to 1 +- PSIG as seen on Downstream Gauge			
12	LN2 available to Meissner Coils			
	Close LN2 Hand Valves, HV-208 & HV-209 (206 is outside the MCF)			
	Connect flex hose X to LN2 dewar liquid outlet			
	Tighten Wrench Tight			
	Open LN2 liquid outlet valve			
13	Cryopumps A and B charged with GHe as seen on compressor.			
	Cryopump A Ghe: PSIG Start Value			
	Cryopump B Ghe: PSIG Start Value			

B.2. Set Point Tables

TABLE 1
PanelMate Page 2
Setpoints Table - Factory Settings

DATE:9/22/02		By: MAK
Parameter	**Setting**	**Units**
Chamber Pressure-FS Mirror		
PAHH 102G-SP	1.000	Torr
PAHH 102H-SP	0.020	Torr
PAHH 102R-SP	1.000	Torr
PAH 102G-SP	0.1	Torr
PAH 102H-SP	4E-6	Torr
PAH 102R-SP	0.100	Torr
PAL 102G-SP	0.015	Torr
PAL 102H-SP	8E-6	Torr
PAL 102R-SP	0.018	Torr
PALL 102G-SP	0.075	Torr
PALL 102H-SP	9E-6	Torr
PALL 102R-SP	0.015	Torr
PALL 102M-SP	0.018	Torr
Glow Discharge Current		
IIC-401-SP	40	%
Cryopump Pressure		
PAH 301AB-SP	0.090	Torr
PAL 301-SP	0.075	Torr
Glow Discharge Time		
KI 401-SP	20	Min
Mirror Temperature		
TAH 511-SP	50	C
TAHH511-SP	60	C
Thickness Measurement		
DI-509		Å

B.3. CRYOPUMP COOL DOWN DATA SHEET

COATING NUMBER:_____DATE EXECUTED:_____

	Time hr: min	***Elapsed Time***	***Cryo Temp TI-301A***	***Cryo Temp TI-301B***	***Comments Notes***
1		5:00min			
2		10:00 min			
3		15:00 min			
4		30:00 min			
5		1 hr			
6		1.5 hr			
7		2hr			
8		2.5 hr			
9		3hr			
10		3.5 hr			
11		4hr			
12		4.5 hr			

B.4. : ROUGH PUMP DOWN DATA SHEET

COATING NUMBER:_____DATE EXECUTED:_____

	Time hr: min	*Elapsed Time min*	*Upper chamber Pressure PI-101 Torr*	*Lower chamber Pressure PI-102 Torr*	*Comments Notes*
1.		1:00			
2.		2:00			
3.		3:00			
4.		4:00			
5.		5:00			
6.		10:00			
7.		15:00			
8.		20:00			
9.		25:00			
10.		30:00			
11.		35:00			
12.		40:00			
13.		45:00			
14.		50:00			
15.		55:00			
16.		60:00			
17.		65:00			
18.		70:00			
19.		75:00			
20.		80:00			
21.		85:00			
22.		90:00			
23.		95:00			
24.		100:00			
25.		105:00			
26.		110:00			
27.		115:00			
28.		120:00			
29.		125:00			
30.		130:00			
31.		140:00			
32.		150:00			
33.		160:00			
34.		170:00			
35.		180:00			

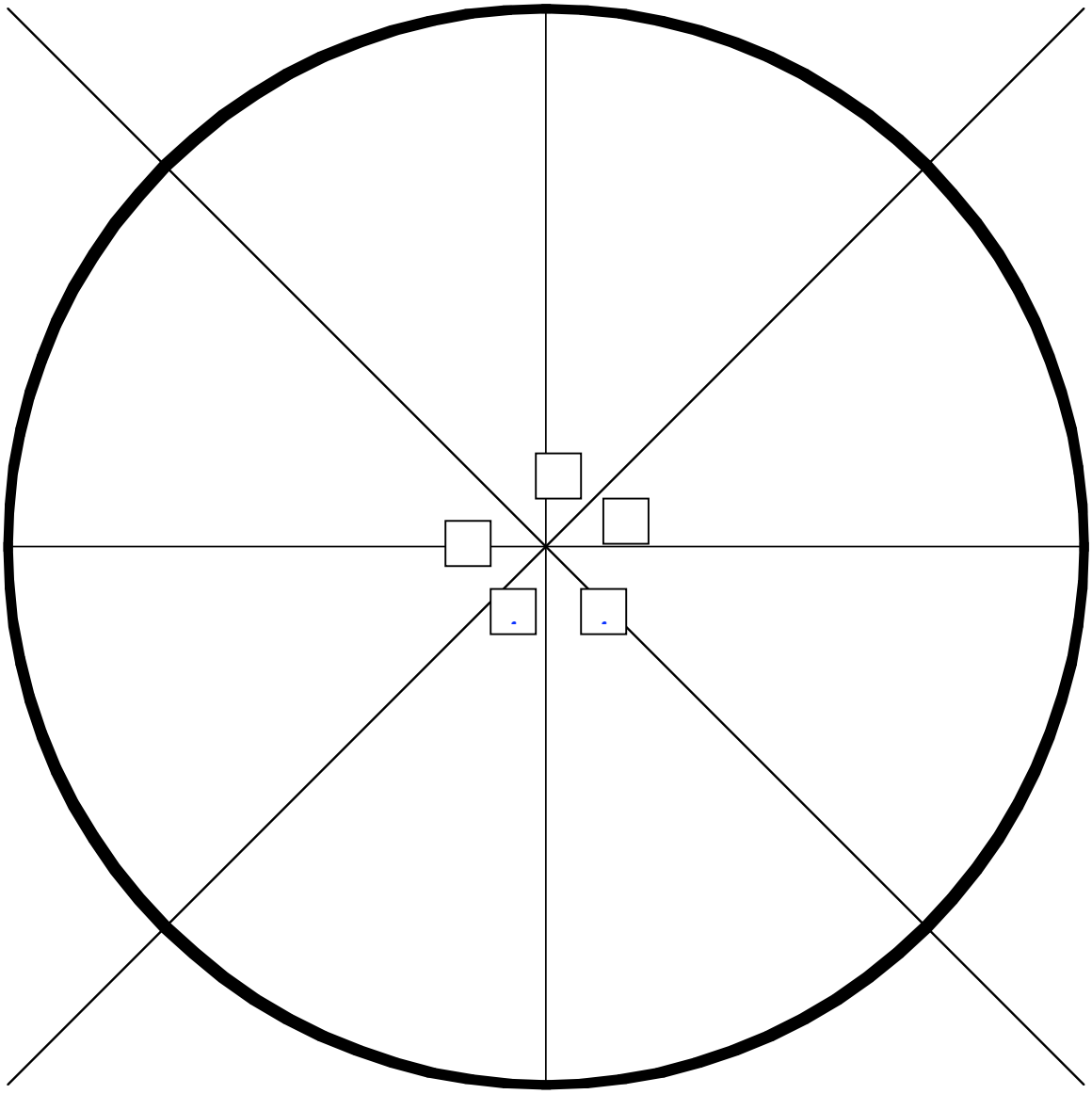
B.5.: HIGH VACUUM PUMP DOWN DATA SHEET

COATING NUMBER:_____DATE EXECUTED: _____

	Time hr: min	***Elapsed Time***	***Upper chamber Pressure PI-101 Torr***	***Lower chamber Pressure PI-102 Torr***	***Comments Notes***
1		0:00min			
2		0:30 min			
3		1:00 min			
4		1:30 min			
5		2:00 min			
6		5:00 min			
7		10 min			

B.6. LOCATION OF WITNESS SLIDES

COATING NUMBER:_____DATE EXECUTED: _____



Manway door

B.7.: GLOW DISCHARGE LOG

COATING NUMBER:_____DATE EXECUTED: _____

	hr: min	***Elapsed Time***	***PI-101***	***PI-102***	***TI_511***	***EI_402***	***IIC_401***
1		0:00min					
2		5:00 min					
3		10:00 min					
4		15:00 min					

B.8.: VENTING LOG

COATING NUMBER:_____DATE EXECUTED: _____

	Time hr: min	***Elapsed Time***	***Upper chamber Pressure PI-101 Torr***	***Lower chamber Pressure PI-102 Torr***	***HV-602 turns***
1		5:00min			
2		10:00 min			
3		15:00 min			
4		30:00 min			
5		1 hr			
6		1.5 hr			
7		2hr			
8		2.5 hr			
9		3hr			
10		3.5 hr			
11		4hr			
12		4.5 hr			

B.9.: CLOCKWISE FILAMENT INSPECTION LOG

COATING NUMBER:_____DATE EXECUTED: _____

	511	***512***	***513***	***Comments***
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				

B.10.: Sycon Power/Pressure Profile

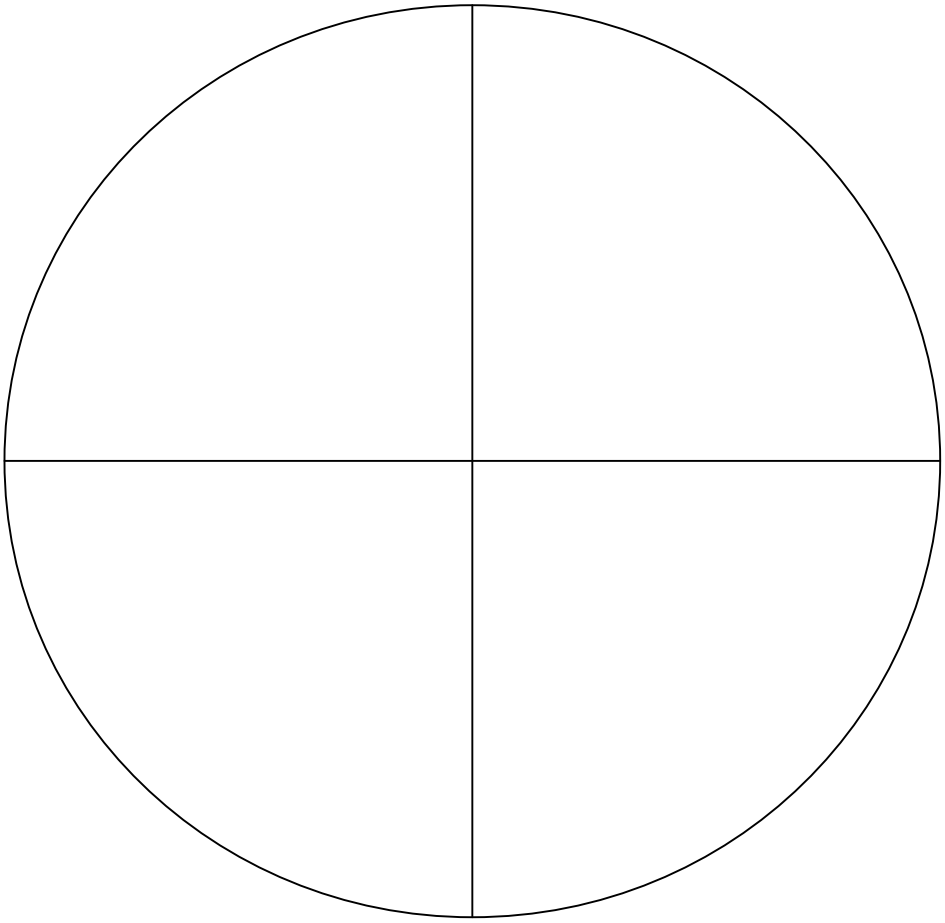
COATING NUMBER:_____DATE EXECUTED: _____

Record data as available

Power Level	PI-101	PI-102	TI-511

B.11.: Mirror Inspection Sheet

COATING NUMBER:_____DATE EXECUTED: _____

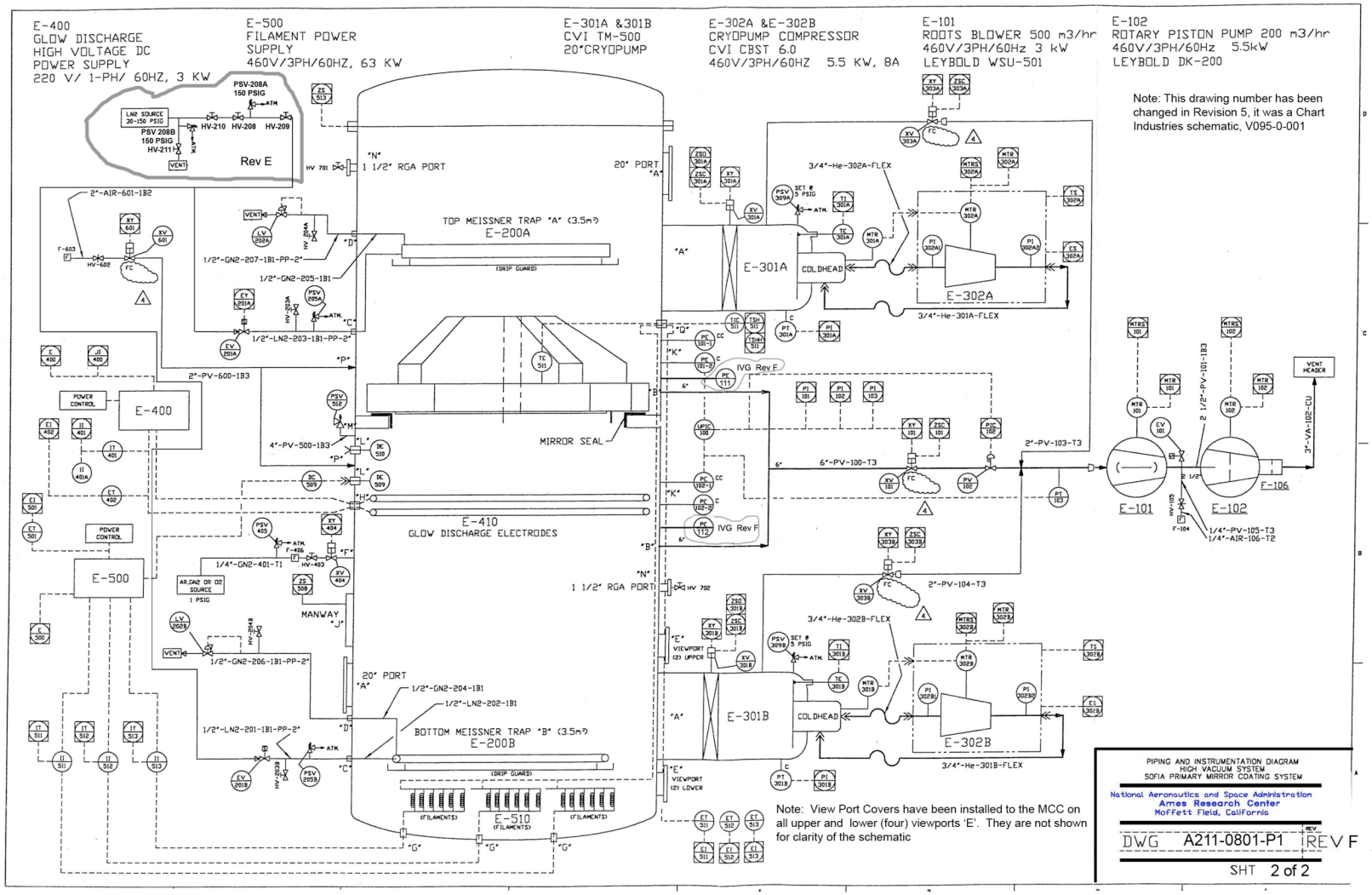


APPENDIX C: DISCREPANCY LOG

Use this page, attach more pages as needed, to document any discrepancies discovered during the performance of this procedure. Each entry to be sequentially number, to identify the work step (s), identify the discrepancy and needed correction (s) and each be 'initialed / dated' by TD and QA prior to performing the correction.

This page intentionally left blank

APPENDIX D: –MCC SCHEMATIC



APPENDIX E: MCF TECHNICAL NOTE

SOFIA MCF TECHNICAL NOTE

CHANGES IN TUNGSTEN FILAMENT AND ALUMINUM CLEANING AND MOUNTING PROCEDURES FOR THE MCF COATING CHAMBER FROM THOSE USED BY CHART INDUSTRIES DURING COMMISSIONING

ACRONYMS USED IN THIS DOCUMENT

MCF	Mirror Coating Facility
MTS	Midwest Tungsten Service
PMA	Primary Mirror Assembly

PURPOSE

Chart Industries has specified tungsten filament cleaning and aluminum clip cleaning and mounting procedures in document V095-1-025. Document V095-2-025 specifies the tungsten size and configuration and document VO95-2-026 shows the aluminum clip specifications. The above documents are included in Appendices 1, 2 and 3 respectively. A change in Chart's procedure for cleaning the tungsten filaments and for forming, cleaning and mounting the aluminum clips are detailed as follows as well as a justification.

BACKGROUND

Midwest Tungsten Service (MTS) was the original supplier of filaments for the MCF commissioning tests and will also supply the same specification filaments for the MCF reactivation and PMA coating. MTS assigned a part number of 1450H-2 to this item.

The aluminum clips were made on site by Chart Industries using aluminum wire manufactured by the A.D. MacKay Company.

MTS CLEANING PROCEDURES

In order to remove any contaminants from the filaments during manufacturing, the MTF procedure for cleaning is to soak them in sulfuric acid (H2SO4) followed by a dual stage tap water rinse. The filaments are then air dried and sealed in plastic bags and are then ready to send to the customer.

APPENDIX Z: EMERGENCY INSTRUCTIONS

Appendix Z: EMERGENCY INSTRUCTIONS

In case of any injury obtain medical treatment as follows call 911 (from NASA/ARC phone only) or 650-604-5555 from cell phone.

Perform the following work steps in the event of an MCC emergency:

Press MCC STOP button located on the left side of the PLC cabinet
Shutdown MCF from MCF cabinet located in Room 97 Turn off BHM Breaker in room 97

Any perceived hazard to valuable hardware or personnel and/or actual damage to hardware or injury to personnel constitute an emergency situation. Examples of potential emergencies include the following:

- Cryogenic Burns
- Hazardous Chemical Spills
- Hazardous Chemical Fumes
- Vacuum Pump Failure
- Unexpected power outage to MCF
- Unexpected Venting of the MCC
- Compressor Failure

CHEMICAL HAZARDS

In the event of a physical emergency involving personnel chemical injury –
DIAL 911 on ARC phone or 650.604.5555 from a cell phone to contact Ames Emergency Medical Services – you are in building 211, Rm 95.

CONFINED SPACE

In the event of a physical emergency within the Chamber (Confined Space) –
DIAL 911 on ARC phone or 650.604.5555 from a cell phone to contact Ames Emergency Medical Services – you are in building 211, Room 95, Closest entrance to the chamber is the Southeast Entrance.

LN_2 SHUTDOWN PROCEDURES

At the LN_2 Dewar – CLOSE the Liquid Outlet Valve
Close HV-210
Open Drain valve HV-211

USRA

UNIVERSITIES SPACE RESEARCH ASSOCIATION

STRATOSPHERIC OBSERVATORY FOR INFRARED ASTRONOMY
NASA AMES RESEARCH CENTER • MS N211-3 • MOFFETT FIELD, CA 94035
• 650-604-1984 (fax) • WWW.SOFIA.USRA.EDU •

19 November 2008
08-HJH-2005

Ms. Kathleen R. Giffin
NASA Ames Research Center
Mail Stop N211-3
Moffett Field, CA 94035-1000

Dear Ms. Giffin:

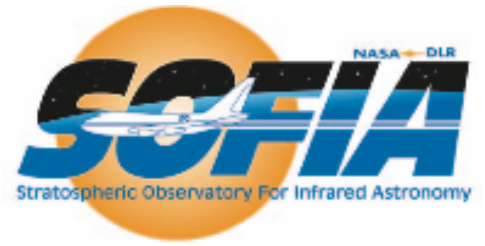
In accordance with the Document Requirements of Contract NAS2-97001, Stratospheric Observatory for Infrared Astronomy, Universities Space Research Association is pleased to provide SCI-US-PRO-SV02-2013, Revision A, the Mirror Coating Chamber Integrated System Test, a type 2 document.

If you would like to discuss any of this material, please do not hesitate to call.

Respectfully,

Helen J. Hall
USRA SOFIA Program Director

HJH/hsc



Mirror Coating Chamber Integrated System Test
SSMOC-MCF-PRO-2300C

SCI-US-PRO-SV02-2013

Date: October 30, 2008
Revision: A

DFRC
Dryden Flight Research Center
Edwards, CA 93523

ARC
Ames Research Center
Moffett Field, CA 94035

German Space Agency, DLR
Deutsches Zentrum für Luft und Raumfahrt

Mirror Coating Chamber Integrated System Test
SSMOC-MCF-PRO-2300C
SCI-US-PRO-SV02-2013, Revision A

PROCEDURE CONTAINS HAZARDOUS WORK STEPS

AUTHOR:

Karen Savage, USRA Test Engineer	30 Oct 08 Date

APPROVALS:

Edward Harmon, NASA SOFIA Science Operations Manager	Nov 10, 2008 Date
Edward Ingraham, NASA Safety & Mission Assurance	11/19/08 Date
Nancy McKown, USRA Mission Operations Manager	4 Nov 2008 Date
Helen Hall, USRA Program Manager	11.21.08 Date

REVISION HISTORY

REV	DATE	DESCRIPTION
-	080111	Released as USRA-DAL-SSMOC-MCF-PRO-2300
	080513	Renamed document to “Integrated System Test” Updates to correct improper placement of some work steps. Made format change. Incorporated changes requested by IRB.
	080513	Updated to incorporate changes requested by IRB on 080513
	080513	Added DR number SCI-US-PRO-SV02-2013 and re-released.
	081027	Updated to include all redlines from last As-Run and comments from MCF team and NASA

Mirror Coating Chamber Integrated System Test
SSMOC-MCF-PRO-2300C
SCI-US-PRO-SV02-2013, Revision A

Table of Contents

Acronyms

CSO	Chief System Safety and Mission Assurance Officer
CODE Q	Quality and Environmental Health
DLOG	Discrepancy Log
FILA	Filament Sequence
FPS	Filament Power Supply
GDPS	Glow Discharge Power Supply
GLOW	Glow discharge sequence
HVAC	High Vacuum
LN_2	Liquid Nitrogen
MCC	Mirror Coating Chamber
MCF	Mirror Coating Facility
O_2	Oxygen
PLC	Programmable Logic Controller
PMA	Primary Mirror Assembly
PPE	Personal protective equipment
PSIG	Pounds per Square Inch Gauge
QA	NASA SSP CSO or SSMA Representative
RGEN	Regeneration Sequence
RGN1	Regeneration Sequence for cryopump A
RGN2	Regeneration Sequence for cryopump B
RVAC	Rough Vacuum Sequence
SOFIA	Stratospheric Observatory for Infrared Astronomy
SSMA	System Safety and Mission Assurance
SSP	SOFIA Science Project
TD	Test Director
VCP	Video Control Panel
VENT	Vent Sequence

Mirror Coating Chamber Integrated System Test
SSMOC-MCF-PRO-2300C
SCI-US-PRO-SV02-2013, Revision A

1. PURPOSE

This procedure provides detailed work instructions and describes the preparation of the coating tank for the aluminizing of the PMA as well as the deposition process after the PMA has been installed.

2. PERSONNEL

2.1.Test Director

The Test Director is responsible for the performance of this procedure. The Test Director must have a detailed understanding of all procedures and facility operations. The performance of this procedure requires a minimum complement of personnel as determined by the Test Director and as indicated in each step. The Test Director may stop any work as deemed appropriate.

2.2.Procedure Performer(s)

The Procedure Performer(s) is (are) responsible for conducting the work steps of the procedure. These personnel must have a detailed understanding of all tasks they are performing and the knowledge of the facility around them. Procedure Performers should only perform work they have been properly trained to perform safely. During the performance of this procedure, they should take direction from the Test Director. The Procedure Performer(s) should stop work deemed unsafe to personnel or flight hardware/software.

2.3. NASA SOFIA Science Project (SSP), Chief System Safety and Mission Assurance Officer (CSO)

The SSP CSO is responsible for System Safety and Mission Assurance (SS&MA) functions while performing this procedure. The SSP CSO may delegate specific authority to a SSMA Representative during this procedure. The SSP CSO also coordinates all Code Q activities in the facility. The SSP CSO may stop any work deemed unsafe to personnel, flight hardware/software, or in violation of this procedure.

2.4.SSMA Representative

The SSMA Representative is responsible for a variety of SSMA functions including, but not limited to witnessing operations, signing-off steps requiring SSMA involvement, approving red-lines, approving minor discrepancies, and reviewing the facility/operation for system safety. The SSMA Representative may stop any work deemed unsafe to personnel or flight hardware/software. Issues that cannot be resolved directly with the Test Director or Procedure Performers should be referred to the SSP CSO for resolution.

2.5. Occupational Safety (OS) Representative

The OS Representative is responsible for ensuring the personnel are conducting this procedure in safe manner and the facility is safe for the operations needed. The OS ensures personnel are properly trained, assesses the facilities safety, and monitors the safety of the personnel performing the procedure. The OS Representative may stop any work deemed unsafe to personnel or flight hardware/software. Issues that cannot be resolved directly with the Test Director or Procedure Performers should be referred to the SSP CSO, or the OS Rep.'s. supervisor as the OS Rep. deems necessary, for resolution.

2.6. Qualified Personnel

Test Director	***Procedure Performers*** Additional as appointed by TD	
Ken Bower William Brown Nancy McKown Karen Savage Patrick Waddell	Ken Bower Bill Brown Dave Black Karen Savage Olyvia Han Paul Keas	
SSP CSO	***SSMA Representative***	***OS Representative***
Edward Ingraham	Edward Ingraham Rich Junnila Additional as appointed by CSO	Ramsey Razik

At the start of this procedure the names of the individuals performing this procedure (by role) should be initialed next to their names in the qualified personnel section.

3. SAFETY

3.1. General

The following is a list of Potential Hazards that will be present during SOFIA Sample Coating Operations:

- Liquid Nitrogen (LN2) and pressurized LN2 Cryogenic burns can be caused by contact with the cold liquid or gas, high pressures can result if boiling liquid or cold gas is confined without a vent path, and asphyxiation can result if the vent gas is allowed to accumulate.
- Working with Hazardous Chemicals
- Working within a Confined Space, the Mirror Coating Chamber (MCC)
- Working near the MCC windows when under high-vacuum.
- Working at heights above 30 inches

3.2. Mitigation of Hazards

- Fall hazard training is required for any individual performing operations that pose a fall hazard
- Only authorized and trained personnel are allowed in the MCF Cleaning and Coating Laboratories without escort.
- When appropriate, tools or other items used with the potential to damage the SOFIA Primary Mirror shall be tethered.

3.3. Safety Training Requirements

Any participants engaging in restricted activity must have training in the applicable areas according to NASA ARC Standards for Health and Safety -

- Fall Protection
- Confined Space
- LockOut– Tag Out
- Chemical Hygiene
- Hazardous Communication
- Cryogens/Compressed Gases

3.4. Mishap Notification

Mishap Notification - Injury

- In case of any injury obtain medical treatment as follows call 911 (from NASA/ARC phone only) or 650-604-5555.

Hardware Mishap

- In case of an accident, incident, or mishap, notification is to proceed per the procedures outlined in NASA ARC APR 1700.1 Chapter 4, "Ames Health & Safety Procedural Requirements - Mishap Reporting and Investigating."

4. QUALITY ASSURANCE

4.1. Configuration Control

The Test Director is responsible to ensure the procedure and any other support documents used in performing this procedure are the most current version and approved per the project's configuration management plan. The NASA SSP CSO or his/her designated SSMA Representative should review this.

4.2. Red-Line Authority

Authority to red-line this procedure (e.g. making minor changes during procedure execution) is given solely to the Test Director or his/her designate and shall be approved by the NASA SSP CSO or his/her designated SSMA representative. Red-lines must be in red and initialed/stamped (to the right of the red-line) by these two individuals in a hardcopy of the document prior to

execution of the red-line step. Issues that cannot be resolved by these two individuals should be flowed up the management chain for resolution.

4.3. Discrepancies

All discrepancies will be recorded in a D-log located in Appendix C. The performer of the procedure should immediately notify the NASA SSP CSO or his/her designated SSMA Representative review of any discrepancy noted during this procedure. Resolution and approval of D-Log items shall be made by the Test Director and NASA SSP CSO or his/her designated SSMA Representative.

During the review of this D-log, the NASA SSP CSO or his/designated SSMA Representative will assess if the D-log item requires the creation of a Discrepancy Report. All discrepancies that effect flight hardware fit or functions, shall be documented in a Discrepancy Report. The NASA SSP CSO using information from the Test Director will open all Discrepancy Reports.

4.4. Documentation

- Unless stated otherwise within this procedure, the performance of each step of this procedure should be performed in sequence. Once a step is completed, it is the responsibility of the person performing the step or the Test Director who is witnessing the completion of the step, to initial to the right of the step. Steps requiring additional witness initial or stamp (i.e. NASA SSP CSO, SSMA representative, OS representative, etc.) will specifically indicate this.
- During a fabrication or test phase, all completed procedures should be contained in a binder located with the hardware in the order they were performed. A copy of the complete procedure will be provided to the NASA SSP CSO.
- When recording data during the As-Run, record the value and the units used to describe the value.
- The AS-RUN procedure, paper copy, shall be printed in Color to maintain color coding of VCP work steps.
- The completed AS-RUN Procedure will be sent for archival through the USRA Configuration Management process.
- Use of Discrepancy Log, Appendix C. This log is used to document, other than trivial, deviation from the procedure. Each deviation shall be evaluated by QA to determine whether a Non-Conformance Report should be initiated or not.

5. TEST REQUIREMENTS

5.1. Tools, Utilities, Materials, and Consumables Required:

Accumulate the following equipment/material and consumables. Store items in appropriate area.

Description	Quantity	Part number
Halogen lamps	3	N/A
Allen Wrenches	2	Sz=5/32”
Tungsten Filaments – bare set	63	Part Number=1450H-2
Gaseous Argon	200 cu ft	Spec: MIL-PRF-27415A
LN_2 w/100 psi relief valve	1000 liters/day	Airgas – 265 Liter dewars x 4
Electrical Power	Verify functional	
Instrument air - • Adjust/confirm air regulator = 80-100 psig • Check Filter	1	CA22 – cutoff valve for instrument air in room 97
Vacuum Grease	1 Tube	NSF61 FC-976
O_2 sensor	1	Record CalDate:
Commercial Voltmeter and connectors	1	
Cleaning Materials - Isopropanol Squeeze Bottle	2	
Torque Striping tool	1	Pen OK
Clean Room garments	Face Mask, Hood, Coverall, Booties, Gloves	1 ea/entrant into chamber
Particle Counter	1	MetOne Particle Counter
Lock/Key (LN_2)	1	
Lock/Key (Argon)	1	
Lock/Key (Electrical)	1	
MCF Laptop	1	HP w/Win98
RS-232 Cable	1	
UV Goggles	4	UVP p/n UVC-503
Magnets	4	Used for View port shutters
LN_2 PPE	Face Mask, Apron, Gloves	1 ea/operator as needed
Timing devices	1	Wristwatch OK

5.2. Other Training – Certified by Test Director

5.2.1. PLC Engineer

PLC Engineer shall have the following required experience

- Rockwell Automation Software packages maintenance.
- Experience in SOFIA MCF software downloads/uploads to the PLC.
- Experience in configuration and monitoring for Data Acquisition System using RSTrend.

- Experience in RS-232 communication using Rockwell Software package RSLinx
- Experience in the use of MCC PanelMate GUI 1700.

5.2.2. MCC Engineer

MCC Engineer shall have the following experience

- Thorough review and understanding of the MCC electrical and mechanical schematic diagrams.
- Ability to diagnose vacuum gauge failures and vacuum system failures.
- Thorough understanding and experience with Vacuum Systems.
- Panel Mate GUI use on the PLC cabinet.
- Sycon Crystal and controller experience including the ability to program the Sycon Controller for specific thicknesses as requested by the SOFIA Science Program.
- Experience in the use of the MKS 146 Vacuum gauge controller.

5.3. Test Personnel

The successful performance of these procedures requires a minimum complement of personnel as determined by the Test Director. A Test Director shall be designated for each test and is required to sign all test sheets or logbooks.

5.4. MCC Maintenance Requirements

Item	**Replacement/Upgrade frequency**
PLC Board	Mean Time Between Failures: 46 years
PLC Battery	1/ five years
PLC Software Packages	Upgrade as needed
Vacuum System • MKS 146 controller • Pirani gauges • Cold Cathode	Controller and Gauges get calibrated when the Pirani gauges disagree by 20% or cold Cathode Gauges disagree by 50%
Roots Blower	Oil levels to be checked monthly
Roughing Pump	Oil levels to be checked monthly
Helium Compressor • PI-301A • PI-301B	Helium compressors need to be serviced when static pressure goes below 200 psig

6. REFERENCE DOCUMENTS

6.1.Drawings and Schematics

Drawing No.	Title
A211-0801-P1 Rev F	MCC Schematic (app D)

6.2.Supporting Documentation

Document Author	Document No.	Title
Chart	V095-2-058	Acceptance Test Plan
NASA Safety / QUALITY DOCS	SSMOC-MCF-PRO-2110	Confined Space Entry Procedures
NASA Safety / QUALITY DOCS	SSMOC-MCF-PRO-2111	Lockout/Tagout Procedure

6.3.Reference Documentation

Document No.	Title
V095-2-012	Control System Operation
V095-1-013	Instrument List
V095-1-014	PLC Database
V095-1-015	Control System Overview
V095-1-016	Video Control Panel
V095-1-017	Valve List
V095-1-018	Line List
V095-1-019	Equipment List
V095-1-021	Requirements Verification Matrix
V095-1-025	Cleaning Procedures for Tungsten Filaments and Aluminum Clip -
SSMOC-MCF-TN-2120	Mounting Procedures for Aluminum Clips onto Filament
V095-2-054	System Handling and Operations for Primary Mirror Coating System.
SOF-1701	Standards for Health and Safety.
NA	Sycon Owners Manual
NA	MKS 146 Gauge controller Manual

7. OPERATIONS

All steps in the following sections refer to working with the PLC5/20 operating system. The user may refer to Appendix B.9 for clarification of all PLC PANELS mentioned. Each panel is accessed from the PLC MAIN Panel.

To start any sequence requires that the user press the sequence button (RVAC, HVAC, MEIS, FILA, GLOW, RGEN) from the PLC MAIN screen. Once the screen for the sequence being executed is active (visible from the VCP) the user can proceed to start the sequence or execute the specified steps dictated below.

7.1. Verify Appropriate QA Notification

The SSMA Representative shall be notified 24 hours prior to the start of this procedure.

QA Notified	Test Director:
_____	_____
(Date & Time)	(Date & Time)

7.2. Pre-Operational Work Steps

#	Step Description	TD	QA
1	Contact David Yee (Oversees Ames Mechanical / Electrical contractor IAP) to verify that there are no planned electrical outages during planned + 30% schedule operations		
2	Verify/Record Calibrated equipment See App. B.8 as needed.		
3	Verify hand valves in Closed Position: HV-203A,HV-204A,HV-203B,HV-204B LN_2 Supply valves HV-210,HV-211. Verify HV-208, HV-209 are in the locked OPEN position.		
4	Visibly inspect upper half of MCC O-Ring located on top interface of the chamber for any scratches, nicks or abrasions and record results Apply vacuum grease as needed to the O-Ring, be sure to wipe any excess and dispose of the wipe in a proper waste container **Note**: This step may be Not Performed if MCC lid is in place and an inspection has occurred within the past year.		
5	Inspect Eyewash / Shower station in the cleaning room to be valved correctly (in-line) and operational • Install large bucket under water head • Exercise Water valves		
6	Record the GHe compressor gauge readings in the Equipment room, 180 psig minimum to begin operations • PI-302A1: _____ psig • PI-302A2: _____ psig		

	• PI-302B1: _____ psig • PI-302B2: _____ psig		
7	Inspect the inlet filter to HV-602, record finding (record method) Note: TD has discretion to Not Perform (NP) step if number of vents of chamber <= 30 Record current # OF Vents to date: _____		
8	Verify View Port protective covers installed with four bolts each		
9	Verify View Port Window Sliders OPEN x 4, if CLOSED, use magnet to OPEN the Viewport Slider.		
10	LN_2 Configuration: LN_2 Dewar positioned nearby, and secured, MCF Flexhose ¾-LN_2-211, with the hose connected to the dewar's LIQUID OUTLET, wrench tight, Dewar LIQUID OUTLET valve closed		
11	Perform Electrical Tag-On to the MCC pneumatic working air compressor located in the North End Shop Area, indicating the need for continuous power to this breaker. Add to the tag 'Contact Rich Ross @ 408.438.7510, MCF Facilities Manager' if there is a need to power off. Notify Shop Management about the need for continuous power to this breaker		
12	Contact Shop Air Compressor Supervisor Arnold Brunswick @ x43503 or customer service @ x45212		

7.3. Control System and Component Checkout

7.3.1. Verify Initial conditions checklist (Appendix B.1) has been completed and signed off.

Record any tooling and/or equipment needed to perform these operations that is not on the equipment list.

Perform work steps provided in Appendix A.2 to power all systems

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB6	Operator Console		
CB7	Glow Discharge		
K6	FPS Relay		

Table Complete:

TD: _____

QA: _____

7.3.2. Programmable Logic Controller (PLC) Boot Verification

PLC Board Revision: PLC5/20

Software Manufacturer: Rockwell Software RSLogix5
Software Revision: 4.00.00.64
Serial License Number: 1112046727
SOFIA Database Revision: _____

PanelMate Configuration Editor: GUI Interface software

Software Manufacturer: Cutler Hammer
Software Revision: Version 1.01 .5.01 b3 SOFIA
Database Revision: PanelMate 1700

PLC running is verified by powering on at the PLC cabinet and verifying PLC program boots and user interface is properly displayed on Video Control Panel (VCP). See Main Panel figure in Appendix B.9.

TD: _____

QA: _____

7.3.3. Configuration Verification and setup

- From the VCP verify system set points and initial configuration in the PLC as defined on PLC Set point Datasheet provided in Appendix B.
- Hook up MCF laptop to the PLC5/20 over the RS-232 serial connection.
- Start RSTrend executable on the MCF Laptop. Setup data acquisition on all channels required for re-activation.
    - Record Trend File Name:

TD: _____

QA: _____

7.3.4. Input/Output Check Out

Input/Output checkout will be performed while the PLC is in System Off Mode. See Main Panel figure in Appendix B.9.

Prior to starting this section, perform particle measurement and log room pressures as seen on the magnahelic gauges located along the hangar wall outside the MCF

Using the Particle Counter, take samples in the Chamber Room, Cleaning Room and Equipment Room and record results in the table below.

Date	Measurement Type	Location	Value
	Particulate count: 0.5 micron/ft^3	Chamber Room	
	Particulate Count 0.5 micron/ft^3	Cleaning Room	
	Particulate Count 0.5 micron/ft^3	Equipment Room	
	Pressure/Magnahelic	Cleaning Room to hanger	Pa
	Pressure/Magnahelic	Coating Room to cleaning room	Pa

Note: The MCF may remain in its initial condition otherwise. i.e. Administrative lock installed over the MCF breaker cabinet

Exercise the following valves by using the Video Control Panel (VCP) provided individual permissives are satisfied: (Reference interlock checklists for permissives in V095-2-58)

#	Inst/Device	Description	PLC Panel	Verification	TD
1	XV-601	Chamber vent valve	VENT	Close: Open:	
2	XV-303A	Regeneration Valve A	RGEN	Close: Open:	
3	XV-303B	Regeneration Valve B	RGEN	Close: Open:	
4	XV-404	Glow Discharge Argon Supply Valve	GLOW	Open: Close:	
5	EV-201A	Upper Meissner Solenoid Valve	MEIS	Open: Close:	
6	EV-201B	Lower Meissner Solenoid Valve	MEIS	Open: Close:	
7	XV-101	Roughing Vac Isolation Valve	RVAC	Open: Close:	
8	ZS-508	Chamber Lid Limit Switch	RVAC	Open: Close:	
9	ZS-513	Manway Door Limit Switch	RVAC	Open: Close:	
10	PE-101_1	Chamber Upper Level Pressure Gauge	RVAC	Cable Hardwire Checkout	
11	PE-102_1	Chamber Lower Level Pressure Gauge	RVAC	Cable Hardwire Checkout	
12	DE-509	Sycon Crystal Signal	FILA	Cable Hardwire Checkout	
13	TI-511	Temperature Sensor	Omega Sensor	Cable Hardwire Checkout	

7.3.5. Shutdown Procedures

Shutdown the system using system shutdown procedures given in Appendix A. Note the state of all circuit breakers in the table below

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB7	Glow Discharge		
K6	FPS Relay		

TD: _____

QA: _____

NP:_____
TD has discretion to Not Perform (NP)

7.4.Sub-system Operation Checkout

List all personnel performing operational work steps and Test Director

_____
_____
_____

Verify that Steps in Section 7.3 have been completed and signed off.

TD: _____
QA: _____

The following (sections 7.4.1-7.4.7) can be performed in any order as allowed by permissives defined for each subsystem as given in interlock checklists. See V095-2-58Rev1.

NOTE:

The MCC has a set of gauges installed parallel to PI-101 and PI-102 which are independent of the PLC (designated PI-111 and PI-112 on the MCC schematic). These gauges are present to allow independent verification of gauge performance, and should be utilized by an MCC Engineer to evaluate the proper state of the system whenever PI-101 and PI-102 disagree significantly, or there is reason to believe that both are incorrect. In general, the following guidelines may be useful:

1) For 979B gauges:

a) above 100 Torr, the Convection Enhanced Pirani gauges (PE-101-2 & PE-102-2) will be most accurate;
b) between 100 Torr and 20 milliTorr, the gauges have similar performance;
c) between 20 milliTorr and 50 microTorr the 979B's will be most accurate; and
d) below 50 microTorr, the Cold Cathode gauges (PE-101-1 & PE-102-1) and the 979B's will have similar performance.

2) For 999 Quattro gauges:
a) above 50 Torr, the 999's will be most accurate;
b) between 50 Torr and 20 milliTorr, the Pirani's and 999's will have similar performance;
c) between 20 milliTorr and 50 microTorr, the 999's will be most accurate; and
d) below 50 microTorr, the Cold Cathode gauges and the 999B's will have similar performance.

PI-101 & PI-102 are known to be least reliable between 15 milliTorr and 1 milliTorr. In this pressure range, the MCC engineer should often consult the independent gauging to ensure reasonable system performance. This condition occurs during the start of Meissner and Glow sequences.

Refer to Appendix B for VCP panels

7.4.1. Rough Vacuum System

Section A must be completed without interruption

- Expected Run Time — Up to 12 hrs
- Personnel required — 3 people
  - ✓ MCF/PLC Engineer
  - ✓ Test Director

A. EXTERNAL GAS BALLAST ADJUSTMENT

Required PLC Condition

PLC System State: OFF

PLC Breaker Conf: CB5 switched Off, indicate all breaker positions and relays below

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		

CB6	Operator Console		
CB7	Glow Discharge		
K6	FPS Relay		

Device Being Tested

Metering valve: HV-105

Note: The gas ballast metering valve needs to be adjusted to get the correct amount of air flow to prevent back streaming of oil into chamber:

If communication is required between rooms, user cell phones are permitted.

1. Verify chamber isolation Valve XV-101 is closed via PLC Main panel display indication (ZSC-101)

XV-101 Closed:

Start Time:

2. Fully Close then Fully Open metering HV-105

Record number of turns

3. Close HV-105 to half way point

Record number of turns

4. From the RVAC panel start the rough pump skid with Rotary piston pump running only.

- Press RVAC from Main VCP Panel
- Press E-102 □Vac. Pump E-102 Start on the right hand side of the panel
- Verify (audible) start and record time:

Note: Wait 10 minutes for Rough Pump to warm up

5. Observe the pressure drop at PI-103 until it stabilizes, i.e. there is no turbulence seen in the readings

6. Adjust and record turns of HV-105 until PI-103 reads 0.015-0.025 Torr, Verify the pressure has stabilized by recording pressure/time on PI-103 Stabilization Datasheet found in Appendix B.

7. Shutdown rough pump skid from PLC panel. Press RVAC to close/shutdown skid. Record time of shutdown _____

8. Torque stripe HV-105 (pen)

9. Return to PLC MAIN Panel

10. Cutoff power to Motor E101 and Verify that XV101 closes. Verify that a Motor Failure MTR-101 is displayed on the PLC. Record result

11. Cutoff power to Motor E102 and Verify that XV101 closes. Verify that a Motor Failure MTR-101 is displayed on the PLC. Record result

12. Perform MCF shutdown procedures found in Appendix A.2

13. Re-enable CB5 within PLC Breaker Cabinet. indicate all breaker positions and relays below

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB6	Operator Console		
CB7	Glow Discharge		
K6	FPS Relay		

Section complete.

TD: _____

QA: _____

Caution:
HV-105 will be open when we perform chamber pump-down. Once it is set it should not be touched again.

B. CHAMBER PUMP DOWN

Required PLC Condition

PLC System State: Test

Devices Being Tested

Chamber Isolation Valve

Lower Pressure gauge

Upper Pressure gauge:

Roughing Pump

Roots Blower

Chamber inlet Pressure Valve

Expected run time is 3 hours. At the end of 3 hours the expected vacuum will be approximately 15 milliTorr as seen on gauge PI-101, TD has discretion to start when above stated pressure.

1. In the table below record all starting point values and verify that each channel is responding once the RVAC sequence is started.

Inst/Device	Description	PLC Panel/ Sequence	Verification	Value
PI-103	Inlet Pressure	RVAC		
E-101	Roots Blower	RVAC	On	
E-102	Roughing Pump	RVAC	On	
PI-101	Upper Pressure	RVAC		
PI-102	Lower Pressure	RVAC		
XV-101	Chamber Isolation Valve	RVAC	Time Open:	

Step	Description
1.	Record Start Time:_____
2.	From PLC Main panel activate the RVAC panel
3.	Press RVAC button on the right hand side of the RVAC panel
4.	Verify permissives have been met. • No sequence active • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK.
5.	Press RVAC□RVAC Seq. Start and start recording data on Rough Pump Down DATA SHEET provided in Appendix B

Note: In the first few minutes the pressures will appear to bounce around significantly. This is due to turbulence occurring next to the pressure transducers.

2. Record final pressures and Stop time.
   Stop Time:_____
   PI-101:_____
   PI-102:_____

3. Verify that chamber holds a vacuum while the pumping line is at ambient when limit switch ZSC101 indicates XV101 is closed.

- Pump down the chamber to a range between 10 and 20 mTorr. Leave the chamber overnight with XV-101 closed. Record resulting chamber pressure.

  PI-101:

  PI-102:

Section complete.

TD: _____

QA: _____

Note: TD has discretion to place chamber operations on hold at this point until next shift is available to resume operations. (e.g. This could be overnight or to stop for organizational meetings, etc.).

7.4.2 Cryopump: Regeneration and Cool Down

- Expected Run Time 3 Hr
- Personnel required 2 people
  - MCF/PLC Engineer
  - Test Director
- Required PLC Condition
  - PLC System State**:** TEST
- Devices Being Tested
  - Helium Compressors: LV-202A, LV-202B
  - Cryopumps
- Equipment Required:
  - 210 psi static pressure in helium compressors

A. CRYO-PUMP REGENERATION SEQUENCE

Note: Regeneration **MUST** be performed before cool down can start.

Summary:
Execute regeneration sequence for Cryo pumps using the RGEN sequence from the PLC. Note: A successful regeneration sequence will result in a pressure between 75 mTorr and 90 mTorr in the Cryopump being held for one minute.

Step	Description
1.	Record Start Time:
2.	From the PLC main panel press RGEN
3.	Press RGN1→Start from the right side of the RGEN Panel
4.	Verify Permissives for RGN1 • 301A OK, GATE VALVE, CLSD • 303A OK, CLSD

	• TI-301A OK > 100K
5.	Wait for roughing pumps to start and note state of limit switch Regen Valve A Limit Switch: XIC_ZSC_303A (Opens when PI-103 < 50mTorr)
6.	Wait for RGN1 to complete before starting RGN2
7.	Press RGN2→Start from the right side of the RGEN
8.	Verify Permissives for RGN2 • 301B OK, GATE VALVE, CLSD, • 303B OK, CLSD • TI-301B OK > 100K
9.	Wait for roughing pumps to start and note state of limit switch Regen Valve B Limit Switch: XIC_ZSC_303B (Opens when PI-103 < 50mTorr)
10.	Record final value of PI-301A and PI-301B • PI-301A _____ • PI-301B

Section complete.

TD: _____

QA: _____

B. CRYO-PUMP COOL DOWN

When the regeneration sequence is completed, the cryopumps can be cooled.

1. Record cryopump helium gas pressure

   Start Time:_____ Date: _____
   PI-302A1: PI-302A2:
   PI-302B1: PI-302B2:

2. Start cooldown from HVAC Panel.
3. Record temperatures from TI-301A TI-301B/Time on data sheet provided in Appendix B.
4. When the cryo-pump temperature sensors, TI-301A TI-301 B read less than 20K record pressure on gauges PI-302A1-A2 and PI-302B1-B2. Note: The gauge indicator will bounce around due to the pulsing. RECORD the midpoint reading of the bouncing gauge indicator.

   Log data for cryopump sensors below:
   TI-301A: _____
   PI-302A1:_____
   PI-302A2:_____

TI-301B: _____
PI-302B1:_____
PI-302B2:_____

Section complete.

TD: _____

QA: _____

Note: TD has discretion to place chamber operations on hold at this point until next shift is available to resume operations. (e.g. This could be overnight or to stop for organizational meetings, etc.).

7.4.3 Meissner Surfaces Operation

- Expected Run Time 1 Hr
- Personnel required 2 people
  - MCC Engineer
  - Test Director
- Required PLC Condition
  - PLC System State**:** TEST
- Devices Being Tested
  - Vent Valves: LV-202A, LV-202B
  - EV-201A and EV-201B
- Equipment Required:
  - 100 liters of LN_2 in Dewars
  - LN_2 PPE
  - O_2 Sensor

1. Verify LN_2 dewars are secured.
2. Verify Chamber evacuated to minimum vacuum of 2x10-2 Torr.
3. MCC Engineer verifies LN_2 available and first dewar connected
4. MCC Engineer performs the following to supply Liquid Nitrogen to the MCC
   a. DON LN_2 PPE
   b. Verifies with TD that system is ready for LN_2
   c. Turn On O_2 sensor and place near the inner MCC LN_2 connection – close to the floor
   d. Open HV-210
   e. Open slowly Dewar Liquid Supply Valve
   f. Adjust dewar high pressure valve to achieve 75 +/- 50 psig

TD: _____

QA: _____

5. Initiate cooldown of the Meissner surfaces using the PLC

Step	Description
1.	Press MEIS from PLC Main panel to get to the MEIS panel.

	Record Start Time To activate: MEIS->Start from the right hand side of the MEIS panel
2.	Verify permissives have been met. • Step Pointer OK • PI-102 <50mTorr • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK.
3.	When cold gas vents and frost forms meissner sequence has stabilized. Verify pressure drop in PI-101 and PI-102 PI-101: PI-102:
4.	Verify Cold Cathode Gauges on state (1) At 10mT verify channels 3 and 4 come on automatically and register a pressure, (These channels correspond to the cold cathode gauges) (2) Verify Cold Cathode gauges take over at 3mT. Channels 3 and 4 outputs on the MKS should be equal to the values indicated on PI-102 and PI-102 displayed on the PLC
5.	Return to MAIN Panel once MEIS sequence Completed. (Do not halt sequence, it runs until venting stops.)

Section complete.

TD: _____

QA: _____

7.4.4 High Vacuum System

Verify Initial Conditions as given in Appendix B.1.

- Expected Run Time 1 Hr
- Personnel required 4 people
  - MCF/PLC Engineer
  - Test Director
  - QA Personnel as needed
- Required PLC Condition
  - PLC System State**:** TEST
- Devices Being Tested
  - Upper Cryopump Gate Valve: XV-301A
  - Lower Cryopump Gate Valve: XV-301B
- Equipment Required:
  - 50 liters of LN2 in Dewars
  - LN2 PPE
  - O2 Sensor

Initial Conditions:

Note: To start HVAC it may be necessary to HALT or suspend RVAC and MEIS

1. Verify LN_2 available and first dewar connected and perform the following to supply Liquid Nitrogen to the MCC
   a. DON LN_2 PPE
   b. OPEN SLOWLY Dewar Liquid Supply Valve
   c. Turn On O_2 sensor and place near the inner MCC LN_2 connection – close to the floor

TD _____

2. Verify Initial conditions and permissives
   - ZS-508, manway door limit switch OK
   - ZS-513, Chamber lid limit switch OK.
   - PI-301A, Gate Valve OK
   - PI-301B, Gate Valve OK
   - E-301A, E-302B Cryopumps ready
3. Record:

   Start time:
   PI-101:
   PI-102 :

The next switches cannot be manually exercised. The PLC can be used to open and close the gate valves once the chamber is at a maximum pressure of $10x10^{-3}$ Torr. Read out and record the current state from the PLC Main Panel. Exercise valves from PLC panel indicated and verify response in the table.

#	Inst/Device	Description	PLC Panel/ Sequence	Verification
1	XV-301A	Cryopump A Gate Valve	HVAC/RGEN	Open; Closed:
2	XV-301B	Cryopump B Gate Valve	HVAC/RGEN	Open Closed:

4. Record pressure/time on HIGH VACUUM PUMPDOWN DATA SHEET in Appendix B. until a maximum of 8μTorr is reached at PI-102

5. Perform power loss checkouts on helium compressors and note response of corresponding gate valves.
   - Verify that shutting off power to compressor (E302A) makes XV301A close

     Record Result:
   - Verify that shutoff of power to compressor (E302B) makes XV301B close

     Record Result:

Section complete.

TD: _____

7.4.5 Glow Cleaning System

Note: The needle valve HV-403, which controls the argon supply, will be adjusted manually by 1.5 turns from fully closed position to provide an operating pressure of 20 mTorr+/- 5 mTorr.

Note: The Glow pressure and glow voltage will be set to initiate glow in the normal region as follows:

Initial Condition:

- Chamber pressure < 15mTorr

A. PRESSURE CONTROL LOOP SETUP: GAS SUPPLY NEEDLE VALVE

1. Verify HVAC and Meissner sequences halted.
2. Enter a power level of 0 (zero) and set the timer for 20 minutes. Press GLOW on the PLC MAIN Panel
   a. Press GLOW PS to set Power Level and enter 0
   b. Press KI-400 to set timer to 20 min/1200 sec.
3. Set the gas calibration factor of 1.76 for argon on channels 3 and 4 of the MKS controller. Use the MKS controller manual as reference
4. Set the gas calibration for argon from the list of gas options (N2, Ar, He) on channels 1 and 2 of the MKS controller.
5. Start the glow sequence by pressing GLOW□START from the PLC GLOW menu
6. Record starting pressures
   a. PI-101 _____
   b. PI-102_____
7. Start glow sequence: Press start button from the GLOW sequence menu Note: XV-404 automatically opens when the glow sequence is started
8. Verify that argon is entering the chamber by observing a pressure change in the system at PI-101 and PI-102.

   Note: The RVAC sequence should automatically start the roughing pumps at 15mTorr and XV-101 should open at 18mTorr
9. Manually adjust the HV-403 needle valve until the pressure stabilizes at 20+/-5 mTorr at PI-101 (record)
   a. PI-101

b. PI-102 (reference only)

10. Stripe/Lock HV-403

Section complete.

TD: _____

QA: _____

B. GLOW TESTING: VOLTAGE AND PRESSURE LEVEL ADJUSTMENT

1. Press GLOW from the PLC Main Panel
   a. Start the glow sequence by pressing GLOW→GLOW SEQ START
2. Verify XV-404 Opens by observing a State Change on GLOW Panel. Verify and record chamber pressures.
   i. PI-101
   ii. PI-102
3. Keep increasing the power from the PLC until a purple glow is visible in the chamber by viewing through view port. Record set-point for power from the PLC and values on pressure Gauges PI-101 and PI-102. This should be a percentage of current. (Note: 91 % is current power setting on the PLC)
   i. Power set point_____
   ii. PI-101 _____
   iii. PI-102 _____
4. Stop the GLOW Sequence (or let timer expire)
   a. Press GLOW□STOP from GLOW menu
   b. Verify Glow sequence stops by observing the purple glow disappears.
   c. Verify XV-404 closes audibly and visibly by noting state change on the GLOW Panel of the PLC

Section complete.

TD: _____

QA: _____

7.4.6 Vent System

- Expected Run Time 3 Hr
- Personnel required 2 people
  - MCF/PLC Engineer
  - Test Director
  - QA Personnel as needed

Purpose: The back-fill system needs to be checked for proper back-fill time of 195 + / 30 min. HV-602 is adjusted manually to correct if out of adjustment. (Note: 4-5 Torr/minute rate of rise should yield an appropriate venting time)

1. Determine open position of HV-602 by counting the number of turns it takes to fully close, then re-open by this same amount. Record:_____
2. From PLC main panel Enter VENT Mode Record Time

Time:_____

Date: _____
PI-101: ____

PI-102: ____

3. Press VENT chamber is venting by observing pressure rise at PI-101 and/or PI-102
4. Record time for getting back to 750+ Torr

   If time is out of required range then

   a) Adjust the setting on HV-602 Record adjustments made
   b) RVAC chamber to$2x10^{-2}$Torr
   c) Restart steps from "i" above.

   If time recorded is within preset time span
   a) Mark Valve
   b) Note number of turns from closed and record valve setting (number of turns)
   c) Record pressure/time as chamber comes back up to atmospheric pressure.

   Perform rough pump procedures from section 7.4.1-B as required to repeat back fill process in order to set the valve and reach the desired back fill time.

   Record number of times chamber Vented in vent log

Section complete.

TD: _____

QA: _____

NP: _____
TD has discretion to Not Perform (NP) this section

Note: TD has discretion to place chamber operations on hold at this point until next shift is available to resume operations. (e.g. This could be overnight or to stop for organizational meetings, etc.).

7.4.7 Filament Power Supply and Array Checkout

List all personnel performing operational work steps and Test Director

_____

_____

Summary

This checkout is done at atmospheric pressure with Bare Filaments Installed.

Install 63 bare filaments (no aluminum clips) for the power supply checkout.

Prior to starting this section, perform particulate measurement and record results

Date	Measurement Type	Location	Value
	Particulate count: 0.5 micron/ft^3	Coating Room	
	Particulate count: 0.5 micron/ft^3	Cleaning Room	
	Particulate count: 0.5 micron/ft^3	Equipment Room	
	Pressure/Magnahelic	Cleaning Room to hanger	Pa
	Pressure/Magnahelic	Coating Room to cleaning room	Pa

WARNING:

The following work steps require Confined Space Entry, permit required and **Electrical Lockout/ Tagout**

C. Initial Conditions

1. Perform Lockout/Tagout procedures for de-energizing system for electrical, Argon and Liquid Nitrogen. Record breaker and relay positions below

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB6	Operator Console		
CB7	Glow Discharge		
K6	FPS Relay		

Table Complete:

TD: _____

QA: _____

2. Fill out confined Space Entry forms and follow Confined Space Entry Procedures as per SSMOC-MCF-PRO-2110

Open Manway Door

Verify O2 sensor is within Calibration Record Due Date

Hook up O2 sensor inside chamber door and record initial reading (required above 19.5% for entering)

Record initial O_2 reading._____

Perform 10 air changes. Using fan running 800 ft^3/min. For 1942 ft^3 this should take 20 minutes. This takes the initial venting air change into account. Position the fan such that air is being pulled out of the chamber.

3. Gown with following equipment: Face mask, Hood, Coverall, Booties, Gloves
4. Gather 63 bare filaments and installation tools, Record which tools needed
5. Record all items and people entering the chamber.

Tech 1	_____
Tech 2	_____
Wrenches	_____
O2 Sensor	_____
Lights	_____
Filaments	_____
Other	_____

6. Power O2 sensor ON, Open Manway door and insert O2. Record initial reading prior to entry

WARNING:

DO **NOT** ENTER CHAMBER IF O2 LEVEL IS BELOW 19.5%
CONTACT TEST DIRECTOR FOR FURTHER INSTRUCTIONS

7. Enter Chamber through Manway door. Install filaments between each pair of posts and hand tighten using allen wrenches. Take pictures of all activity. Exit.
8. Record all items and people exiting the chamber.

Tech 1	_____
Tech 2	_____
Wrenches	_____
O2 Sensor	_____
Lights	_____
Filaments	_____
Other	_____

9. Final visual check of chamber prior to closing
10. Manway door closed
    1. Swing door close and secure by hand tightening screw
11. Complete confined space protocol per QA Confined Space Entry Procedures given in Appendix B.

TD: _____

D. Power Supply Checkout and Array Checkout

1. Perform Lockout/Tagout protocol to re-energize system in Appendix A.2 for Electrical, Argon, and Liquid Nitrogen. Record breaker and relay positions below

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB6	Operator Console		
CB7	Glow Discharge		
K6	FPS Relay		

Table Complete:
TD: _____
QA: _____

2. Power up PLC from Breaker Box in Room 97
3. Configure Sycon controller output profile as Film 1 for test run

Sycon Parameter	Value
Soak Power Value 1	5%
Ramp up Timing	1 minute
Hold Power value timespan	1 Minute
Soak Power Value 2	8 %
Ramp up timing	30 seconds
Set Point 2 Hold Timespace	10 minutes
Soak Power Value 3	0%
Ramp down timing	0 seconds

Caution:
Do not exceed a programmed maximum output of 8% fixed at constant value as per Sycon Setpoints datasheet Rev date 092402.

4. From the PLC main panel enter SYSTEM TEST MODE sequence

   Press FILA from PLC MAIN Panel

   Press FILA from FILA Sequence

   Record Start Time _____

5. Measure voltage across each of 3 legs of the filament array at the connection lugs on the underside of the Mirror Coating Chamber using a portable Voltmeter. Record voltages at circuits 511a, 512b, and 513c NOTE: each leg represents 21 filaments

   511a

   512b

   513c

   See Figure 2, in Appendix D for MCC schematic

6. Exit TEST MODE FILAMENT sequence
7. Return to PLC Main Panel

Section complete.

TD: _____

QA: _____

E. CONTROL LOOP CHECKOUT

The control loop of the Sycon deposition monitor needs to be verified for proper operation. Run Sycon built-in self test as per Manufacturer Instructions.

Note: TD has discretion to place chamber operations on hold at this point until next shift is available to resume operations. (e.g. This could be overnight or to stop for organizational meetings, etc.).

7.5. Full System Operation

Verify Initial Conditions as given in Appendix B.1.

- Expected Run Time 12Hrs
- Personnel required 4 people
  - MCF/PLC Engineer
  - Test Director
  - Safety Personnel

Prior to starting this section, perform particulate measurement and record results using the Particulate Monitor.

Date	Measurement Type	Location	Value
	Particulate count: 0.5 micron/ft^3	Chamber Room	
	Particulate Count	Cleaning Room	
	Particulate Count	Equipment Room	
	Pressure/Magnahelic	Cleaning Room to	

		hanger	
	Pressure/Magnahelic	Coating Room to cleaning room	

NOTE:

The MCC has a set of gauges installed parallel to PI-101 and PI-102 which are independent of the PLC (designated PI-111 and PI-112 on the MCC schematic). These gauges are present to allow independent verification of gauge performance, and should be utilized by an MCC Engineer to evaluate the proper state of the system whenever PI-101 and PI-102 disagree significantly, or there is reason to believe that both are incorrect. In general, the following guidelines may be useful:

For 999 Quattro gauges:

a) above 50 Torr, the 999's will be most accurate;
b) between 50 Torr and 20 milliTorr, the Pirani's and 999's will have similar performance;
c) between 20 milliTorr and 50 microTorr, the 999's will be most accurate; and below 50 microTorr, the Cold Cathode gauges and the 999B's will have similar performance.

PI-101 & PI-102 are known to be least reliable between 15 milliTorr and 1 milliTorr. In this pressure range, the MCC engineer should often consult the independent gauging to ensure reasonable system performance. This condition occurs during the start of Meissner and Glow sequences.

7.5.1. Cryopump: Regeneration and Cool Down

Note: The following step, 7.5.1, is performed from the PLC while in PLC Test mode.

A. CRYO-PUMP REGENERATION SEQUENCE

Note: Regeneration **MUST** be performed before cool down can start.

Summary:

Execute regeneration sequence for Cryo pumps using the RGEN sequence from the PLC. Note: A successful regeneration sequence will result in a pressure between 75 mTorr and 90 mTorr in the Cryopump being held for one minute.

Step	Description
1.	Record Start Time:
2.	From the PLC main panel press RGEN
3.	Press RGN1□Start from the right side of the RGEN Panel
4.	Verify Permissives for RGN1 • 301A OK, CLSD

	• 303A OK, CLSD • TI-301A OK > 100K
5.	Wait for roughing pumps to start and note state of switches
6.	Wait for RGN1 to complete before starting RGN2
7.	Press RGN2□Start from the right side of the RGEN
8.	Verify Permissives for RGN2 • 301B OK, CLSD, • 303B OK, CLSD • TI-301B OK > 100K
9.	Record final value of PI-301A and PI-301B • PI-301A _____ • PI-301B

Section complete.

TD: _____

QA: _____

B. **CRYO-PUMP COOL DOWN**

After the regeneration sequence is completed, the cryopumps can be cooled.

Step	**Description**
1.	Record Start Time:
2.	Record cryopump helium gas pressure Start Time:_____Date: _____ PI-302A1: PI-302A2: PI-302B1: PI-302B2:
3.	From the PLC main panel press HVAC
4.	Press CLDN from the right side of the HVAC Panel
5.	Verify Permissives for CLDN • 301A OK, CLSD • 301B OK, CLSD • PI-301A < 90mTorr • PI-301B < 90mTor
6.	Press CLDN□CLDN Seq. Start from right side of HVAC Panel
7.	Record temperatures from TI-301A TI-301B/Time on data sheet provided in Appendix B.
8.	When the cryo-pump temperature sensors, TI-301A TI-301 B read less than 20K record pressure on gauges PI-302 A1-A2 and PI-302B1-B2. Note: The gauge indicator will bounce around due to the pulsing. RECORD the midpoint reading of the bouncing gauge indicator. Log data for cryopump sensors below: TI-301A: _____ PI-302A1:_____

	PI-302A2:_____ TI-301B: _____ PI-302B1:_____ PI-302B2:_____

Section complete.

TD: _____

QA: _____

Note: The following steps, 7.5.2-7.5.8, are performed from the PLC while in PLC Aluminizing mode.

If the system is currently in test mode, return to off mode and then proceed to aluminizing mode. It is allowable to proceed to RVAC under aluminization while cooldown executes.

7.5.2. Rough Vacuum

Step	Description
1.	Press SYSTEM ALUM MODE from PLC Main Panel. (See App. B.9. Main Panel)
2.	Verify Aluminization permissives have been met. • No sequence active • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK
3.	Press Start/Stop button on right hand side of Panel and press ALUM MD START
4.	Verify Step Arrow is pointing to RVAC and RVAC is ready. Press Step Advance to RVAC button
5.	Press RVAC from PLC Main panel to get to the RVAC panel. Record time and beginning values PI-101_____ PI-102 _____ Time _____
6.	Press RVAC button on the right hand side of the RVAC panel
7.	Verify permissives have been met. • Step Pointer OK • PALL-102R OK • MTR-101, OK Roots blower • MTR-102 OK • XV-101 OK
8.	To activate: RVAC Start from the right hand side of the RVAC panel
9.	Observe the pressure gauge PI-101 and PI-102.
10.	Record time when 15 mTorr is reached (RVAC should automatically halt at this pressure) Time:

Section complete.

TD: _____

QA: _____

7.5.3. Meissner

Step	Description
1.	Enable LN_2 supply to the Chamber
2.	OPEN Dewar Liquid Outlet
3.	Turn on room O_2 sensor
4.	Observe and record Dewar LN_2 level in the LN_2 Usage Log posted above dewars.
5.	Open valves between LN2 Supply, HV-208, HV-210, HV-209, and chamber
6.	Press Step Advance from main panel to get to MEIS button Press MEIS from PLC Main panel to get to the MEIS panel. Record Start Time
7.	Press MEIS button on right hand side of MEIS Panel
8.	Verify permissives have been met. • Step Pointer OK • PI-102 <50mTorr • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK.
9.	MEIS->MEIQ Seq. Start from the right hand side of the MEIS panel
10.	When cold gas vents and frost forms meissner sequence has stabilized. Verify pressure drop in PI-101 and PI-102 PI-101: PI-102:
11.	Verify Cold Cathode Gauges on state (3) At 10mT verify channels 3 and 4 come on automatically and register a pressure, (These channels correspond to the cold cathode gauges) (4) Verify Cold Cathode gauges take over at 3mT. Channels 3 and 4 outputs on the MKS should be equal to the values indicated on PI-102 and PI-102 displayed on the PLC
12.	Return to MAIN Panel once MEIS sequence Completed. (Do not halt sequence, it runs until venting stops.)

Section complete.

TD: _____

QA: _____

7.5.4. High Vacuum

Step	Description
1	Verify temperature sensors TI-301A, TI-301B are < 20K
2.	Verify HVAC ready condition and press Step Advance to HVAC button
3.	Press HVAC from PLC Main Panel to activate HVAC panel
4.	Press HVAC button on right side of from HVAC panel
5.	Verify permissives have been met. • Step Pointer OK • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK. • PI-301A, Gate Valve OK • PI-301B, Gate Valve OK • PI-303A, Regen Valve OK • PI-303B, Regen Valve OK • E-301A, E-302B Cryopumps ready
6.	Press HVAC ☐ HVAC Seq. Start
7.	Audibly Verify gate valves opened XV-301A XV-301B
8.	Record Starting pressure on PI-101 and PI-102 PI-101: PI-102:
9.	If 3mT pressure was not reached during Meissner sequence, Verify Cold Cathode gauges take over at 3mT. Channels 3 and 4 outputs on the MKS should be equal to the values indicated on PI-101 and PI-102 displayed on the PLC
10.	Record Final Pressure reached: PI-101: PI-102:

Section complete.

TD: _____

QA: _____

7.5.5. Glow Discharge

After degassing in a pumped down state, the system is ready for glow discharge cleaning. (Note: Degassing took place during Meissner sequence and cryopump sequences).

Step	Description
1.	Verify Argon supply at 1psig available to HV-404
2	Verify GLOW step ready condition and press Step Advance from PLC Main Panel to GLOW button
3.	Press GLOW from PLC Main Panel to activate GLOW Panel
4.	Set the gas calibration factor of 1.76 for argon on channels 3 and 4 of the MKS controller. Use the MKS controller manual as reference.
5.	Set the gas calibration for argon from the list of gas options (N2, Ar, He) on channels 1 and 2 of the MKS controller
6.	Press GLOW button on right side of from GLOW panel
7.	Verify permissives have been met. • Step Pointer OK • XV-301A, Gate Valve Closed, OK • XV-301B, Gate Valve Closed OK • XV-101, Isolation Valve Closed OK • TSH-511, Mirror temp OK
8.	Don UV Safety Goggles
9.	Press GLOW □ GLOW Seq. Start
10.	Verify XV-404 opens and observe pressure rise on PI-102
11.	Verify Purple Glow record Power level and Time Power: Time:
12.	Verify pressure rise in PI-101 and PI-102 PI-101: PI-102:
13.	Verify RVAC starts at 15mTorr Verify XV-101 opens at 18mTorr.
14.	Execute Vacuum Gauge transition Test (High->low) See Steps Below
15.	Verify glow sequence automatically terminating after 15 minutes
16.	Return to PLC Main Panel

Vacuum Gauge Transition Test (High to Low Vacuum)

Action: While the pressure rises observe the status of channels 1-4 on the MKS unit and determine when the PLC starts to display a value on channels 1 and 2 corresponding to the Pirani gauges. This should start occurring at 3mT and 7mT. Record results:

1. Verify there is averaging of the channels when the pressure is between the high and low Switch Points of 3mT and 7mT.
2. Verify at 7mT that the Pirani gauges take over completely.

Section complete.

TD: _____

QA: _____

7.5.6. High Vacuum 2

After glow discharge cleaning, the chamber is re-pumped under high vacuum mode until the system has reached vacuum where filament activation is allowed.

Step	Description
1	Verify TI-301A and TI-301B < 20K
2.	Verify HVAC 2 rady and press STEP ADVANCE to step to HVAC 2 button
3.	Press HVAC button on right side of HVAC Panel
4.	Verify Permissives • HVAC 2, Step Pointer OK • ZS-508, manway door limit switch OK • ZS-513, Chamber lid limit switch OK. • PI-301A, Gate Valve OK • PI-301B, Gate Valve OK • PI-303A, Regen Valve OK • PI-303B, Regen Valve OK • E-301A, E-302B Cryopumps ready
5.	Press HVAC-> HVAC SEQ START from HVAC Panel. Record Starting Pressures. PI-101 PI-102
6.	Record Start Time
7.	Verify a minimum pressure of 8μTorr has been reached Record Time
8.	Return to PLC Main Panel

Section complete.

TD: _____

QA: _____

7.5.7. Filament Activation

When a pressure of less then 8μTorr has been reached it is time to activate the filaments.

Step	Description
1.	Record Time:
2.	Verify FILA ready from PLC Main panel and press Step Advance to FILA button
3.	Press FILA button from PLC Main Panel
4.	Verify Sycon Controller is powered on Select Film on Sycon Controller
5.	Press FILA button on right side of FILA Panel
6.	Verify Permissives have been met • Step Pointer OK • PALL-102H, OK • TSH-511, Mirror Temp, OK
7.	Press FILA->FILA SEQ START
8.	At the view port, observe the heating sequence and log comments on a FILA data sheet in Appendix B. The goal is to verify basic function of the filament power supply and Sycon power profile. Note any filaments that appear to be non-functional
9.	Monitor TI-511 and Stop sequence at 40 deg C.

During the simulated aluminizing (a few seconds or minutes), log current vs. Sycon output signal and vs. time on data sheet at approximately 5 second intervals.
Note: No material should be deposited on the Sycon Crystal. Termination will require manual override since no material is being deposited.
Record Stop Time

Section complete.

TD: _____

QA: _____

7.5.8. Vent Chamber

- Expected Run Time 3 Hrs
- Personnel required 2 people
  - MCC/PLC Engineer
  - Test Director

Note: Filaments should have been shutdown in previous step. (Shutdown filaments – terminate Sycon).

Step	Description
1.	Record Time: _
2.	Verify VENT ready and press Step Advance to VENT button
3.	Press VENT from PLC Main Panel
4.	Press VENT button on right side of VENT Panel
5.	Verify Permissives have been met • Step Pointer OK • XV-101, OK • XV-301A, Gate Valve Clsd, OK • XV-301B, Gate Valve Clsd, OK
6.	Press VENT->VENT SEQ START

Venting should automatically perform shutdown on the following sub-systems

Device		Description	State
Cryopumps Shutdown	XV-301A		
	XV-301B		
XV-601 Opens			
Halts Meissner Sequence			

Monitor and record mirror temperature and chamber pressure PI-101 or PI-102 during venting on data sheet B.6 in Appendix B.

Section complete.

TD: _____

QA: _____

7.5.9. Shutdown Procedures

Record state of system and all shutdown operations on shutdown checklist provided in Appendix A.

1. At the LN2 Dewar – CLOSE the Liquid Outlet Valve – Delay a minimum of 30 minutes (permissible to perform below work steps) continue LN2 shutdown at step 8.

2. At the Argon Bottle: Close K-Bottle Isolation Valve – LEAVE HV-403 alone. At the Argon Regulator: Using Wrench ¼ turn CCW to vent residual pressure in line. Tighten Wrench Tight. Fully Reduce regulator
3. Close and/or verify HV-202A, HV-202B, HV203A, HV-203B valves are closed
4. Return PLC to SYSTEM OFF Mode
5. Power down PLC if desired
6. Turn Off System from MCF Power Cabinet if desired
7. Indicate state of PLC Breakers at end of Procedure in the following table

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB7	Glow Discharge		
K6	FPS Relay		

8. Perform Lockout/Tagout on MCF Power Cabinet
9. CLOSE HV-208 or HV-210 (leaving HV-209 OPEN) to vent residual LN2 to atmosphere through the Meissner Traps.
10. Don FULL LN2 PPE, Facemask, Apron, Gloves
11. Ensure no nonessential personnel are nearby

WARNING:
Disconnect of LN2 Line Flexhose from LN2 Dewar – Possible Temporary Spray of LN2

12. HV-211 OPEN to vent, Delay until venting ceases, then CLOSE
13. Using Wrench, Slowly remove Flexhose B-Nut from LN2 Dewar Liquid Outlet Interface
14. CLOSE HV-209
15. HV-210 CLOSE

Section complete.

TD: _____
QA: _____

8. PROCEDURE COMPLETION

Review As-Run procedure for completeness, data sheets filled properly, units are correct and any and all deviations / redlines have been initialed and dated. All identified Work steps have been signed by appropriate signatories.

Send the completed AS-RUN to USRA Configuration Management for Archival.

Final Review of Procedure: Procedure complete and ready for archival:

TD: _____

QA: _____

APPENDIX A: STARTUP, SHUTDOWN, AND ENERGY ISOLATION PROCEDURES

1. PLC Energy Isolation

Power-up test of mirror coating tank control chassis
Purpose: To determine if the MCF control chassis PLC has basic functionality after being powered off for many years.
Reference Documents: Operations & Maintenance Document; Warner Power power supply schematic D65-001673-2, -2A, -3
Chart Documents Package, Book 2; One Line Diagram, V095-3-030

Startup Procedure:

a) Verify 100A breaker in supply panel in MCF equipment room is off.
b) Remove lock from power supply cabinet in MCF equipment room, following Ames LOTO procedures.
c) Unlock and open power supply cabinet. Verify no voltage is present at 115 VAC duplex box.
d) Remove relay K6 (disables filament power supplies).
e) Turn off circuit breakers CB2, CB3 (Cryopumps), CB4, CB5 (Vacuum pump and roots blower), and CB7 (Glow Discharge power supply).
f) Close and lock cabinet
g) Close and lock control cabinet in coating room.
h) Verify no personnel present inside coating chamber.
i) Energize 100A circuit breaker in supply panel in MCF equipment room.
j) Energize control switch on power supply panel; verify 'power' light is on.
k) Energize control switch on control chassis. Push 'reset' button, and verify 'power' light is on.
l) Observe startup of PLC controller.

2. Full System Energizing Procedures

Power-up test of mirror coating tank control chassis
Purpose: To power on all systems to the MCC.
Reference Documents: Operations & Maintenance Document; Warner Power power supply schematic D65-001673-2, -2A, -3
Chart Documents Package, Book 2; One Line Diagram, V095-3-030

Startup Procedure: Follow steps below and indicate state of Circuit Breakers in Table at start of procedure

a) Verify 100A breaker in supply panel in MCF equipment room is off.

- ✓ Remove lock from power supply cabinet in MCF equipment room, following Ames LOTO procedures.
- ✓ Unlock and open power supply cabinet. Verify no voltage is present at 115 VAC duplex box.

b) Install relay K6 (enables filament power supplies).

- ✓ Turn on circuit breakers CB2, CB3 (Cryopumps), CB4, CB5 (Vacuum pump and roots blower), and CB7 (Glow Discharge power supply).
- ✓ Record final state of breakers and relays below

Circuit/Relay	Description	Open	Closed
CB1	MCC Main Breaker		
CB2	Cryopump 302A		
CB3	Cryopump 302B		
CB4	Roughing Pump		
CB5	Roots Blower		
CB6	Operator Console		
CB7	Glow Discharge		
K6	FPS Relay		

c) Close and lock cabinet.
d) Close and lock control cabinet in coating room.
e) Verify no personnel present inside coating chamber.
f) Energize 100A circuit breaker in supply panel in MCF equipment room.
g) Energize control switch on power supply panel; verify 'power' light is on.
h) Energize control switch on control chassis. Push 'reset' button, and verify 'power' light is on.
i) Observe startup of PLC controller.

3. Shutdown Procedure:

a) Push stop button on control chassis.
b) Switch off control switch on control chassis.
c) Switch off control switch on power supply chassis.
d) De-energize 100A circuit breaker in supply panel.
e) Apply lock to power supply chassis control switch, per Ames LOTO procedure

APPENDIX B: CHECKLISTS, FORMS AND DATA SHEETS

B.1. Initial Conditions Checklist
B.2. PI-103 Stabilization Data Sheet
B.3. Cryopump Cool Down Data Sheet
B.4 Rough Pump Down Data Sheet
B.5 High Vacuum Pump Down Data Sheet
B.6 Vent Log
B.7 HV-602 turns open vs. backfill time
B.8 gauge/valve calibration checkl
B.9 Set Point Tables
B.10. VCP Panels

APPENDIX B.1 INITIAL CONDITIONS OPERATOR CHECKLIST

Test Director_____Operator _____ Date:__/__/__

Step	Item	Value	Op	TD
1	Confined Space entry forms and work as needed			
2	All supplies necessary are in place as defined in section 5			
3	View Ports covers installed			
4	Remove Administrative Lock (see appendix A.2)			
5	All breakers plugged in and powered on			
6	Main Power breaker On			
7	Vacuum chamber lid in position			
8	Inspect chamber for personnel and unwanted items			
9	Manway door closed			
	i. Swing door close and secure by hand tightening			
10	Chamber under ambient pressure Record PI-101			
	Gauge: PI-101			
11	Argon available to gas valve XV404			
	Attach delivered Argon spec sheet, Verify Purity of Argon	99.999		
	Fully reduce regulator (calibrated downstream gauge)			
	Connect regulator to tank, Tighten Wrench Tight			
	Connect facility line to regulator outlet			
	Open Argon Isolation valve			
	Increase reg to 1 +/- PSIG as seen on Downstream gauge			
12	LN2 available to Meissner Coils			
	Close LN2 Hand Valves, HV-208 & HV-209			
	Connect flex hose X to LN2 dewar liquid outlet			
	Tighten Wrench Tight			
	Open LN2 liquid outlet valve			
13	Cryopumps A and B charged with GHe as seen on compressor.			
	Cryopump A Ghe: PSIG Start Value			
	Cryopump B Ghe: PSIG Start Value			

APPENDIX B.2 P1-103 STABILIZATION DATA SHEET

Date: __/__/__

Test Director: _____ Operator: _____

Operating Conditions: PLC Test Mode

Time	Pressure

APPENDIX B.3 CRYOPUMP COOL DOWN DATA SHEET

TEST DATE: _____

	Time hr: min	*Elapsed Time*	*Cryo Temp TI-301A*	*Cryo Temp TI-301B*	*Comments Notes*
0		0:00 min			
1		5:00min			
2		10:00 min			
3		15:00 min			
4		30:00 min			
5		1 hr			
6		1.5 hr			
7		2hr			
8		2.5 hr			
9		3hr			
10		3.5 hr			
11		4hr			
12		4.5 hr			
13		5 hr			

APPENDIX B.4 ROUGH PUMP DOWN DATA SHEET

TEST DATE: _____

	Time hr: min	*Elapsed Time min*	*Upper chamber Pressure PI-101 Torr*	*Lower chamber Pressure PI-102 Torr*	*Comments Notes*
0		0:00			
1		1:00			
2		2:00			
3		3:00			
4		4:00			
5		5:00			
6		15:00			
7		20:00			
8		25:00			
9		30:00			
10		35:00			
11		40:00			
12		45:00			
13		50:00			
14		55:00			
15		60:00			
16		65:00			
17		70:00			
18		75:00			
19		80:00			
20		85:00			
21		90:00			
22		95:00			
23		100:00			
24		105:00			
25		110:00			
26		115:00			
27		120:00			
28		125:00			
29		130:00			
30		140:00			
31		150:00			
32		165:00			
33		170:00			
34		180:00			

APPENDIX B.5 HIGH VACUUM PUMP DOWN DATA SHEET

TEST DATE: _____

	Time hr: min	***Elapsed Time***	***Upper chamber Pressure PI-101 Torr***	***Lower chamber Pressure PI-102 Torr***	***Comments Notes***
0		0:00 min			
1		5:00 min			
2		10:00 min			
3		15:00 min			
4		30:00 min			
5		1 hr			
6		1.5 hr			
7		2hr			

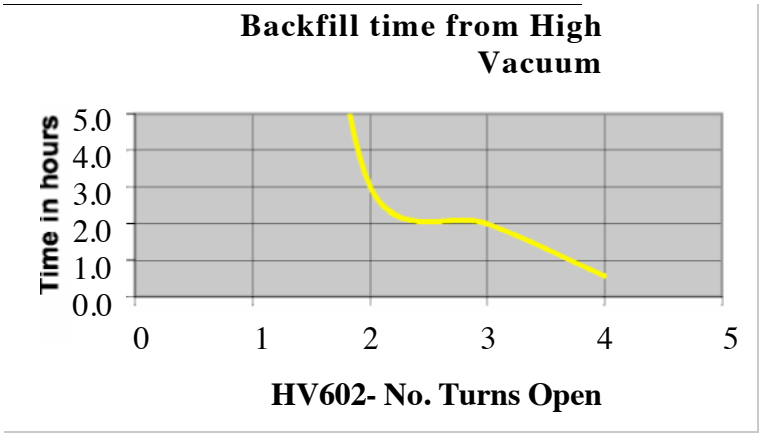
APPENDIX B.6 VENT LOG

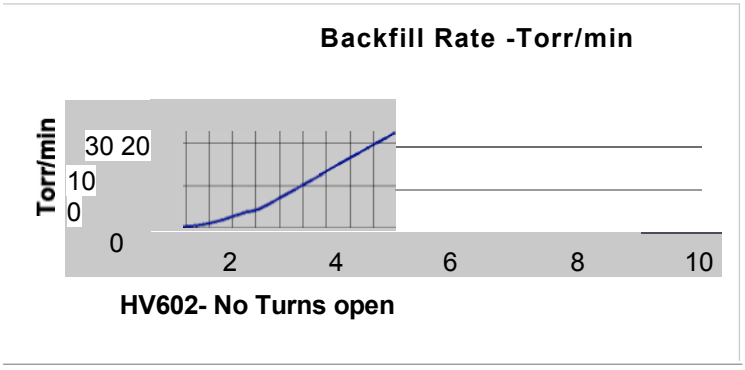
TEST DATE: _____

	Time hr: min	Elapsed Time	TI-511	PI-101	PI-102
1	Start Time	0			
2		30:00 min			
3		1 hr			
4		1.5 hr			
5		2hr			
6		2.5 hr			
7		3hr			
8		3.5 hr			
9		4hr			
10		4.5 hr			
11		5 hr			
12		5.5 hr			
13		6hr			
14		6.5 hr			
15		7hr			
16		7.5 hr			
17		8hr			
18		8.5 hr			

APPENDIX B.7 HV-602 TURNS OPEN VS. BACKFILL TIME

HV602 Turns open	dP/min	Time to atm	hours
0.5	0.067	1134	1.89E+02
1.5	1	760	1.27E+01
2.25	4	180	3.00E+00
2.5	5	120	2.00E+00
4.75	22.4	34	5.67E-01
9			





APPENDIX B.8 GAUGE/VALVE CALIBRATION CHECKLIST

Gauge/Valve	Calibration requirements	Due Date	TD
PE-101_1			
PE-102_1			
PE-101_2			
PE-102_2			
PE-103			
TE-511			
PI-301A			
PI-301B			
PI-302A1			
PI-302A2			
PI-302B1			
PI-302B2			
PSV-309A			
PSV-309B			
PSV-205A			
PSV-205B			
PSV-405	Relief at 5 psi		
PSV-208A			
PSV-208B			
PSV-512			

APPENDIX B.9 SET POINT TABLES

TABLE 1
PanelMate Page 2
Setpoints Table - Factory Settings
Date: 09/22/02 BY: MAK

Parameter	Setting	Units
Chamber Pressure-FS Mirror		
PAHH 102G-SP	1.000	Torr
PAHH 102H-SP	0.020	Torr
PAHH 102R-SP	1.000	Torr
PAH 102G-SP	0.1	Torr
PAH 102H-SP	4E-6	Torr
PAH 102R-SP	0.100	Torr
PAL 102G-SP	0.015	Torr
PAL 102H-SP	8E-6	Torr
PAL 102R-SP	0.018	Torr
PALL 102G-SP	0.075	Torr
PALL 102H-SP	9E-6	Torr
PALL 102R-SP	0.015	Torr
PALL 102M-SP	0.015	Torr
Glow Discharge Current		
IIC-401-SP	100	%
Cryopump Pressure		
PAH 301AB-SP	0.090	Torr
PAL 301-SP	0.075	Torr
Glow Discharge Time		
KI 401-SP	20	Min
Mirror Temperature		
TAH 511-SP	50	C
TAHH511-SP	60	C

Table 2
Sycon Setpoints

Changes from previous settings are highlighted.
For full text of parameters refer to Section 2.11 of Sycon STC200 Users Manual
Rev. Date: 9/24/02

Mode					**Low power**	**Normal**
Parameter		**Description**	**Units**	**Range**	**film1**	**film2**
Density	Material Density	Normally bulk material value. Ref. table 4.1, Sec 4.3	g/cm3	0.40-99.99	2.73	2.73
Z factor	Material Z-Factor	Elastic properties.used to match acoustical properties of the film to the crystal.Ref table 4.1, Sec 4.2	-	0.1-99.99	1.08	1.08
tooling XTL 1	Tooling Factors	Correction factor to correct for position of Sensor 1. >1 for sensor	%	10.0-400	200.0	117.0
tooling XTL 2		Sensor 2	%	10.0-400	200.0	117.0
Start XTL #	Selecting which sensor is used	Active sensor	-		1	1
setpoint lim	Setpoint Thickness Limit	Used to provide a comparison point for thickness setpoint event Triggered whenever thickness display exceeds setpoint value.	kAng □	0-999.999	1.500	1.500
final thk lim	Final Thickness limit	Used to determine end of the deposition run.	kAng	0-999.999	1.500	1.500
setpoint time lim	Setpoint Time Limit	Used to provide a comparison point for theTimer Setpoint Event status. Timer relay is set when this time is exceeded.	min:sec	0:00-99:59	0:00	0:00
soak 1 pwr value	Soak 1 Power Value	Used as the first level of soak power. A value of 0.0% causes the RAMP/SOAK1 to be skipped. Typically used to outgass source material	%	0.0-100.0	5	30

pwr ramp 1 time	Ramp Time to Soak 1	Sets the duration of the power ramp from zero power to the SOAK1 power level. The source is typically heasted slowly enough to permit outgasssing and melt conditioning without causing actual deposition.	min:sec	0:00-99:59	1:00	7,00
pwr soak 1 time	Soak 1 Time	Sets the time the source will remain at Soak 1 power following completion of the ramp.	min:sec	0:00-99:59	0:00	1,00
soak 2 pwr value	Soak 2 Power Value	Sets 2nd level of soak power. A value of 0.0% causes the RAMP/SOAK 2 to be skipped. Typically used to further outgas source material and begin deposition at a low rate.	%	0.0-100.0	0	95
pwr ramp 2 time	Ramp time to Soak 2	Sets the duration of of the power ramp from soak 1 power value or idle power to the value set by soak 2 power parameter.	min:sec	0:00-99:59	0	0,30
pwr soak 2 time	Soak 2 time	Sets the time the source will remain at soak 2 power following completion of the ramp.	min:sec	0:00-99:59	0	10,0
IDLE POWER (soak 3 pwr value)	Idle Power Value	Determines the final (idle) power setting at the completion of the entire deposition profile. If this power level is zero, A START command will begin a new power profile at rise 1, an idle power setting other than zero will cause the power profile to begin at rise 2 after a START.	%	0.0-100.0	0	0
IDLE RAMP TIME (pwr ramp 3 time)	Idle Ramp Time	Sets the duration from the power level at the time that final thickness was reached until the power reaches the	min:sec	0:00-99:59	0	0:00

		value set by the idle power parameter.				
deposit rate	Deposition Rate	Determine the material deposition rate that the closed loop control system will try to establish and maintain	Ang/sec	0.0-999.9	0	0:00
rate ramp mode	Enabling Rate Ramp Mode	Enable disable switch for the rate ramp functionWhen set to offprogramming curser window will skip over the associated parameters.	-	1 =Off 2 = On	off	off
new dep rate	New Deposition Rate	Sets the new deposion rate value to be reache at the end of the rate ramp operation.	Ang/sec	0.0-999.9	0	0
rate ramp time	Rate Ramp Time	Sets the duration of the rate ramp.The rate ramp starts at the rate controlvalue at the time that the rate ramp trigger is reached and ends at the value set by the new dep rate.	min:sec	0:00-99:59	0	0,0
rate ramp trgr	Rate Ramp Trigger Point Thickness	Sets the trigger point for a rate ramp to begin during depostion.	k Angs	0-999.999	0	0
ctl loop -P-	Control Loop Gain Term	Sets the closed loop rate control proportional gain.	-	1-9999	10	100
ctl loop -I-	Control Loop Integral Term	Sets the closed loop rate control integral term time constant.	sec	0.0-99.9	1.0	1.0
ctl loop -D-	Control Loop Differential Term	Sets the closed loop rate control derivative term time constant.	sec	0.0-99.9	0.0	1.0
max power limit	Maximum Power limit	Sets the absolute maximum power that will be allowed to occur at any time.	%	0.0-100.0	20	100.0
abort max power sw	Abort On maximum power Switch	When set to Off it has no effect. When set to On a maximum power will be allowed for the time durations et by the max power dwell	-	1 =Off 2 = On	0ff	0ff
max power dwell	Max Power Dwell	Sets the allowable durationof maximum	min:sec	0:0-99:59	0.05	-0,30

		power before an abort will occur.				
XTAL fault mode	Enabling Measurement Fail Processing	Allows the user to select system execution path if no longer possible to get reliable measurement information from the sensor.	-	1= Abort on Fail 2= Complete on time power	off	time pwr
XTAL backup mode			-		off	off
CTL loop qual L	Control Loop Quality Limit	Sets a threshhold on acceptable control loop quality. 0- disables 1- tightest limits	-	0-9	0	0
XTL stability S	Crystal Stability Limit	Sets threshold for acceptable crystal performance. 0- disables 1- tightest limits	-	0-9	0	0
XTL life loads		Used to provide a setpoint on allowable sensing crystal usage. May be utilized thru the I/O system as a warning or interlock that sensing crystal needs attention.	-	0.0-100.0	0.0	0.0
plot vert SCL V	Vertical Scale RunTime Display	Sets the vertical scale factor of the graphic display on the RunTime Screen	A/sec or % power	1/5/10/ 50/ 100	10	100
plot Hor SCL H	Horizontal Scale RunTime Display	Sets the horizontal seep rate of the graphics display RunTime Screen.Sample are take at a rate of 4/sec. A programmed value will display every sample. The X-axis is 200 sweeps wide. By increasing the sample number the sweep rate is slowed down. Proper selection of this number allows an entire deposition cycle to be	Samples per /display Point	1-600	1	15 smpls

		displayed.				
DATA plot type	RunTime display Type		A/sec or % power	1=Rate 2=Rate deviation 3=Power	power	rate

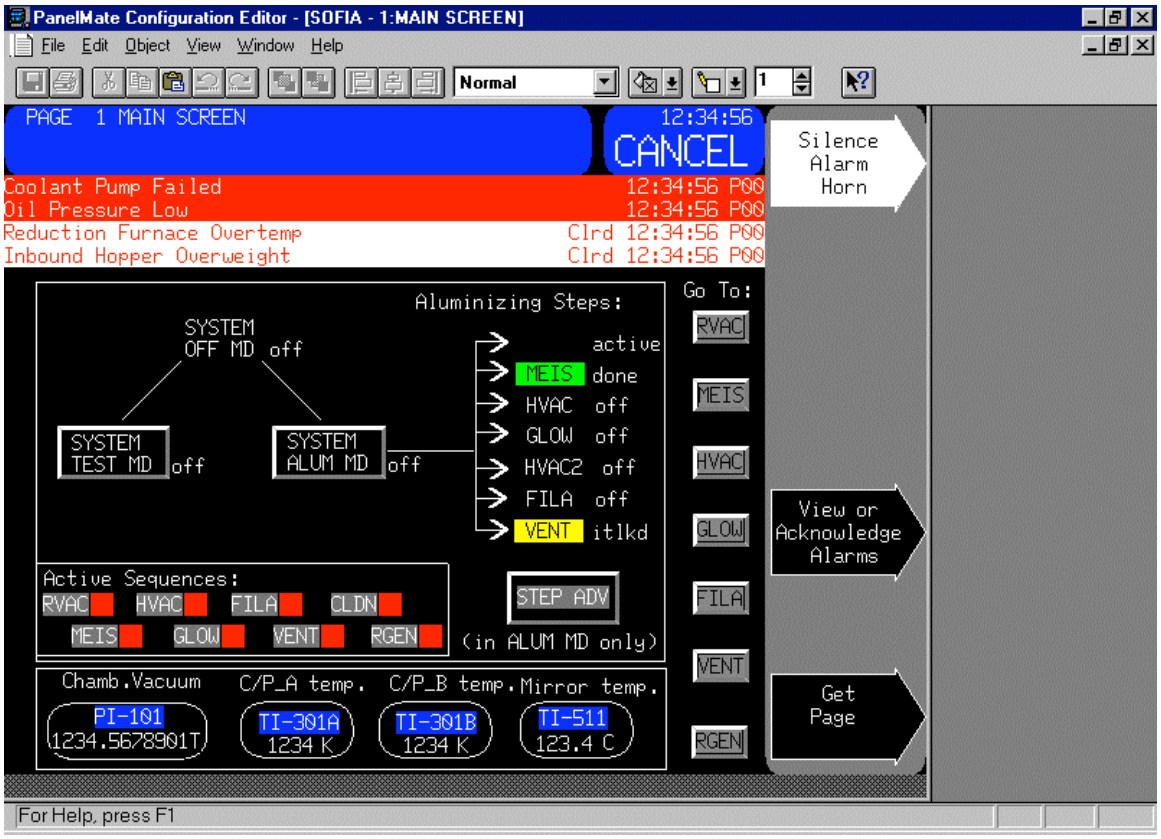
Table 3
MKS Setpoints

Model: 146
SN:
Software: V3.1
Rev. Date: 9/22/02

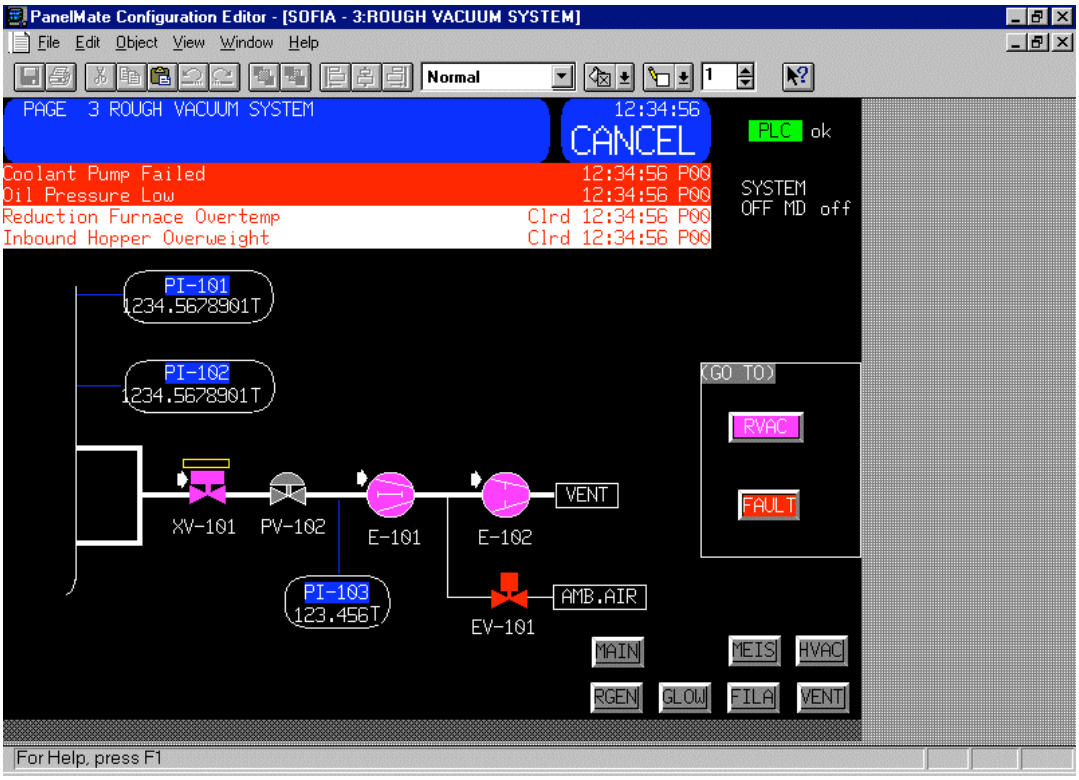
Channel	Vacuum Gauge	Part number
1	PI101 cold cathode	MKS-
2	PI102 cold cathode	MKS-
3	PI101 Pirani	GP-275203
4	PI102 Pirani	GP-275203

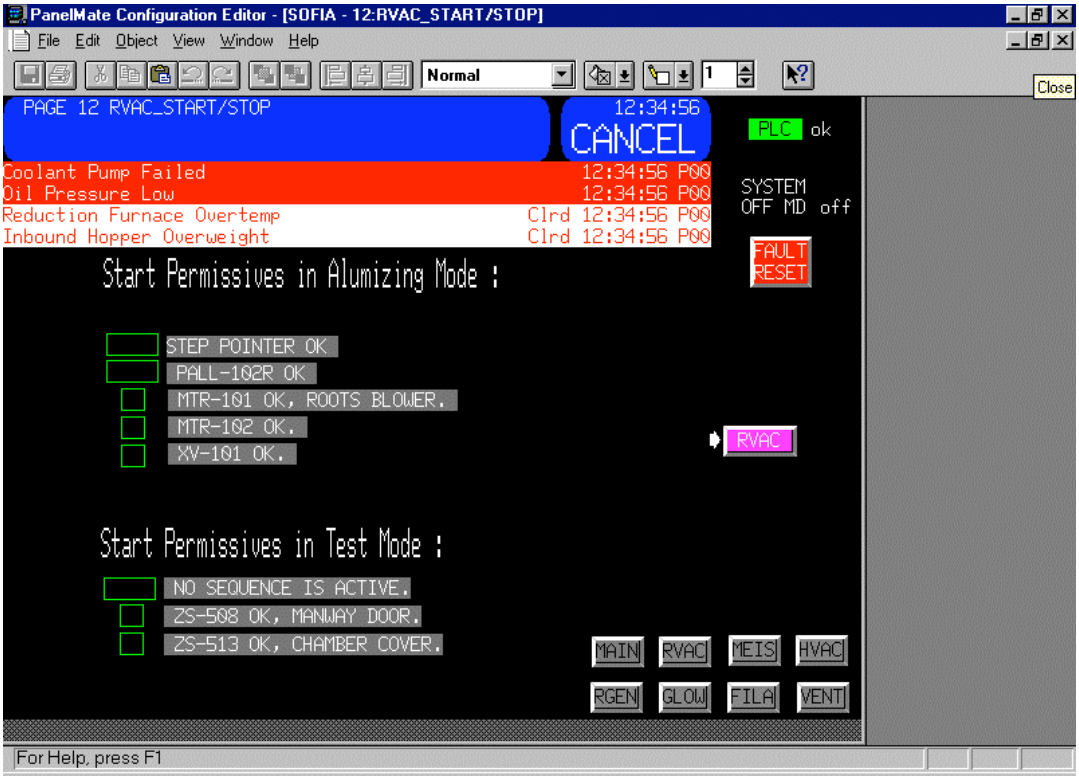
APPENDIX B.10 VCP PANELS

Main Panel

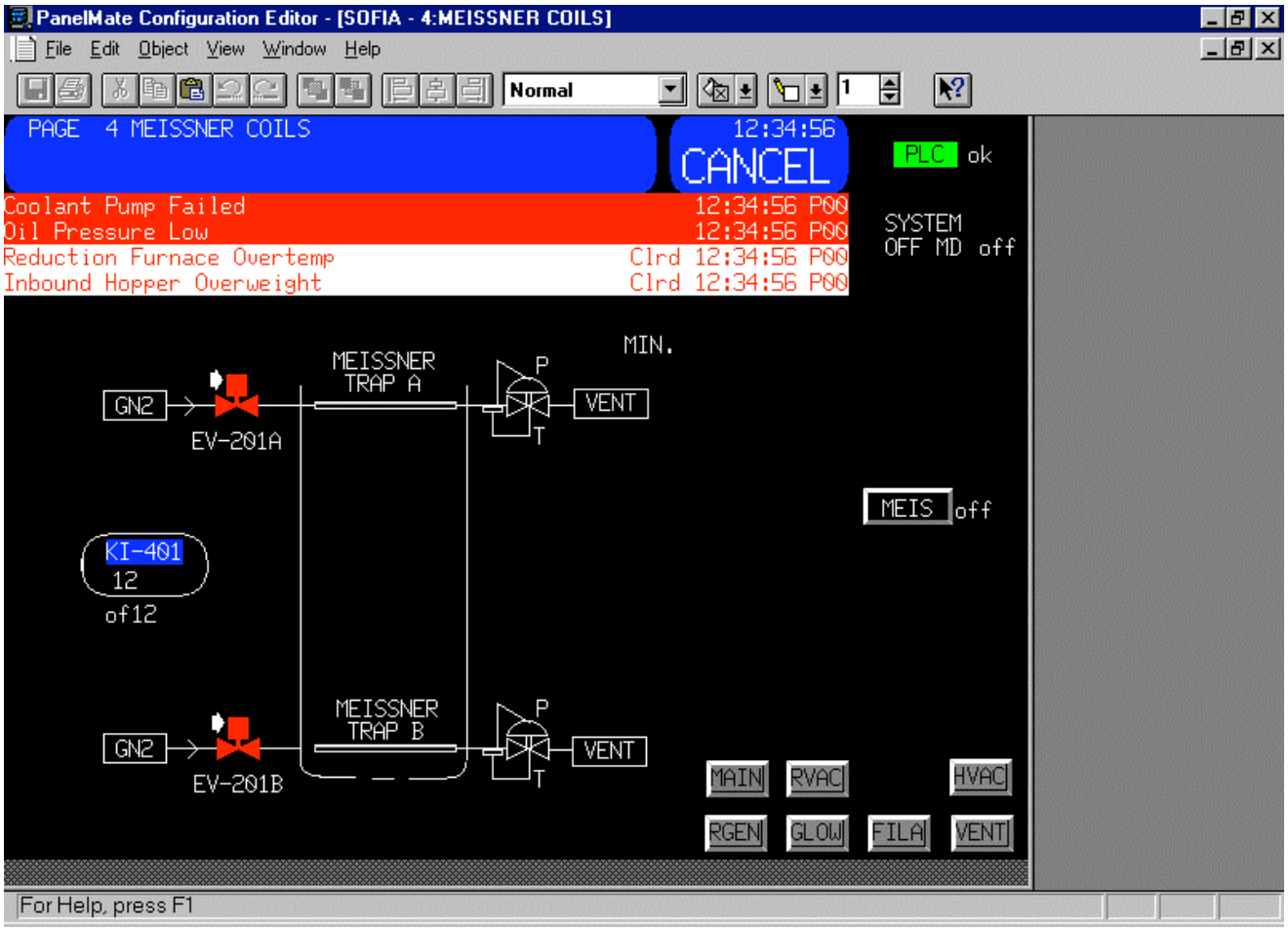


RVAC PANELS

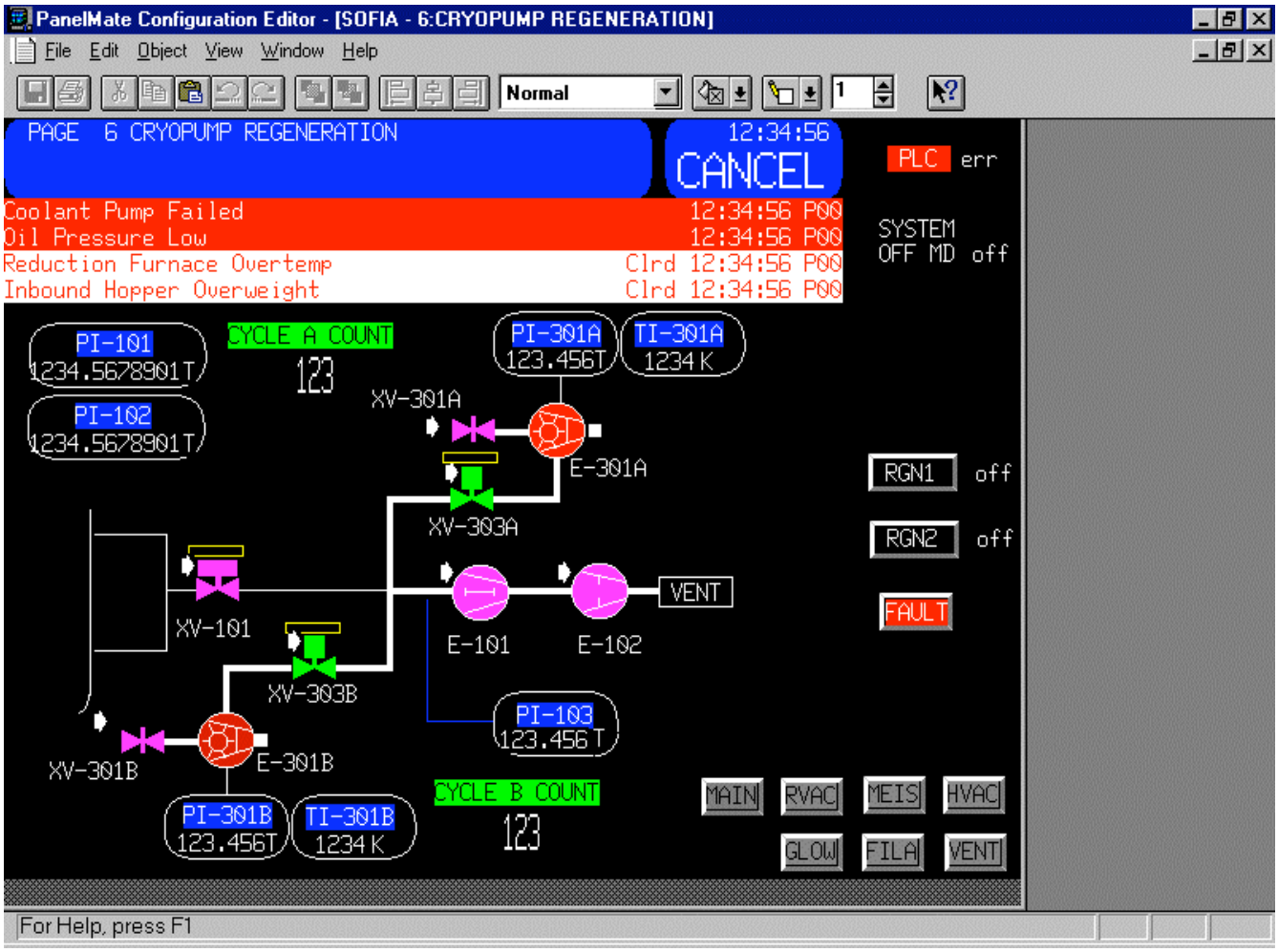

PanelMate Configuration Editor - [SOFIA - 3:ROUGH VACUUM SYSTEM]
File Edit Object View Window Help
Normal
PAGE 3 ROUGH VACUUM SYSTEM
12:34:56
CANCEL
PLC ok
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
PI-101
1234.5678901T
PI-102
1234.5678901T
(GO TO)
RVAC
FAULT
XV-101
PV-102
E-101
E-102
VENT
PI-103
123.456T
AMB.AIR
EV-101
MAIN
MEIS
HVAC
RGEN
GLOW
FILA
VENT
For Help, press F1


PanelMate Configuration Editor - [SOFIA - 12:RVAC_START/STOP]
File Edit Object View Window Help
Normal
Close
PAGE 12 RVAC_START/STOP
12:34:56
CANCEL
PLC ok
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
FAULT RESET
Start Permissives in Alumizing Mode :
STEP POINTER OK
PALL-102R OK
MTR-101 OK, ROOTS BLOWER.
MTR-102 OK.
XV-101 OK.
RVAC
Start Permissives in Test Mode :
NO SEQUENCE IS ACTIVE.
ZS-508 OK, MANWAY DOOR.
ZS-513 OK, CHAMBER COVER.
MAIN
RVAC
MEIS
HVAC
RGEN
GLOW
FILA
VENT
For Help, press F1

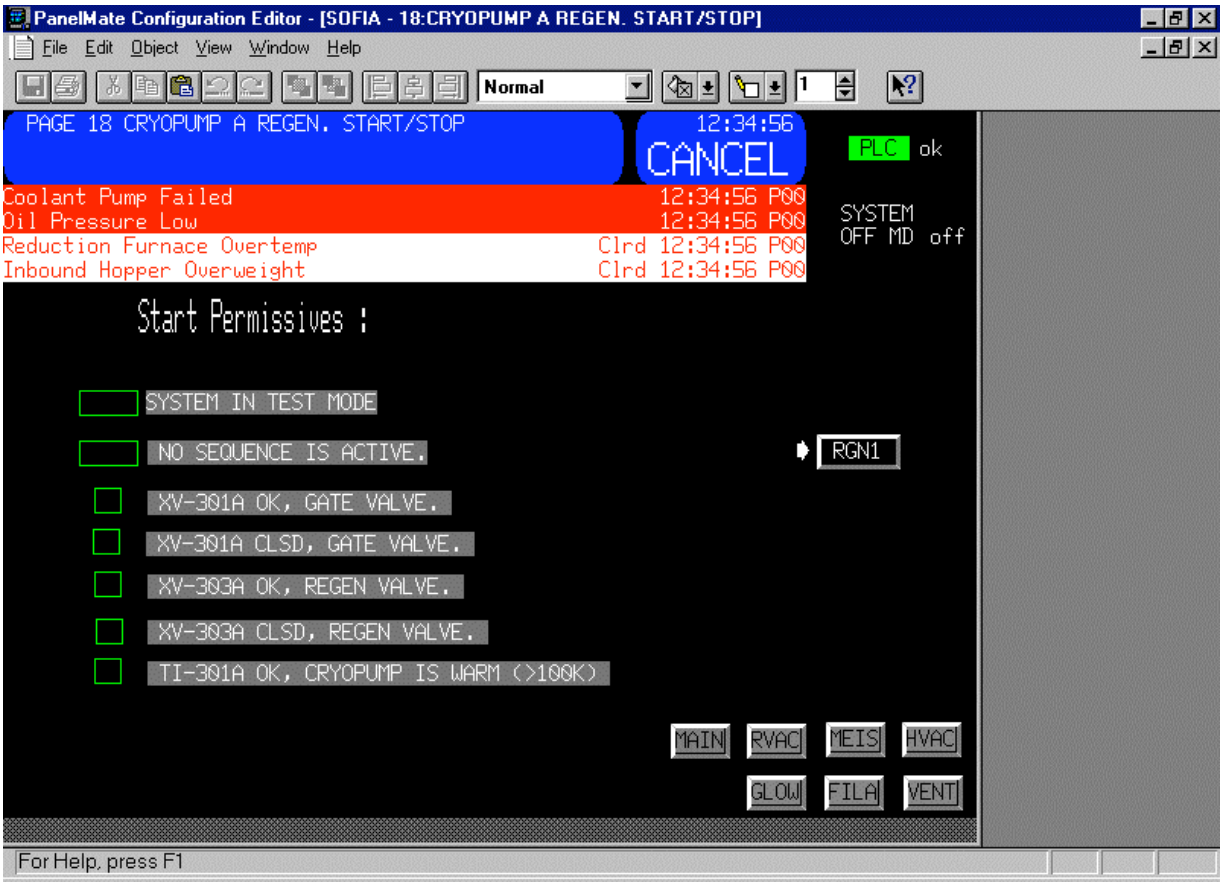
MEIS Panel


PanelMate Configuration Editor - [SOFIA - 4:MEISSNER COILS]
File Edit Object View Window Help
Normal
PAGE 4 MEISSNER COILS
12:34:56
CANCEL
PLC ok
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
MIN.
MEISSNER TRAP A
P
T
GN2
EV-201A
VENT
MEIS off
KI-401
12
of12
MEISSNER TRAP B
P
T
GN2
EV-201B
VENT
MAIN
RVAC
HVAC
RGEN
GLOW
FILA
VENT
For Help, press F1

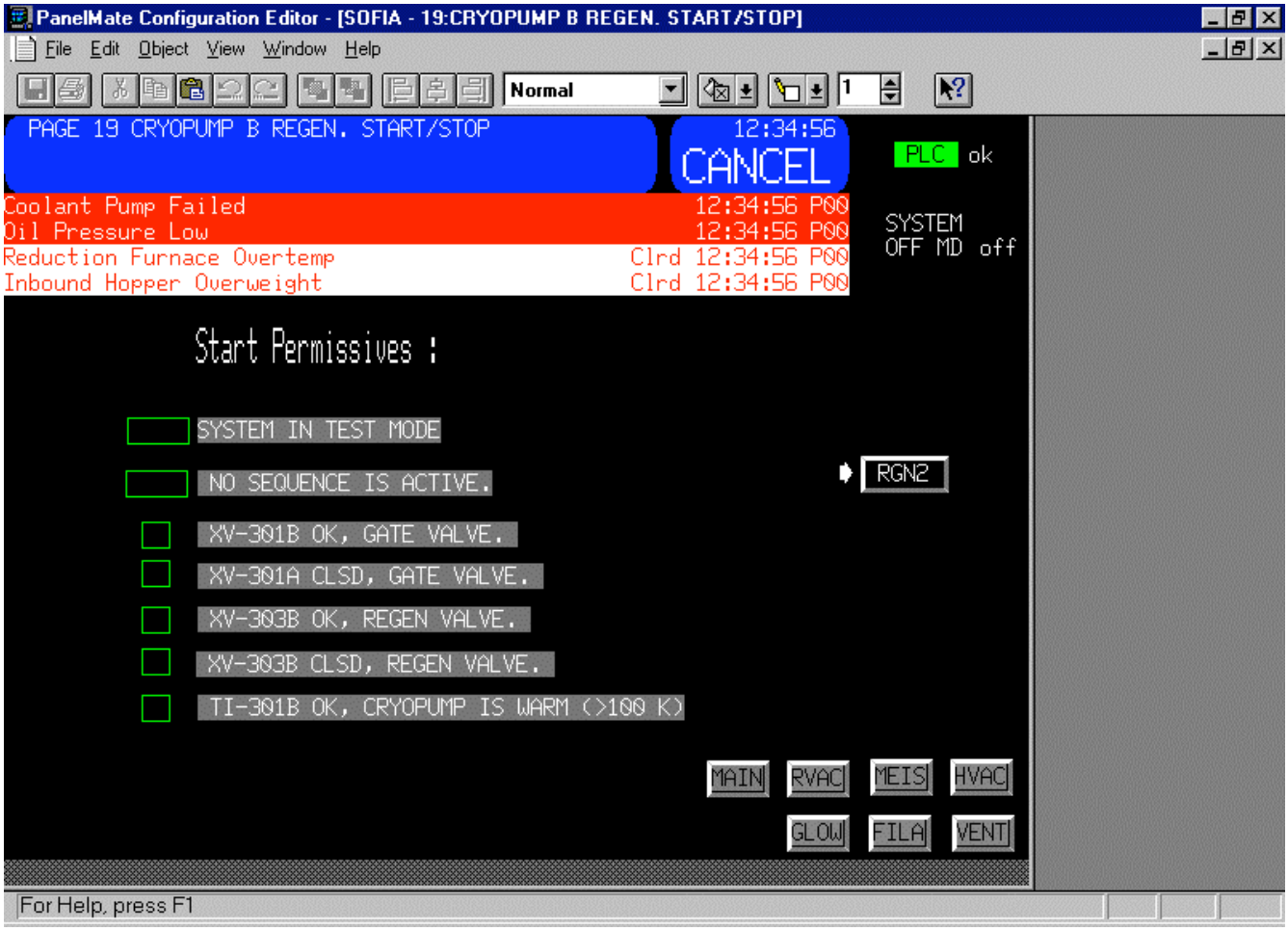
RGEN Panel


PanelMate Configuration Editor - [SOFIA - 6:CRYOPUMP REGENERATION]
File Edit Object View Window Help
Normal
PAGE 6 CRYOPUMP REGENERATION
12:34:56
CANCEL
PLC err
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
PI-101
1234.5678901T
PI-102
1234.5678901T
CYCLE A COUNT
123
PI-301A
123.456T
TI-301A
1234 K
XV-301A
E-301A
XV-303A
RGN1 off
RGN2 off
FAULT
VENT
XV-101
E-101
E-102
XV-303B
PI-103
123.456 T
XV-301B
E-301B
PI-301B
123.456T
TI-301B
1234 K
CYCLE B COUNT
123
MAIN
RVAC
MEIS
HVAC
GLOW
FILA
VENT
For Help, press F1

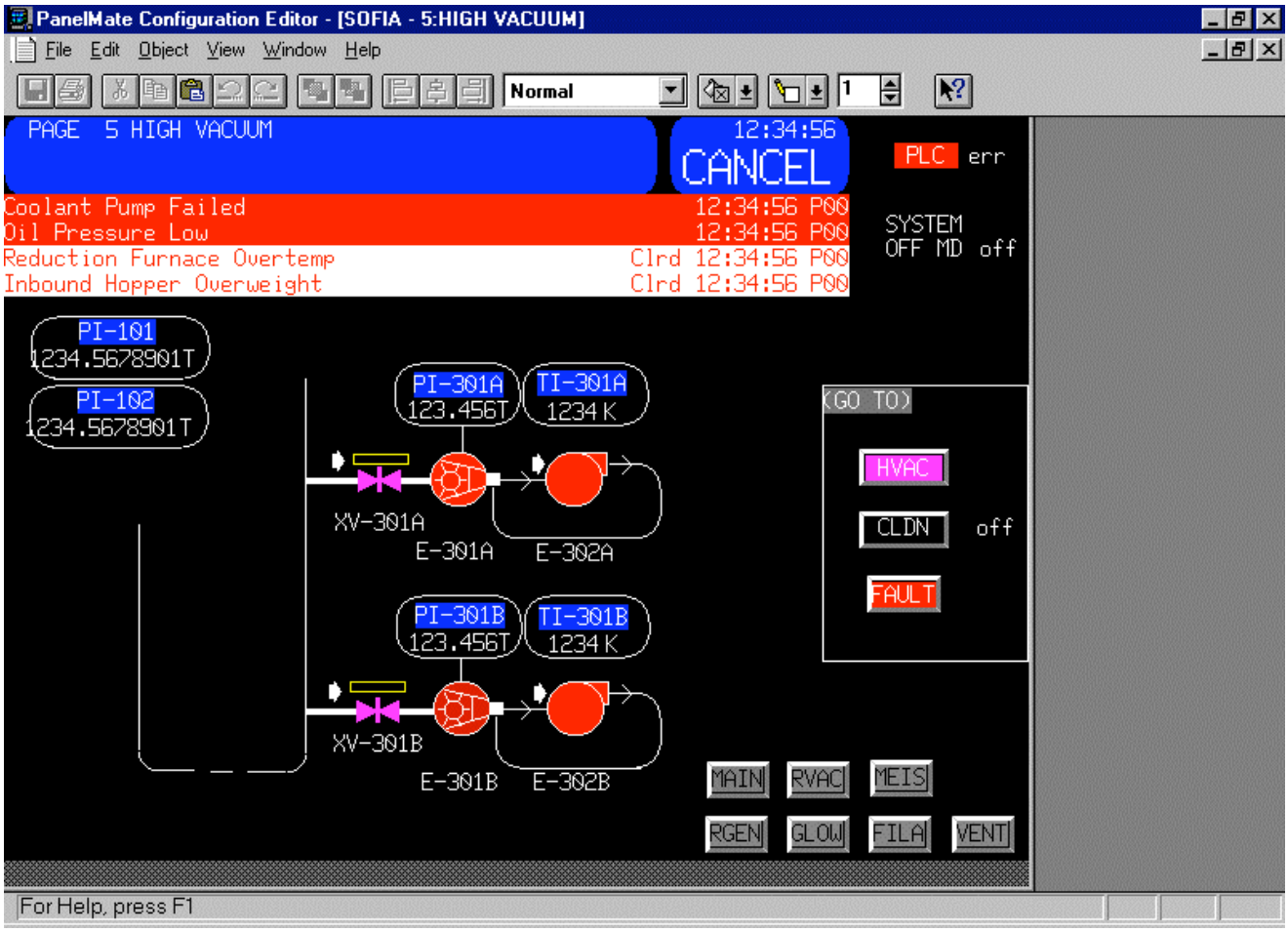
RGN1 Panel


PanelMate Configuration Editor - [SOFIA - 18:CRYOPUMP A REGEN. START/STOP]
File Edit Object View Window Help
Normal
PAGE 18 CRYOPUMP A REGEN. START/STOP
12:34:56
CANCEL
PLC ok
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
Start Permissives :
SYSTEM IN TEST MODE
NO SEQUENCE IS ACTIVE.
RGN1
XV-301A OK, GATE VALVE.
XV-301A CLSD, GATE VALVE.
XV-303A OK, REGEN VALVE.
XV-303A CLSD, REGEN VALVE.
TI-301A OK, CRYOPUMP IS WARM (>100K)
MAIN
RVAC
MEIS
HVAC
GLOW
FILA
VENT
For Help, press F1

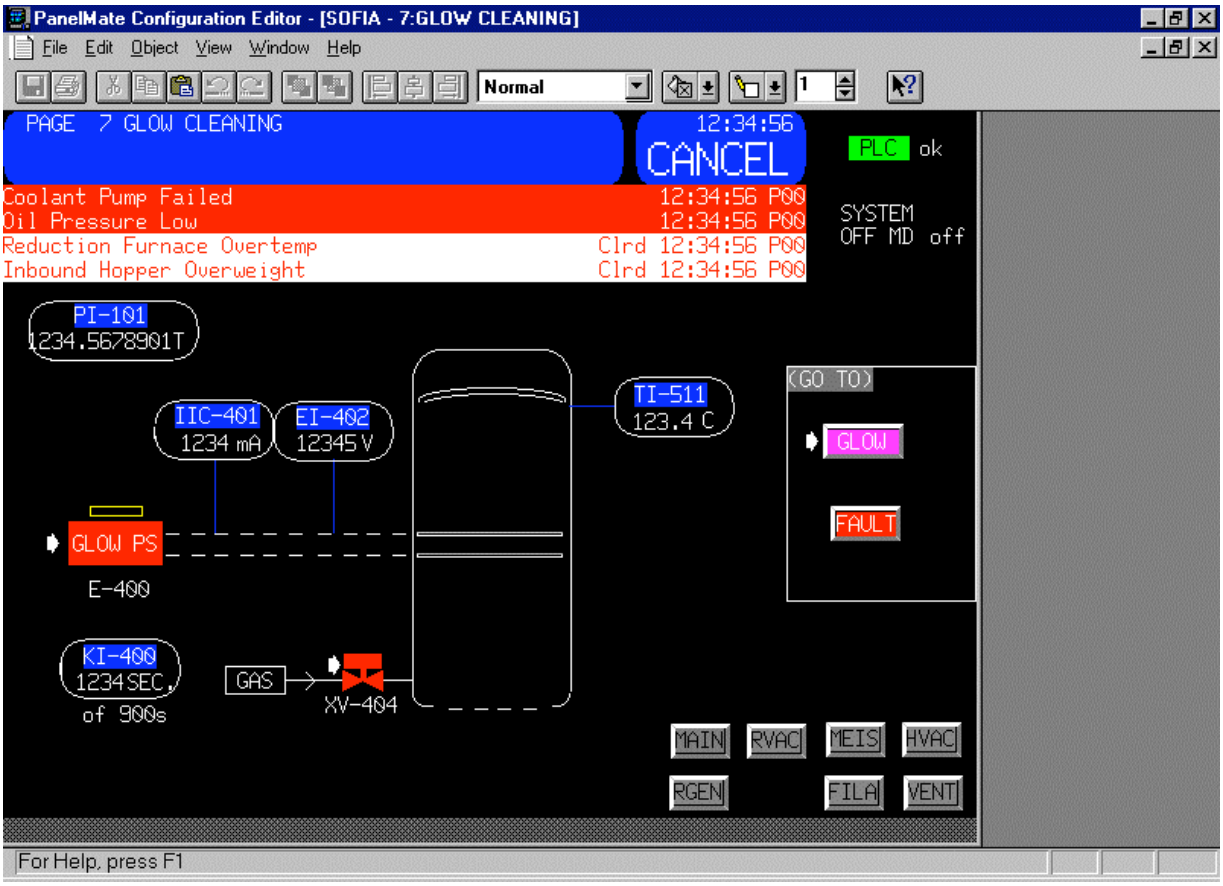
RGN2 Panel


PanelMate Configuration Editor - [SOFIA - 19:CRYOPUMP B REGEN. START/STOP]
File Edit Object View Window Help
Normal
1
PAGE 19 CRYOPUMP B REGEN. START/STOP
12:34:56
CANCEL
PLC ok
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
Start Permissives :
SYSTEM IN TEST MODE
NO SEQUENCE IS ACTIVE.
RGN2
XV-301B OK, GATE VALVE.
XV-301A CLSD, GATE VALVE.
XV-303B OK, REGEN VALVE.
XV-303B CLSD, REGEN VALVE.
TI-301B OK, CRYOPUMP IS WARM (>100 K)
MAIN
RVAC
MEIS
HVAC
GLOW
FILA
VENT
For Help, press F1

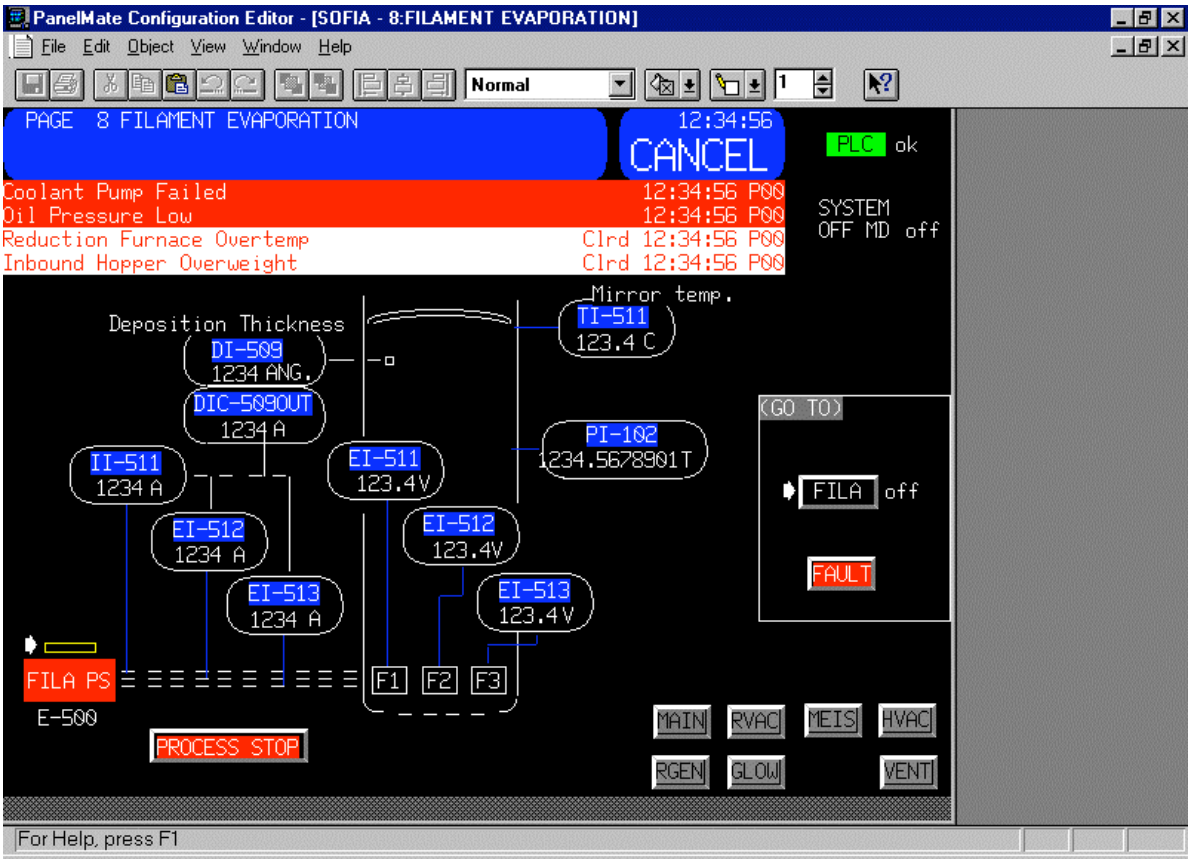
HVAC Panel


PanelMate Configuration Editor - [SOFIA - 5:HIGH VACUUM]
File Edit Object View Window Help
Normal
PAGE 5 HIGH VACUUM
12:34:56
CANCEL
PLC err
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
PI-101
1234.5678901T
PI-102
1234.5678901T
PI-301A
123.456T
TI-301A
1234 K
XV-301A
E-301A
E-302A
PI-301B
123.456T
TI-301B
1234 K
XV-301B
E-301B
E-302B
(GO TO)
HVAC
CLDN
off
FAULT
MAIN
RVAC
MEIS
RGEN
GLOW
FILA
VENT
For Help, press F1

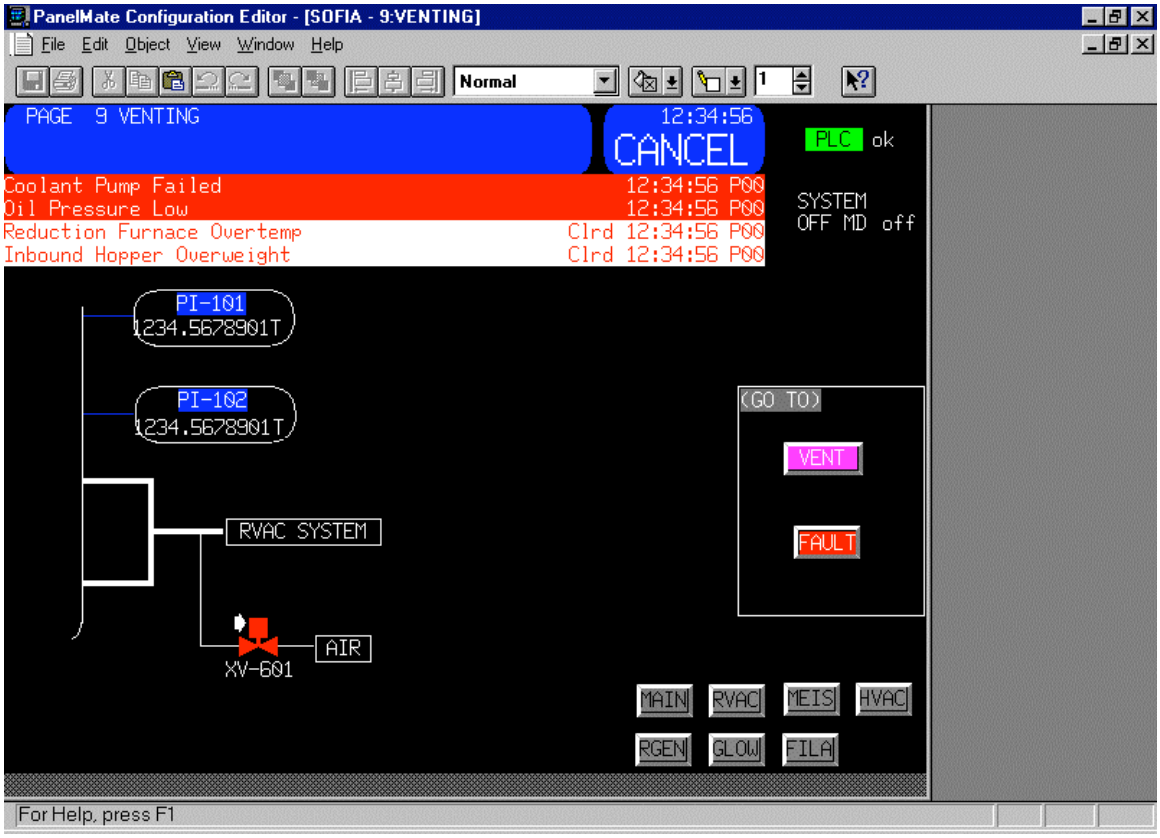
Glow Panel


PanelMate Configuration Editor - [SOFIA - 7:GLOW CLEANING]
File Edit Object View Window Help
Normal
PAGE 7 GLOW CLEANING
12:34:56
CANCEL
PLC ok
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
PI-101
1234.5678901T
IIC-401
1234 mA
EI-402
12345 V
TI-511
123.4 C
(GO TO)
GLOW
FAULT
GLOW PS
E-400
KI-400
1234 SEC
of 900s
GAS
XV-404
MAIN
RVAC
MEIS
HVAC
RGEN
FILA
VENT
For Help, press F1

FILA Panel


PanelMate Configuration Editor - [SOFIA - 8:FILAMENT EVAPORATION]
File Edit Object View Window Help
Normal
PAGE 8 FILAMENT EVAPORATION
12:34:56
CANCEL
PLC ok
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
Deposition Thickness
DI-509
1234 ANG.
DIC-509OUT
1234 A
Mirror temp.
TI-511
123.4 C
PI-102
1234.5678901T
II-511
1234 A
EI-511
123.4V
EI-512
1234 A
EI-512
123.4V
EI-513
1234 A
EI-513
123.4V
(GO TO)
FILA off
FAULT
FILA PS
E-500
F1
F2
F3
PROCESS STOP
MAIN
RVAC
MEIS
HVAC
RGEN
GLOW
VENT
For Help, press F1

Vent Panel

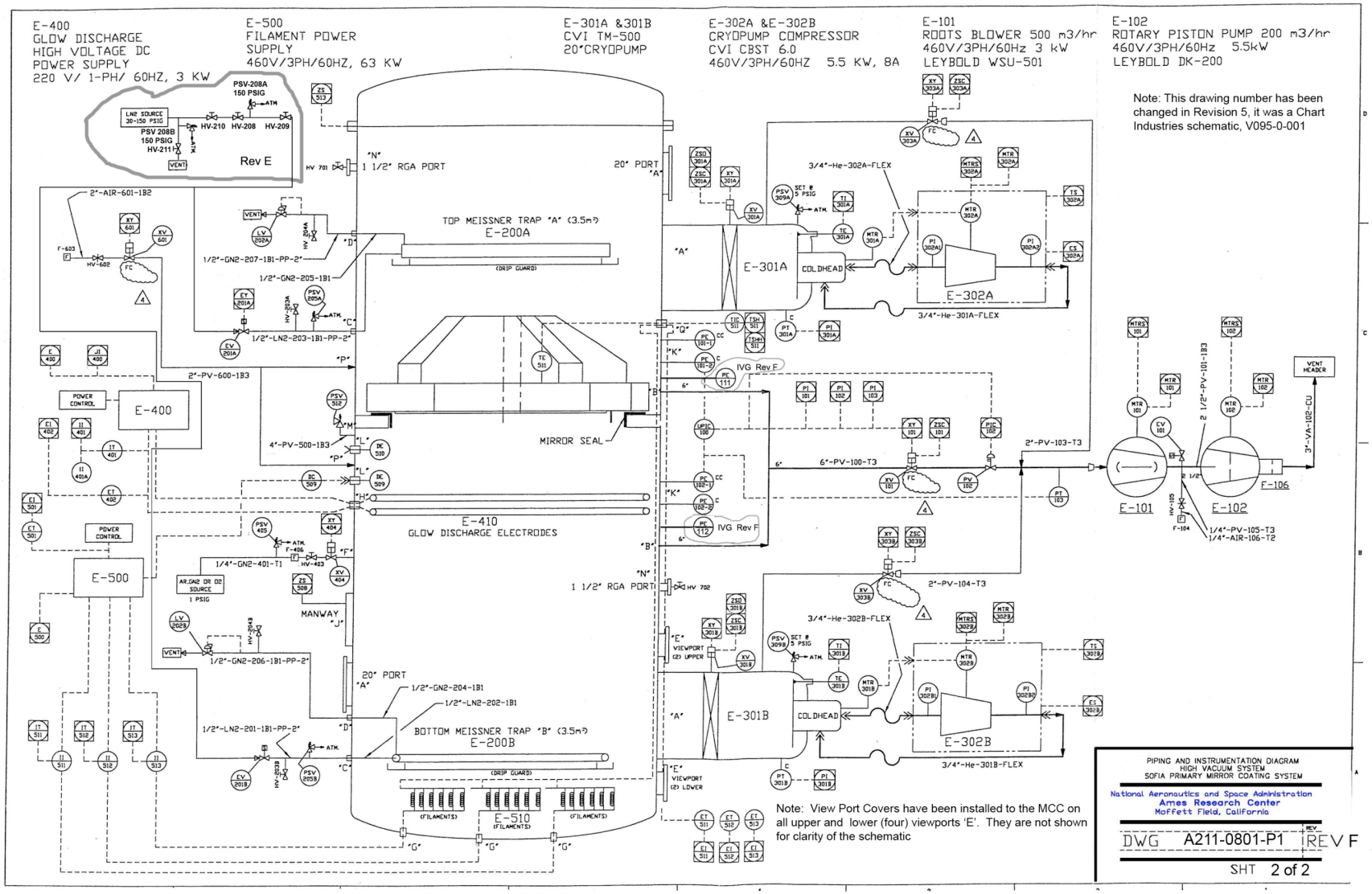

PanelMate Configuration Editor - [SOFIA - 9:VENTING]
File Edit Object View Window Help
Normal
PAGE 9 VENTING
12:34:56
CANCEL
PLC ok
Coolant Pump Failed 12:34:56 P00
Oil Pressure Low 12:34:56 P00
Reduction Furnace Overtemp Clrd 12:34:56 P00
Inbound Hopper Overweight Clrd 12:34:56 P00
SYSTEM
OFF MD off
PI-101
1234.5678901T
PI-102
1234.5678901T
RVAC SYSTEM
AIR
XV-601
(GO TO)
VENT
FAULT
MAIN
RVAC
MEIS
HVAC
RGEN
GLOW
FILA
For Help, press F1

APPENDIX C: DISCREPANCY LOG

Use this page and attach more pages as needed, to document any discrepancies discovered during the performance of this procedure. Each entry to be sequentially number, to identify the work step (s), identify the discrepancy and needed correction (s) and each be 'initialed / dated' by TD and QA prior to performing the correction.

This page intentionally left blank.

APPENDIX D: FIGURE 2, MCC SCHEMATIC



APPENDIX Z: EMERGENCY INSTRUCTIONS

In case of any injury obtain medical treatment as follows call 911 (from NASA/ARC phone only) or 650-604-5555 from cell phone.

Perform the following work steps in the event of an MCC emergency:

Press MCC STOP button located on the left side of the PLC cabinet
Shutdown MCF from MCF cabinet located in Room 97 Close BHM Breaker in room 97

Any perceived hazard to valuable hardware or personnel and/or actual damage to hardware or injury to personnel constitute an emergency situation. Examples of potential emergencies include the following:

- Cryogenic Burns
- Hazardous Chemical Spills
- Hazardous Chemical Fumes
- Vacuum Pump Failure
- Unexpected power outage to MCF
- Unexpected Venting of the MCC
- Compressor Failure

CHEMICAL HAZARDS

In the event of a physical emergency involving personnel chemical injury –
DIAL 911 on ARC phone or 650.604.5555 from a cell phone to contact Ames Emergency Medical Services – you are in building 211, Rm 95.

CONFINED SPACE

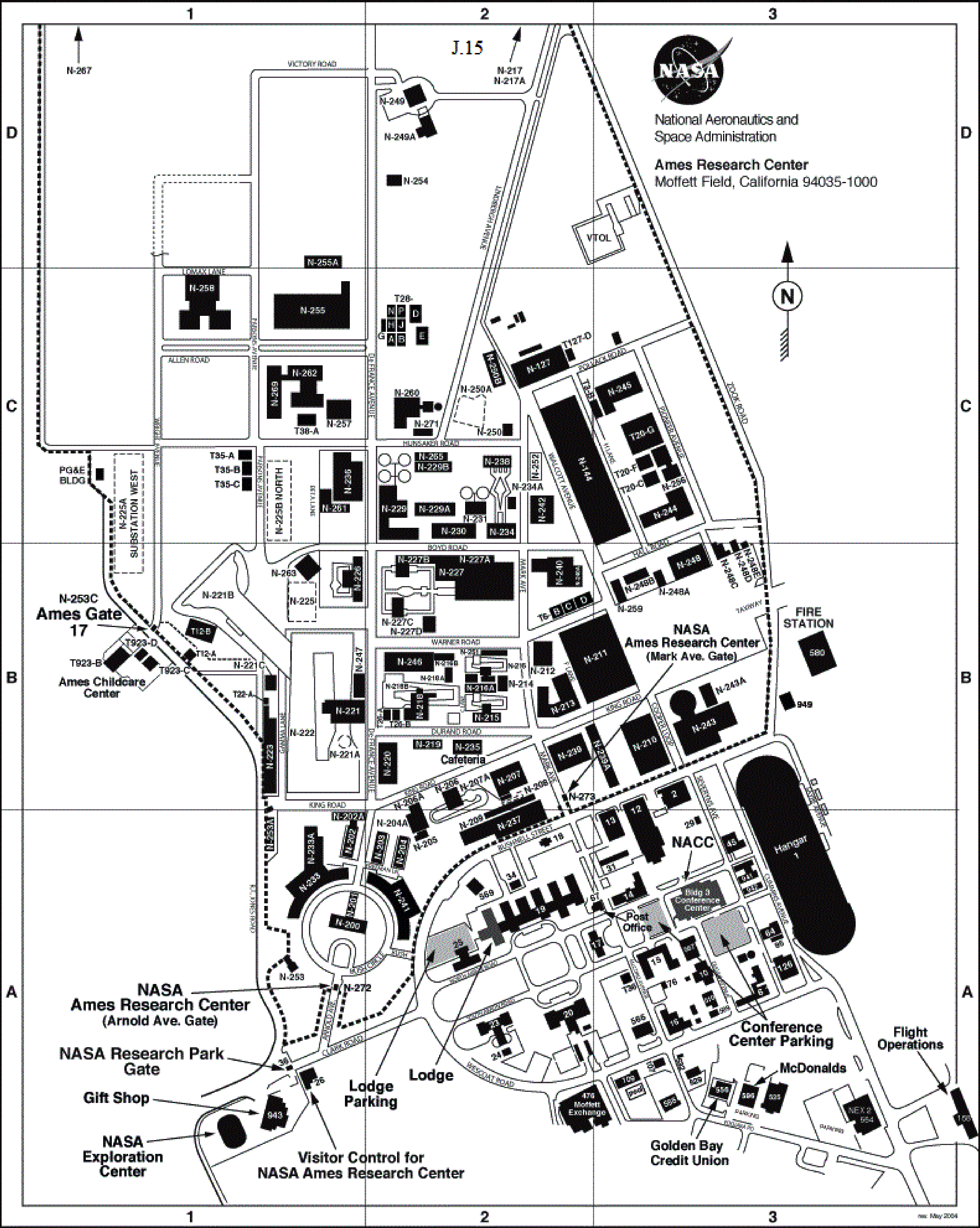
In the event of a physical emergency within the Chamber (Confined Space) –
DIAL 911 on ARC phone or 650.604.5555 from a cell phone to contact Ames Emergency Medical Services – you are in building 211, Closest entrance to the chamber is

LN_2 SHUTDOWN PROCEDURES

At the LN2 Dewar – CLOSE the Liquid Outlet Valve
Close HV-210
Open Drain valve HV-211


8
7
6
5
4
3
2
DWG NO.
SH.
REV
D
C
B
A
ZONE
LETTER
DESCRIPTION
DRAWN
DATE
APPRVD
REVISIONS
DRAWN
DESIGNED
CHECKED
PROJMGR
REQUESTER
R&QA
SAFETY
SUPERVISOR
DATE
Ames Research Center
Moffett Field, California
PROJECT TITLE
SIZE
D
CAGE CODE
25307
REV
SCALE
INDEX
SHEET
OF
FILE NAME:

J.15



National Aeronautics and Space Administration
Ames Research Center
Moffett Field, California 94035-1000
N
1
2
3
A
B
C
D
N-267
N-217
N-217A
VICTORY ROAD
N-249
N-249A
N-254
VTOL
N-255A
LOMAX LANE
N-258
N-255
T28-
N
P
D
N
J
G
A
B
E
T127-D
N-127
ALLEN ROAD
N-262
N-269
N-257
T38-A
N-260
N-250A
N-271
N-250
N-245
T20-G
N-144
HUNSAKER ROAD
T35-A
T35-B
T35-C
PG&E BLDG
N-225A SUBSTATION WEST
N-225B NORTH
N-236
N-261
N-265
N-229B
N-238
N-252
N-234A
N-229
N-229A
N-231
N-230
N-234
N-242
T20-F
T20-C
N-256
N-244
BOYD ROAD
N-263
N-227B
N-227A
N-227
N-226
N-225
N-240
N-248
N-248B
N-248A
N-248C
N-248D
N-248E
N-221B
N-253C
Ames Gate 17
T12-B
T12-A
T923-D
T923-B
T923-C
N-221C
Ames Childcare Center
T22-A
N-227C
N-227D
T6
B
C
D
N-259
FIRE STATION
580
NASA Ames Research Center (Mark Ave. Gate)
N-211
N-212
N-213
N-247
N-246
N-218B
N-218A
N-216
N-214
N-216A
N-218
N-215
N-221
N-222
N-221A
T20-B
DURAND ROAD
N-219
N-235
Cafeteria
N-220
N-239
N-239A
N-210
N-243A
949
N-243
N-223
KING ROAD
N-206
N-206A
N-207A
N-207
N-208
N-273
2
12
13
N-202A
N-202
N-203
N-204
N-204A
N-205
N-209
N-237
BUSHNELL STREET
18
29
NACC
Hangar 1
N-253A
N-233A
N-233
N-201
N-200
N-241
34
569
19
31
14
45
57
Post Office
Bldg 3 Conference Center
25
17
15
N-253
N-272
NASA Ames Research Center (Arnold Ave. Gate)
T36
76
126
23
20
566
16
Conference Center Parking
Flight Operations
NASA Research Park Gate
24
26
Gift Shop
943
Lodge Parking
Lodge
470 Moffett Exchange
McDonalds
NEX 2 554
NASA Exploration Center
Visitor Control for NASA Ames Research Center
Golden Bay Credit Union
rev. May 2004

NASA
Ames Research Center

Entry Permit For Permit Required Confined Spaces
This Entry is a Hazardous Operation

Confined Space Number:_____ Location_____

Description of Confined Space:_____

Purpose for entry:_____ Communication: Verbal, radio, visual (circle one)

Date:_____ Time Issued:_____ Time Expired:_____ Evaluation Pulled: Yes_____ No_____

Name of Entrants (Print)/ Date Trained:	Name of Attendants (Print)/ Date Trained /	Time Start /Time Stop
1)_____/_____	1)_____/_____	_____/_____
2)_____/_____	2)_____/_____	_____/_____
3)_____/_____	3)_____/_____	_____/_____
4)_____/_____	4)_____/_____	_____/_____

Confined Space Hazards:

(Describe and state how the hazard was eliminated. If hazard does not exist enter N/A.) **N/A**

Atmospheric Hazards: (ie. O2 deficiency, O2 enrichment, toxicity, flammability)
Describe: _____ ___
Mechanical Hazards: (ie. Agitators, blenders, fan blades)
Describe:_____ ___
Chemical Hazards: (ie. Acids, alkalils, sensitizers, skin irritants)
Describe:_____ ___
Electrical Hazards: (ie. lines and cables, high voltage, transformers, exposed terminals)
Describe:_____ ___
Engulfment Hazards: (ie. Water, plastics and chemicals, inwardly converging walls, sloping floors)
Describe:_____ ___
Ignition Hazards: (ie. open flames, heat sources, welding)
Describe:_____ ___
Process Hazards: (ie. pressurized fluids, chemicals, hydraulic fluid, traffic hazards)
Describe:_____ ___
Environmental Hazards: (ie heat, cold, insects, vermin, slippery surfaces)
Describe:_____ ___
Noise Hazards: (ie. ambient noise levels, loud equipment)
Describe:_____ ___

Any other Serious Safety Hazards or procedure deviations: DESCRIBE ON BACK THE HAZARD AND MITIGATION OR THE DEVIATION THAT OCURRED ___

Personal Protective & Safety Equipment

□ Hard Hat □ Coveralls □ Boots □ Face Shield □ Explosion Proof Light □ SCBA □ gloves (Specify:_____)
□ Safety Harness □ Goggles □ Hot work permit □ GFCI Equip. □ Hearing Protection □ Respirator (Specify:_____)
□ Fire Extinguisher □ Crane/Tripod w Wench □ □ Other:(Specify_____)

Atmospheric Monitoring

Acceptable Range	Pre Entry	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7
Oxygen 19.5 to 23.5%								
Flammability <10%LEL								
CO <12ppm								
H2S <5ppm								
Toxicity <1/2 PEL								
Testers Initials/Time								

Instrument Make Model	Serial Number	Calibration Date	Conditions Measured (O2, CO, LEL, etc)

Rescue and Emergency

□ **Notify** NASA dispatch, ext 4-5416 that a confined space entry is expected.
□ Pre-entry Safety Mtg. held, employees briefed on emergency Procedures
□ **Ensure** attendant understands methods of emergency alert to others, ie Health unit and fire Dept.
□ All entrants wear harness and are attached to lifeline. Unless retrieval equipment will increase overall risk or benefit during a rescue.

Permit Authorization

I certify that all actions and conditions necessary for safe entry have been performed.

_____ _____ _____
Entry Supervisor Name(Print) Entry Supervisor Signature Date:

Confined Space Evaluation Form	NASA Ames Research Center

Identification #_____ Date:_____
Location:_____Dimensions:_____
Description:_____

Type Of Evaluation (Check one): Initial ☐ Re-evaluation ☐

Does this space meet the definition of a confined space? Yes ☐ No ☐
If no, evaluation is complete and space is not a confined Space. Sign, date, & file the evaluation form.

If yes, determine if the space is a Non-Permit Confined Space or a Permit-Required Confined Space.

Hazard Identification:	**Yes or No**	**Describe:**
Atmosphere (e.g. oxygen deficiency or enrichment; toxic air contaminants; combustible gases, vapors, or particulate; rust formation; biological decomposition; exhaust from internal combustion engines; etc.)	Yes ☐ No ☐	Describe:_____
Chemical contact (e.g. acids, alkalis, coal tar products, sensitizers, skin irritants, solvents, paints, cleaners, adhesives, etc.)	Yes ☐ No ☐	Describe:_____
Electrical (e.g. lines and cables, transformers, capacitors, relays, switch gear, exposed terminals, etc.)	Yes ☐ No ☐	Describe: _____
Biological (e.g. sewage, storm drains, waste water, blood or other bodily fluids, live/dead animals, etc.)	Yes ☐ No ☐	Describe: _____
Environmental (heat stress; cold stress, slippery surfaces; lighting; potential for insects; flooding due to groundwater, tide or rain, etc.)	Yes ☐ No ☐	Describe: _____
Hazardous Materials (e.g. pressurized fluids in chemical piping or hydraulic systems, residual process chemicals, etc.)	Yes ☐ No ☐	Describe: _____
Ignition Sources (e.g. open flames, heat sources, frictional sparks, non-hazard classified electrical equipment, welding/cutting, hot riveting, hot forging, static discharge, grinding, chopping, etc.)	Yes ☐ No ☐	Describe:_____
Mechanical (e.g. agitators, blenders, stirrers, conveyors, unguarded belts, unguarded fans, etc.)	Yes ☐ No ☐	Describe:_____
Noise (e.g. posted high noise level area, fans and blowers, noise from work operations in space, or nearby equipment, etc)	Yes ☐ No ☐	Describe:_____
Physical Hazards (e.g. falls, engulfing materials such as liquids or flowing particles, entrapment due to confined space configuration, access, etc.)	Yes ☐ No ☐	Describe:_____
Process Hazards (e.g. contaminant producing activities in or around the space such as sandblasting, painting, or other unique process activities).	Yes ☐ No ☐	Describe: _____
Radiation (e.g. lasers, welding flash, RF and microwaves, radioactive sources, etc.)	Yes ☐ No ☐	Describe:_____
Traffic (e.g. pedestrian, public walk way, forklifts, etc.)	Yes ☐ No ☐	Describe:_____
Other:	Yes ☐ No ☐	Describe:_____

Oxygen Content: _____% H_2S: _____ppm
Flammability (LEL) _____%LEL CO: _____ppm
The space has been determined to be (check one):

☐Not a confined space ☐Non-permit confined space ☐Permit-Required confined space
If a confined space is the appropriate sign posted?

If No, contact the Confined Space POC. Sign provided? Yes ☐ No ☐

This space has been inspected and evaluated for the purpose of determining the permitting status as a confined space. Work in this space must be further evaluated prior to entry, as the status may change based on new conditions or the work performed.

_____ Date:_____
Evaluator

NASA Ames Hot Work Permit

Seek an alternative/safer method if possible!

This Hot Work Permit is required for any operation involving open flame or producing heat and/or sparks. This work includes, but is not limited to, welding, brazing, cutting, grinding, soldering, thawing pipe, torch-applied roofing, powder actuated tools or chemical welding.

Expiration Date: ___/___/_____

Permit Number:	**Permit Valid Date:** ___/___/___	**Time Started:**	**Time Completed:**

1. Requester's name, Organization/Company, Phone Number

2. Location (Building/Rm #/Outside)

3. Operation to be Performed

4. Precautions to follow

- ☐ Available sprinklers, hose streams, and extinguishers are in service and operable. If buildings or areas are equipped with smoke or flame sensing detectors, the alarm techs shall be notified prior to commencing work (650) 604-5961 or (650) 604-5416.
- ☐ Hot work equipment is in good working condition in accordance with manufacturer's specifications.
- ☐ Provide adequate ventilation in areas where smoke and harmful fumes or vapors may be generated.

Requirements within 35 ft (11 m) of hot work

- ☐ Flammable liquid, dust, lint, and oily deposits removed.
- ☐ Explosive atmosphere in area eliminated.
- ☐ Floors swept clean and trash removed.
- ☐ Combustible floors wet down or covered with damp sand or fire-resistive/noncombustible materials or equivalent.
- ☐ Personnel protected from electrical shock when floors are wet.
- ☐ Other combustible storage material removed or covered with listed or approved materials (welding pads, blankets, or curtains; fire-resistive tarpaulins), metal shields, or noncombustible materials.
- ☐ All wall and floor openings covered.
- ☐ Ducts and conveyors that might carry sparks to distant combustible material covered, protected, or shut down.

Requirements for hot work on walls, ceilings, or roofs

- ☐ Construction is noncombustible and without combustible coverings or insulation.
- ☐ Combustible material on other side of walls, ceilings, or roofs is moved away.
- ☐ Fire watch is provided during hot work on roofs for a minimum of 60 min. after hot work, including any break activity.

Requirements for hot work on enclosed equipment/system / space

- ☐ Enclosed equipment is cleaned of all combustibles. Containers are purged of flammable liquid/ vapor.
- ☐ Adequate ventilation equipment provided, operable and intrinsically safe.
- ☐ Pressurized vessels, piping, and equipment removed from service, isolated, and vented.

Requirements for hot work fire watch and fire monitoring

- ☐ Provided during and for a minimum of 30 min. after hot work, including any break activity.
- ☐ Provided with approved type and size of fire extinguishers and, where practical, a fire hose. These have to be immediately available for use.
- ☐ Trained in use of equipment and in sounding alarm.
- ☐ Required in adjoining areas including above and/or below as applicable.
- ☐ Yes ☐ No Per the PAI/fire watch, monitoring of hot work area has been extended beyond the 30 min.

5. Immediately report any **FIRE or EMERGENCY** to Moffett Field dispatch. Dial 9-1-1 or **(650)604-5555** from a mobile phone

6. I am fully qualified to perform this operation and understand my responsibilities regarding fire safety on this operation, and will apply and abide by the precautions outlined above.

_____

SIGNATURE of Official-in-Charge or Designated Representative performing Hot Work

7. I verify that the above location has been examined, the precautions marked on the checklist above have been taken, and permission is granted for this work.

Name (print)	SIGNATURE of permit-authorizing individual (PAI)	Date

PROJECT MANAGERS GUIDE

REFERENCES

NASA-STD-8719.9

ASME B30.0 SERIES

OSHA STD 29 CFR 1910 SERIES

AHB 1700.1 (Ames Health and Safety)

Project Manager Crane Lift Checklist
NASA-STD-8719.9

- **Lifting Device Equipment Manager (LDEM) Robert S. Munoz 4-5162 (JCM) Bldg. 213 room 253**

1) <u>Notifications:</u> (if applicable)

- **Safety office (code Q)**
- **Security/Fire Department (road blocks, emergencies, fire hazards etc.) Give building/streets affected by lift**
- **Facility Safety Managers (building/room evacuations, written e-mails and visible posting of notifications)**
- **NASA Airfield Control Tower (nuqops@mail.arc.nasa.gov)**

2) <u>Permits Code Q Safety)</u>

- **Burn permit if torching or burning required**
- **Lead abatement signoff**
- **Asbestos containment**
- **Applicable Carcinogens**
- **Electrical/Voltage (power on/off requirements)**

3) <u>Project Manager Requirements:</u>

- **Submit prior to lift, (minimum 5 working days) a lift plan/job scope (critical or non critical) refer to NASA –STD-8719.9 3.1.5 or 3.1.34**
- **Ensure crane company submitted safety plan is on site**

4) <u>Crane company requirements:</u>

- **Crane vehicle Annual Certification available and daily inspection signoff (to be performed before arrival or on site PRIOR to lift)**
- **Licensed Operator (CCO) /Rigger Certifications**
- **Rigging equipment in compliance (certifications) within Federal/OSHA standards**
- **Safety equipment (hard hat, safety shoes, body harness etc.)**

- **<u>References:</u>**
- **NASA-STD-8719.9**
- **ASME B30.2, 30.5 Overhead /Mobile Crane Requirements**
- **AHB 1700.1 (Ames Heath and Safety Manual)**
- **OSHA STD-1910 General Industry**

Definition of a Critical Lift

NASA-STD-8719.9

1.5.1 Critical lifts are lifts where failure/loss of control could result in loss of life, loss of or damage to flight hardware, or a lift involving special high dollar items, such as spacecraft, one-of-a-kind articles, or major facility components, whose loss would have serious programmatic or institutional impact. Critical lifts also include the lifting of personnel with a crane, lifts where personnel are required to work under a suspended load, and operations with special personnel and equipment safety concerns beyond normal lifting hazards. Personnel shall not be located under suspended or moving loads unless the operation adheres to the OSHA-approved NASA Alternate Standard for Suspended Load Operations (see Appendix A). Lifting of personnel with a crane shall be in accordance with 29 CFR 1926.550 (see Appendix C).

CRITICAL LIFT REQUIREMENTS

This job has been deemed a "CRITICAL LIFT" and must meet the following NASA-STD-8719.9/OSHA/ASME30.0 series / AHB 1700.1 requirements/standards

1) **All rigging (shackles, slings etc.) must have been certified within the past year. Certifications tags and or hard copy documentation must be in place and presented before lift is to take place.**
2) **All rigging personnel shall have had proper training and mobile crane operator shall have a current CCO license**
3) **Mobile\Overhead crane shall have current annual/quadrennial inspection paperwork readily available with a daily inspection to be completed before leaving facility yard or inspection done before operation/lift is to take place**
4) **Safety circle meeting/sign in sheet will take place before job begins**
5) **All personnel shall have proper protective equipment on and in place before job begins.**
6) **Personnel Certifications: Crane (overhead) operators license, health unit clearance (physical on record)**
7) **Copy of lift/rig plan (reviewed and signed off)**

NASA Lift Device Equipment Manager: Robert Munoz
M/S 213-16 (650) 604-5162
Cell # (650) 793-2178

Code of Safe Practices

1. **All persons shall follow these safe practice rules, render every possible aid to safe operations, and report all unsafe conditions or practices to the foreman or superintendent.**
2. **Foremen shall insist on employees observing and obeying every rule, regulation, and order as is necessary to the safe conduct of the work, and shall take such action as is necessary to obtain observance.**
3. **All employees shall be given frequent accident prevention instructions. Instructions shall be given at least every 10 working days.**
4. **Anyone known to be under the influence of drugs or intoxicating substances that impair the employee's ability to safely perform the assigned duties shall not be allowed on the job while in that condition.**
5. **Horseplay, scuffling, and other acts that tend to have adverse influence on the safety or well-being of the employees shall be prohibited.**
6. **Work shall be well planned and supervised to prevent injuries in the handling of materials and in working together with equipment**
7. **No one shall knowingly be permitted or required to work while the employee's ability or alertness is so impaired by fatigue, illness, or other causes that it might unnecessarily expose the employee or others to injury.**
8. **Employees shall not enter manholes, underground vaults, chambers, tanks, silos, or other similar places that receive little ventilation ,unless it has been determined that it is safe to enter.**
9. **Employees shall be instructed to ensure that all guards and other protective devices are in proper places and adjusted, and shall report deficiencies promptly to the foreman or superintendent.**
10. **Crowding or pushing when boarding or leaving any vehicle or other conveyance shall be prohibited.**
11. **Workers shall not handle or tamper with any electrical equipment, machinery, or air or water lines in a manner not within the scope of their duties, unless they have received instructions from their foreman.**
12. **All injuries shall be reported promptly to the foreman or superintendent so that arrangements can be made for medical or first aid treatment.**
13. **When lifting heavy objects, the large muscles of the leg instead of the smaller muscles of the back shall be used.**
14. **Inappropriate footwear or shoes with thin or badly worn soles shall not be worn.**
15. **Materials, tools, or other objects shall not be thrown from buildings or structures until proper precautions are taken to protect others from the falling objects.**

_____. _____.

Contractor Signature & Company **Date**

LIFT INFORMATION

Include the following information in all lift plans:

1. The weight of the item to be lifted: _____
2. The weight of all rigging and fixtures used (this becomes part of the load) : _____
3. The weight of the hook and block: _____
4. Total load weight imposed on the crane: _____
5. Maximum radius (mobile cranes): _____
6. Maximum boom extension (mobile cranes): _____
7. Rated Working Load (RWL) at maximum boom extension & radius: _____
8. Type of rigging configuration (include sketch or drawings, if necessary): _____
9. Type of slings used and RWL of slings at the angle of attachment: _____
10. Size and RWL of lifting hardware, i.e. shackles, turnbuckles, etc., if used: _____
11. Sketch of pick and set areas *(Include as a separate sheet, or use designated section below)*: _____
12. Proof of annual inspection of crane & hook: _____
13. Operator certification issued by operator's employer: _____

Comments/Remarks:

JCM CONSTRUCTION SAFETY SURVEY

Inspector_____ **Building/Location & Date** _____

Write Date Under "Fixed"

Program Administration	**Yes**	**No**	**N/A**	**Fixed**	**Material Storage/Handling**	**Yes**	**No**	**N/A**	**Fixed**
OSHA Posting					Material Properly Stored/Stacked				
Emergency Numbers/contacts Posted					Duct Protection Adequate				
Hazard Communication Program					Loads Lifted Correctly				
Daily/Weekly Safety Meetings Held					**Excavation & Shoring**	**Yes**	**No**	**N/A**	**Fixed**
Housekeeping/Sanitation	**Yes**	**No**	**N/A**	**Fixed**	Shoring Proper Soil & Depth				
Work Areas Orderly					Adjacent Structures Properly Shored				
Adequate Lighting					Necessary Ladders provided				
Hand washing/Toilet Facilities					Excavation Barricaded				
Passageway & Walkways Clear					Spoil Setback at Least 2 Feet				
Fire Protection	**Yes**	**No**	**N/A**	**Fixed**	Equipment Away from Edge				
Fire Extinguisher Available					Equipment Ramps Adequate				
Correct Extinguishers for Job					**Ladders**	**Yes**	**No**	**N/A**	**Fixed**
No Smoking Posted & Enforced					Ladders in Good condition				
Electrical/Utility	**Yes**	**No**	**N/A**	**Fixed**	Side Rails Extend 36" above Landing				
Electrical Hazards Posted					Proper for Job and Secure				
Drop Cords Protected					Ladders Fully Open when in Use				
Underground Electrical Lines Staked					**Scaffolding**	**Yes**	**No**	**N/A**	**Fixed**
Lockout Procedures Utilized					Equipment in Good Condition				
Access to Breaker Box Clear					Scaffold Is Tied to Structure				
Underground Gas Lines Staked					Guardrails, Top, Mid, Toe Boards in Place				
Hand & Power Tools	**Yes**	**No**	**N/A**	**Fixed**	Connections Sound & secure				
Hand Tools in good Working Condition					Planking cleats in Place				
Cords in Good Condition					Worker Protection from Falling Objects				
All Mechanical Safeguards in Use					**Welding & cutting**	**Yes**	**No**	**N/A**	**Fixed**
Proper Tools Utilized for Each Job					Screen & Shields in Place				
Tools Grounded or Doubled Insulated					Electrical Equipment Grounded				
Heavy Equipment	**Yes**	**No**	**N/A**	**Fixed**	Compressed Gas Cylinders Secure/Upright				
Operation Manuals Available					Proper Personnel Protection Utilized				
Brakes, Lights, Signals/Alarms Operative					Fire Extinguishers Immediately Available				
Wheels Choked when Necessary					Welding Cable in Good Condition				
Seat Belts Worn					**Personal Protection Equipment**	**Yes**	**No**	**N/A**	**Fixed**
Daily Inspections Documented					Hard Hats Worn				
Barricades & Fencing	**Yes**	**No**	**N/A**	**Fixed**	Gloves Available				
Site Fenced					Steel Toe Footwear				
Roadways & Sidewalks Protected					Eye Protection Utilized				
Floor Opening Planked or Barricaded					Hearing Protection Utilized				
Access Traffic Controlled					Safety Belts & Lanyards Utilized				
					Respirators & Masks Utilized				

Building/Location & Date_____

Comments and Corrective Actions

Name (Printed)_____Signature_____Date_____

PRE-LIFT SAFETY CHECKLIST

□ **Company:**	□ **Crane Operator (name):**
□ **Date:** **Time:**	□ **CCO License #:**
□ **Crane Type/Capacity:**	□ **Location:**
□ **Maximum Radius During Lift:**	□ **Crane Certified/Inspected:**
□ **Discription of Load:**	□ **Capacity at Maximum Radius:**
□ **Rigging Type/Capacity:**	□ **Load Weight:**

CHECKLIST

Crane Operator	**Project Manager**
□ **Crane Stable**	□ **FSM Notified**
□ **Load Path Clear**	□ **Traffic Safety** (Security, Fire, Tower as req'd)
□ **Rigging Equipment** (Certified/Inspected)	□ **Rigger Certification Current**
□ **Critical Lift** (Slings & Rigging Equipment #s)	□ **Personnel Safe**
□ **Affected Areas Evacuated** (Signs Posted)	□ **Load in Approved Zones**

Safety Concerns/Comments:

Completed By: (Print)	**Signature** **Date:**

“DANGER”

DO NOT ATTEMPT TO ENTER AREA BETWEEN THE HOURS

Of: _____

And:_____

Date:_____

Plant Engineering Branch
JCM

POC: Robert Munoz
AMES LIFT MANAGER
4-5162
N-213
Rm 253

CAUTION

THERE WILL BE CRANE WORK BETWEEN THE HOURS

OF: _____ AM____

AND:____ PM____

DATE:___/ /_____

PLANT ENGINEERING BRANCH

DANGER, DO NOT PASS THROUGH BARRIERS

POC: Robert Munoz
AMES LIFT MANAGER
4-5162
N-213
Rm 253

THIS BUILDING WILL BE CLOSED BETWEEN THE HOURS

OF: _____

AND:_____

DATE:_____

PLANT ENGINEERING BRANCH (JCM)

DANGER, DO NOT PASS THROUGH BARRIERS

POC: Robert Munoz
AMES LIFT MANAGER
4-5162
N-213
Rm 253