R M Yamamoto

RHIC/PHENIX DETECTOR

Magnet Subsystem- Muon Piston Coil Final Design Review

Arthur R. Harvey
Winston J. Wong
Robert M. Yamamoto

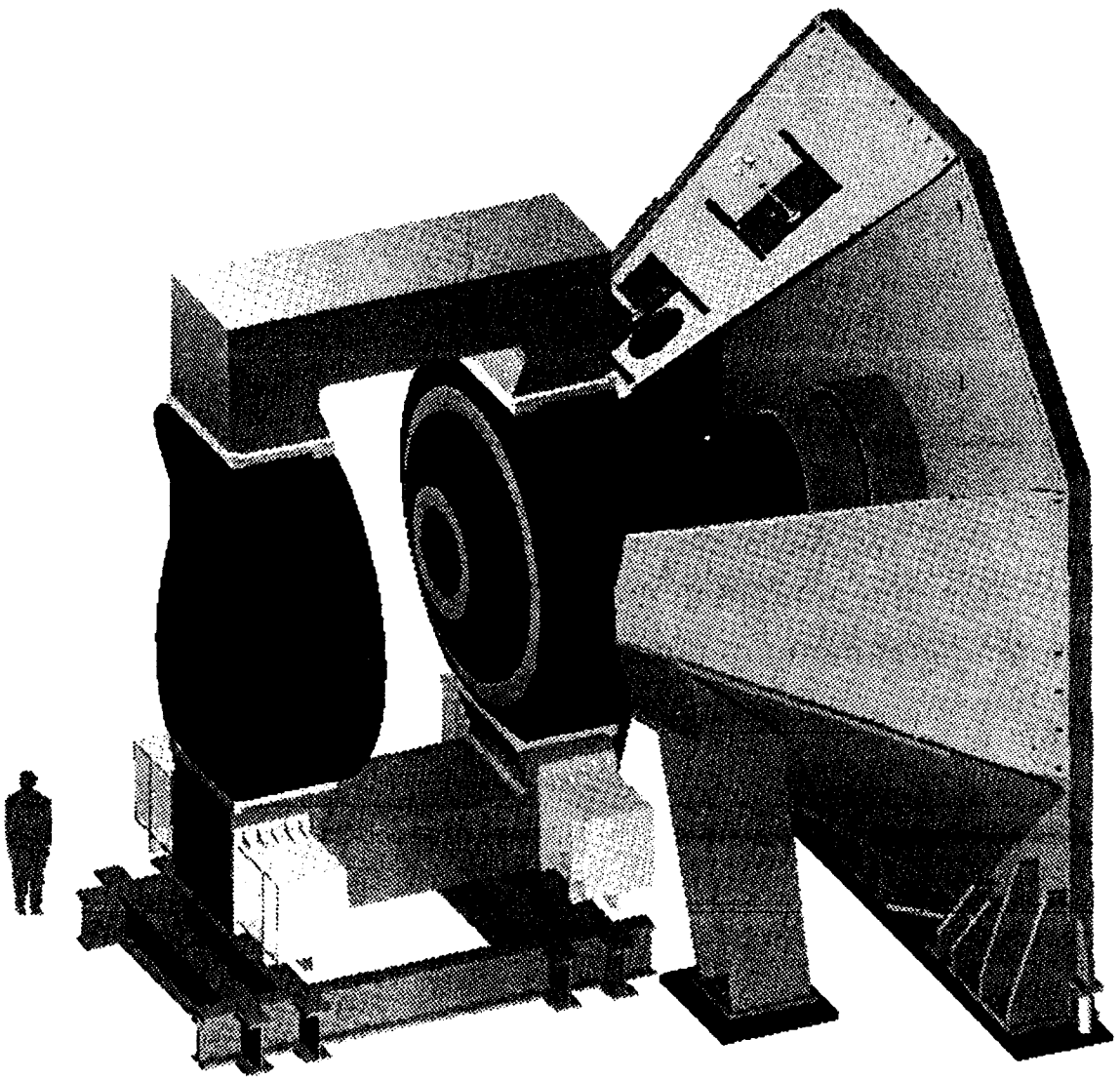
representing the BNL, LANL and LLNL Design Team

August 2-3, 1993

PHENIX MM Coil - Final Design Review - Agenda

- Top Level Requirements
- Coil Parameter Summary
- Coil Design
- Hazards Analysis
- Facility Interfaces
- Cost/Schedule

PHENIX Magnet Subsystem



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PHENIX MM Coil - Top Level Requirements

- **Amp-turns:** 300,000 nominal
  (587,700 calculated maximum)

- **Coil Temperature:** <32°C average temperature preferred
  50.0°C maximum allowed average

- Final "potted" coil dimensions consistent with Tom Shea's configuration control drawing

- Design consistent with muon chamber and facility requirements

PHENIX Muon Magnet - Coil Parameters

	Muon Magnet	
	Small #1 Coil	Large #2 Coil
Amp-Turns	300,000	
Configuration	2 Layer Solenoid	2 Layer Solenoid
Cond Material	Copper	Copper
Inside Dia (mm)	1623.8	1880.6
Outside Dia (mm)	1740.4	1997.2
# of Turns	51	51
Cond Size (mm)	24.13 square	24.13 square
Cond Hole ø (mm)	15.49	15.49
Cond Length (m)	270	311
Current (amps)	2941	
Voltage (volts)	35.5	41.1
Power (kwatts)	225	
Flow rate (gpm)	35.3	32.6
Weight (kg)	951	1096
Avg Coil Temp °C	25.6	27.1

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PHENIX Muon Magnet - Coil Parameters - Max

	Muon Magnet	
	Small #1 Coil	Large #2 Coil
Amp-Turns (nominal)	300,000	
Amp-Turns (maximum)	587,700	
% Increase	96	
Current (amps)	5762	
Voltage (volts)	164	
Power (kwatts)	944[1]	
Avg Coil Temp °C	42.9	49.2

1 Power supply sized @ 450 kw

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PHENIX MM Coil - Design/1

- Coil is made up of two individual solenoidal coils:
  - a small (#1) coil and a large (#2) coil

- Coils are identical except for:
  - overall diameters
  - detail of bus flags

- Coils are:
  - made from square hollow copper conductor
  - bifilar wound (two in-hand)
  - 2 layer solenoids
  - cooled in parallel - 8 inlet & 8 outlet water fittings (each layer of coil cooled individually)
  - vacuum epoxy impregnated

PHENIX MM Coil - Design/2

- Coils run electrically in series
  - utilizes one power supply
  - uses a single pair of water cooled leads (actual coil conductor used - has its own independent cooling circuit)
  - inlet and outlet power physically attached to coils between the end of coil #1 and the beginning of coil #2
  - power leads come from the bottom of the magnet at 22.5° from the vertical centerline (west side of magnet) and hides in the shadow of the muon chambers support structure
  - an intermediate bus station somewhere on the detector floor connects the 4/0 cables coming from the power supplies to the water cooled bus leads that attach to the coil flags (8 supply and 8 return power cables are required to carry the 3000 amperes of current to the coils)

PHENIX MM Coil - Design/3

- Final "potted" coil dimensions consistent with Tom Shea's mid-July configuration control drawing

- Because of piston steel saturation concerns, all clearances required between the OD of the muon piston and the ID of the coil are taken up by enlarging the ID of the coil

	Tom Shea	Small #1 Coil	Large #2 Coil	Piston Steel
Radius	*808.70 mm*	811.15 mm		808.20 mm
		812.67 mm		*808.70 mm*
	937.40 mm		939.55 mm	936.90 mm
			941.07 mm	*937.40 mm*
Radial Clearance:		+2.45 mm	+2.15 mm	
Length:	*700.00 mm*	677.93 mm	677.93 mm	>695.00 mm

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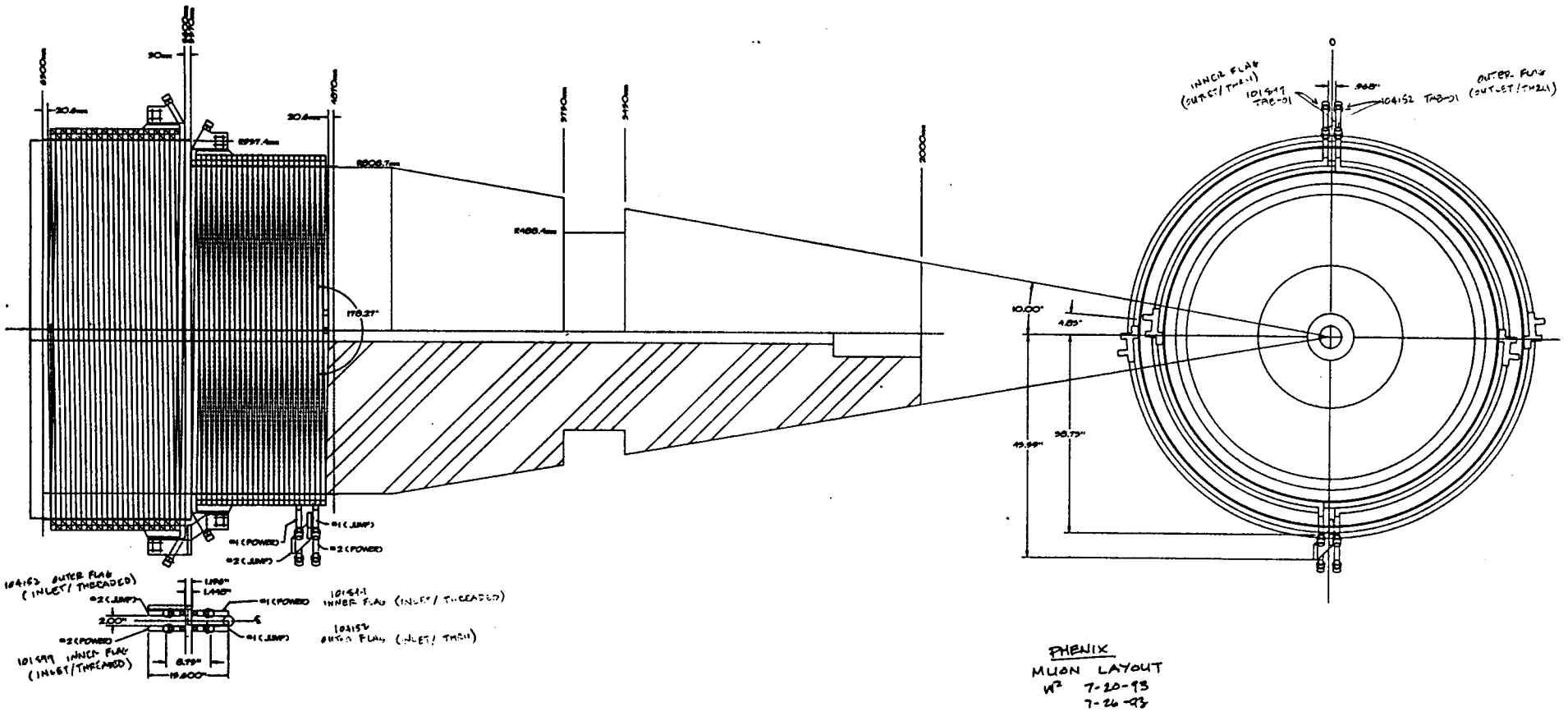
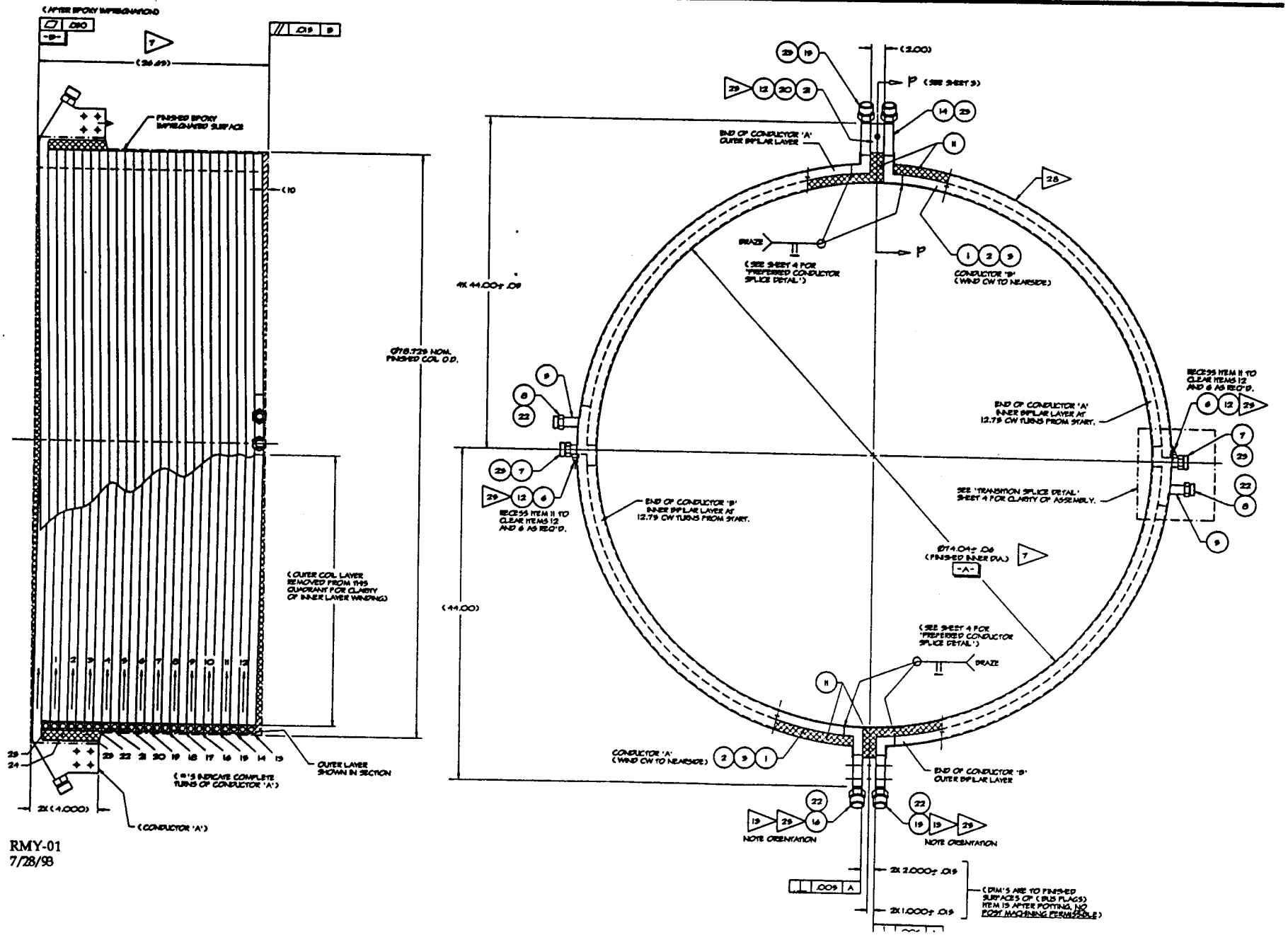
PHENIX Muon Magnet - Overall Layout



PHENIX Muon Magnet - Large (#2) Coil



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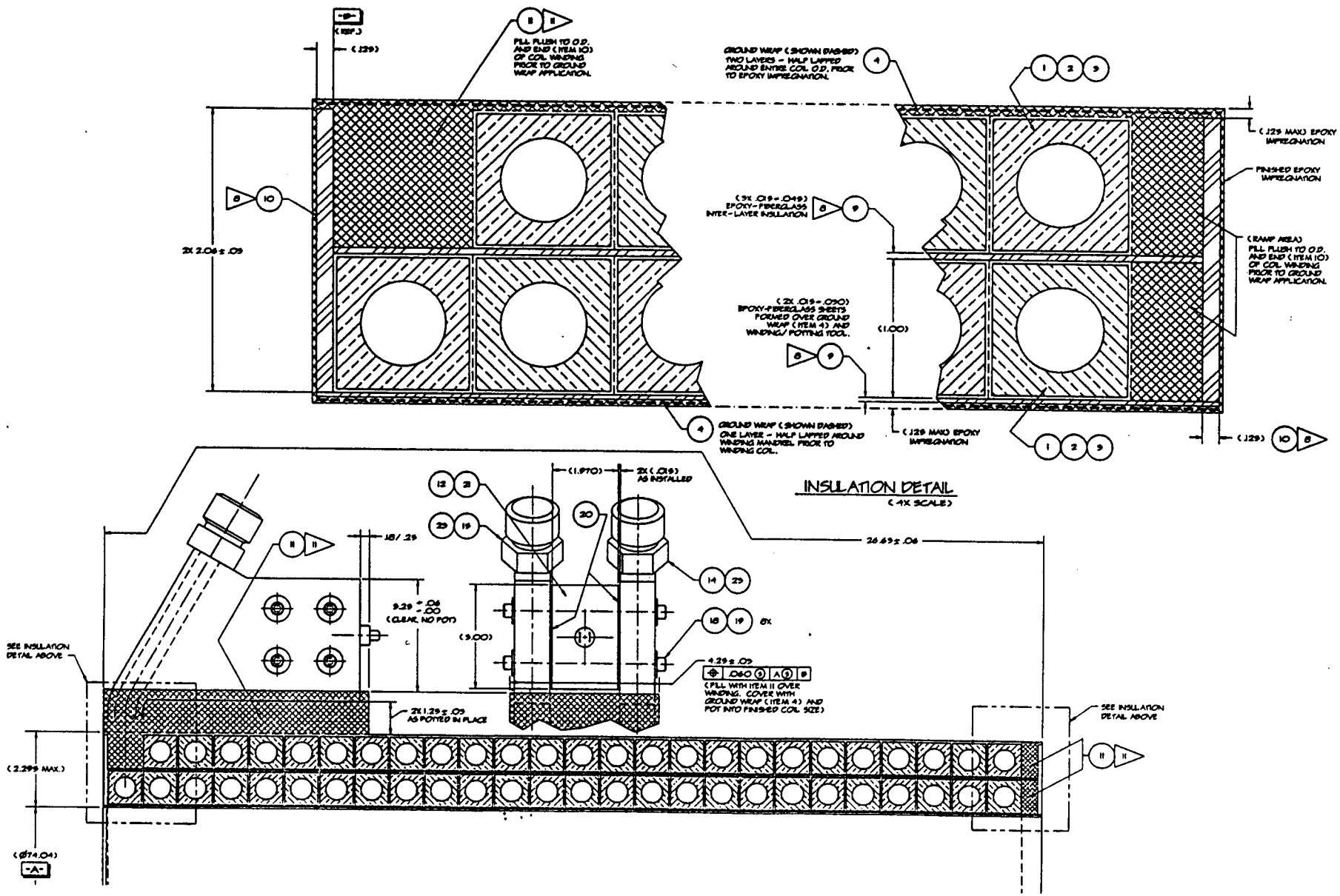
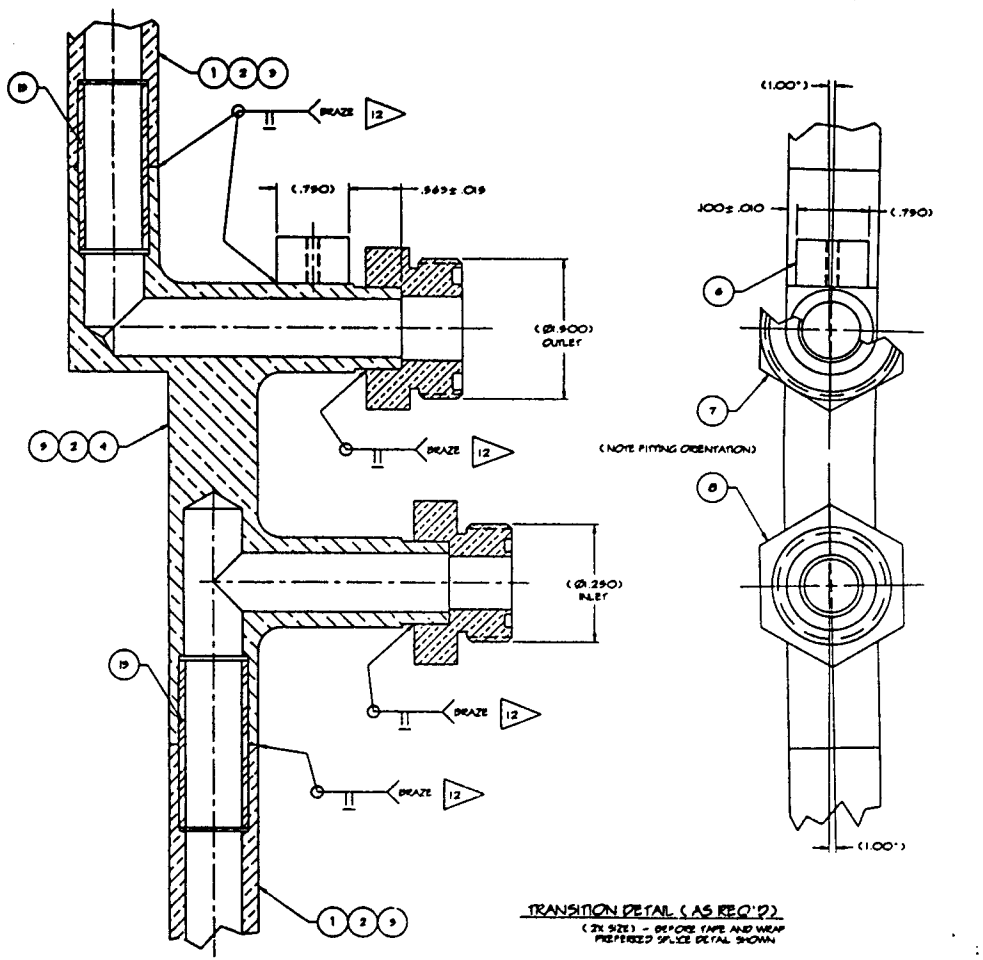
PHENIX Muon Magnet - Coil Cross-section



PHENIX Muon Magnet - Transition Detail



TRANSITION DETAIL (AS REQ'D)
(2X SIZE) - BEFORE TAPE AND WRAP
PREFERRED SPLICE DETAIL SHOWN

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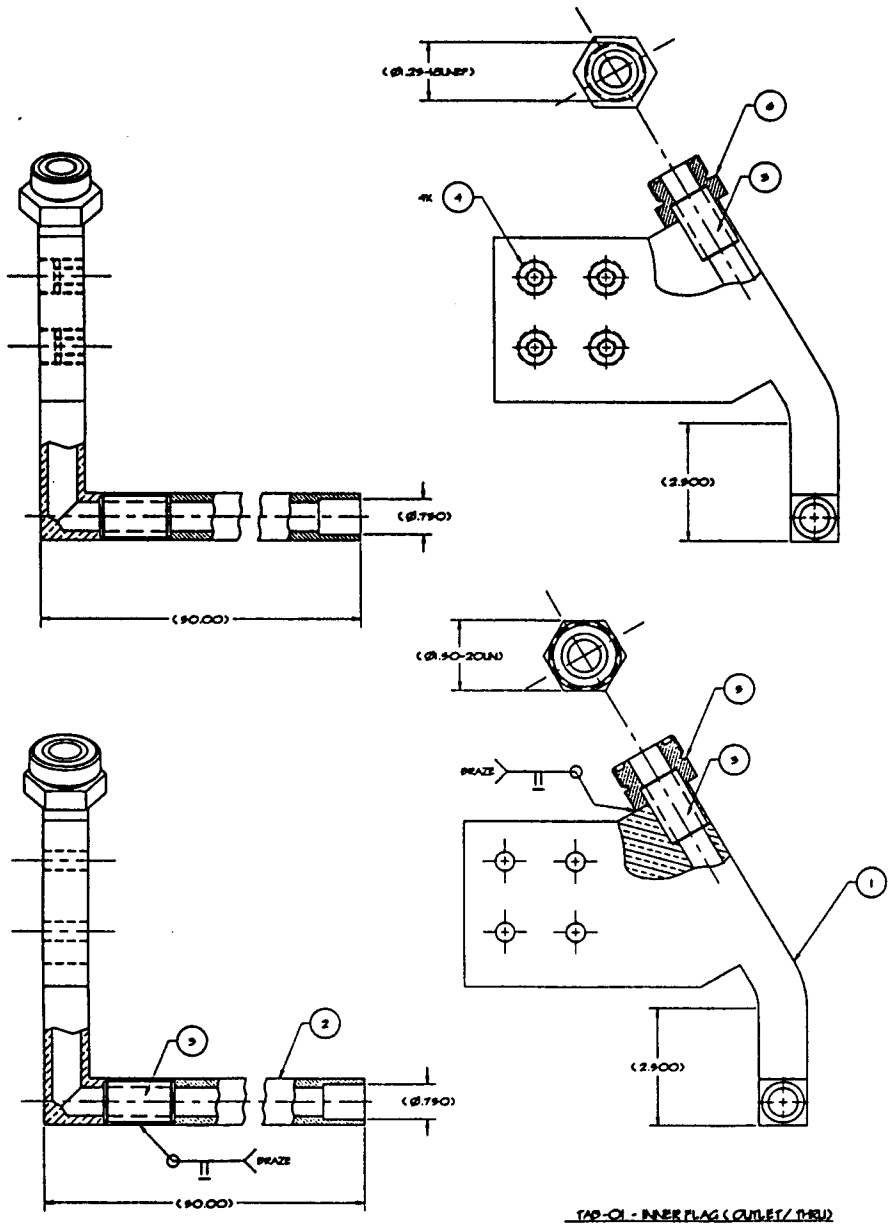
PHENIX Muon Magnet - Bus Flag Detail



TAP-01 - INNER FLAG (OUTLET/ THRU)

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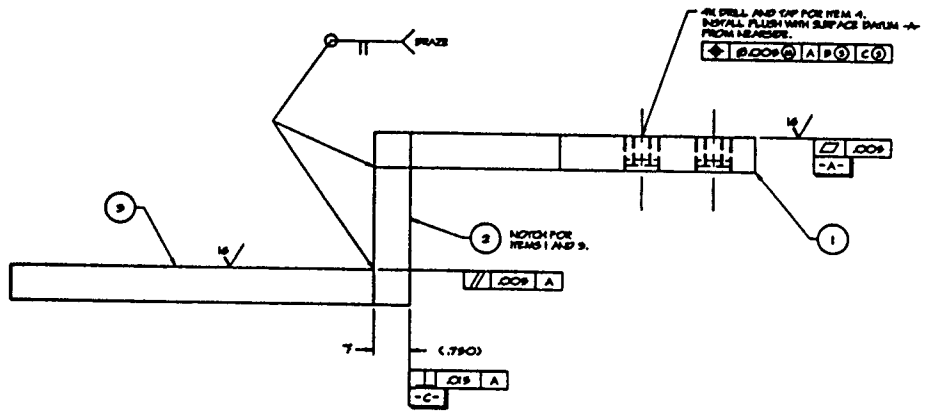
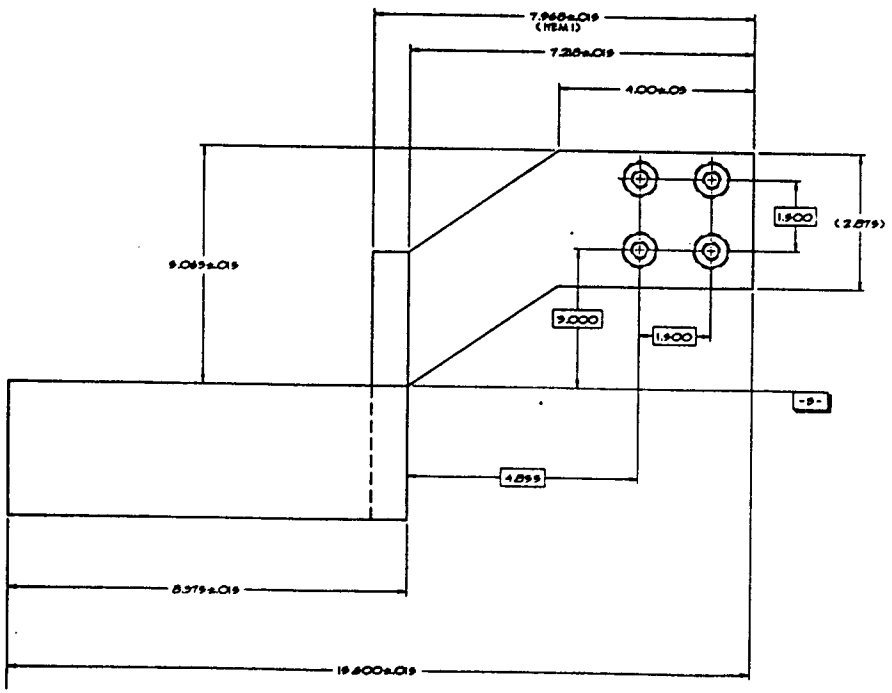
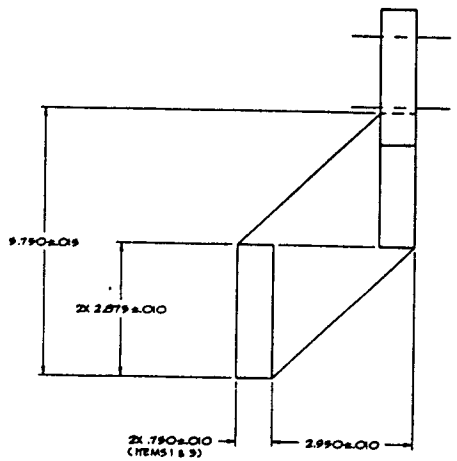
PHENIX Muon Magnet - Coil Jumper Detail







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SYSTEM: PHENIX Magnet Subsystem

PROJECT ENGINEER: R.M. Yamamoto

DATE: August 2-3, 1993

REVISION: 0

SUBSYSTEM: Muon Magnet Coil

SHEET 1 OF 2

1 COMPONENT		2 HAZARD						3 PREVENTATIVE ACTION
				CLASS				
NO.	DESCRIPTION	MODE	EFFECT	1	2	3	P**	
1	Break in water line	Normal operation	Overheating of coil or electrical shorting of coil creating a fire		X		L	Use of interlocked instrumentation: "Klixon" temperature switches and in-line flow switches
2	Electrical shock	Normal operation	Personnel could be electrically shocked and injured		X		L	All electrical areas on the coil & bus will be shielded; administrative control will be used to ensure that no personnel enter the detector area while the coils are energized
3	Magnetic field	Normal operation	Heart pace makers and some electronic devices become inoperative		X		L	Administrative control will be used to ensure that no personnel enter the detector area while the coils are energized

*HAZARD CLASS: 1-MINOR, 2-MODERATE, 3-MAJOR

**P=PROBABILITY: L=LOW, M=MEDIUM; H=HIGH

SYSTEM: PHENIX Magnet Subsystem

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1 COMPONENT		2 HAZARD						3 PREVENTATIVE ACTION
				CLASS				
NO.	DESCRIPTION	MODE	EFFECT	1	2	3	P**	
4	Over pressure and rupture of water lines	Normal operation	Overheating of coil, flooding of detector hall		X		L	Use of interlocked instrumentation: multiple pressure relief valves; use of hoses/fittings which are rated much higher than normal operating pressure
5	High voltage in area by power supplies	Normal operation	Personnel could be electrically shocked and injured		X		L	Area to be secured and locked; grounding hooks supplied; proper safety training of personnel

*HAZARD CLASS: 1-MINOR, 2-MODERATE, 3-MAJOR

**P=PROBABILITY: L=LOW, M=MEDIUM; H=HIGH

PHENIX MM Coil - Facility Interfaces

- Hydraulic Interfaces:
  - Required flow rate: approx. 70 gpm total
  - Inlet pressure: 80 PSI
  - Outlet pressure: 20 PSI (ΔP=60 PSI)

- Electrical Interfaces:
  - Approx. 3000 amp current carrying capability
  - Requires 8 supply & 8 return 4/0 power cables from power supply to intermediate bus station in detector hall

- System Interlocks:
  - Coil temperature sensors
  - Water pressure sensors
  - Water flow switches
  - Computer monitoring and control

PHENIX MM Coil - Cost Summary

(coil costs include conductor and coil winding/epoxy impregnation only; water manifolds, support structure and hardware, and special handling/installation fixtures are in addition to these estimates)

	Muon Magnet Coil (estimates based on tapered coil design - vendors estimate a 10% cost savings for two cylindrical coils)
CDR 10/92	$157,000
KEK/TOKIN 1/93	$150,000+ (@ $1 = ¥125)
US Vendor #1 1/93	$108,000
US Vendor #2 2/93	$85,000

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PHENIX MM Coil - Power Supply Estimates

Muon Magnet Power Supply (1)
(450 kw - 125 volts @ 3600 Amps)

US Vendor #A 3/93	**$46,000** **(24 weeks ARO)**
US Vendor #B 4/93	**$70,000**

Power supply specifications were as follows:

Input Voltage	13.8 kv - 3 phase
Rectifier Configuration	12 phase
Output Voltage Ripple	5 volts (use output filter)
Long Term Reproducibility	0.1% (one year)
One Hour Stability	0.01%
One Minute Stability	0.001%
Control and Status Interface	Digital (Optional)
Trim Input Analog Range	1%
Input Tap Switch Settings	100%, 50% and 25%, (Optional)
Reversing Switch	Mechanical (Optional)

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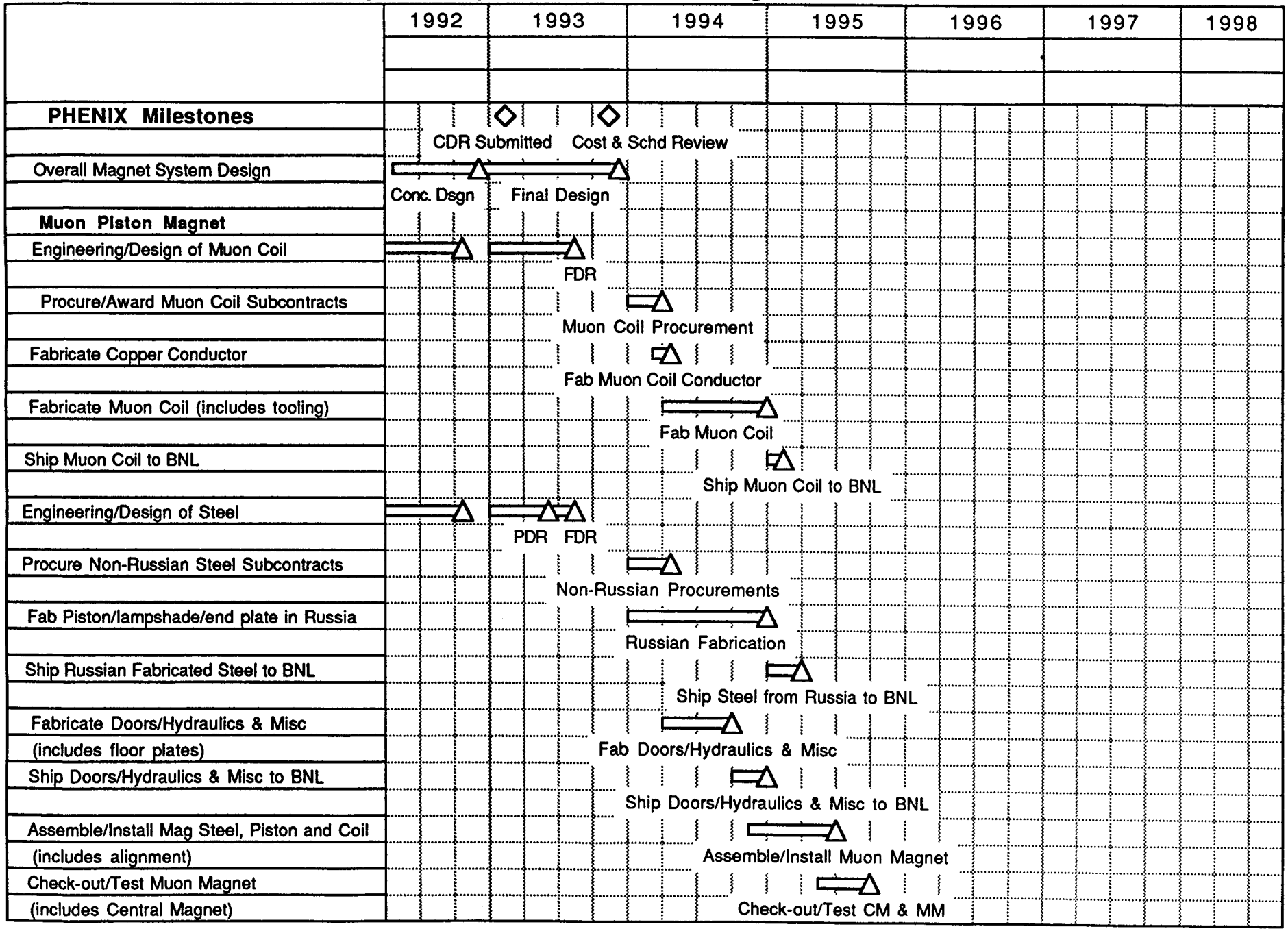
PHENIX Magnet Subsystem - Muon Piston Magnet Rev 'A'



Wednesday, July 28, 1993

PHENIX MM Coil - Schedule

- MM coil is NOT on the critical path

- MM coil procurement can start Jan '94
  - after Nov '93 cost and schedule review
  - fabrication drawings will be complete in Aug '93

- MM coil fabrication will take approx. 1 year
  - 3 months for procurement
  - 2-3 months for conductor fabrication
  - 9 months for coil fabrication

- MM coil to be shipped to BNL the 1st qtr. '95

- MM coil test/checkout 2nd & 3rd qtrs. '95

PHENIX MM Coil - Appendix

- Coil engineering analysis summary sheets (Art Harvey)

- Drawings (Winston Wong)

- AAA93-101857-00	Coil #2 Assembly	(4 sheets)
- AAA93-XXXXX-00	MM Coil Layout	(1 sheet)
- AAA93-101856-00	Coil Transition	(1 sheet)
- AAA93-101899-00	Bus Flag - Inner Lead	(2 sheets)
- AAA93-104152-00	Bus Flag - Outer Lead	(2 sheets)
- AAA93-104153-00	Coil Jumper	(1 sheet)
- AAA93-101897-00	Outlet Conductor Fitting	(1 sheet)
- AAA93-101898-00	Inlet Conductor Fitting	(1 sheet)
- AAA93-104150-00	Shorting Pad	(1 sheet)
- AAA93-104151-00	Shorting Block	(1 sheet)

- Tom Shea's configuration control drawings (2 sheets)

MUON PISTON COILS
CONFIRMING COMPUTATIONS
A. R. HARVEY JULY 4, 1993

INPUT

AMP_TURNS := 300000

WATER_IN_TEMP := 20 deg C

PRESSURE_DROP := 60 psi

MAX_WATER_OUT_TEMP := 80 deg C

$COND\_OD_{in} := 0.95$

$COND\_BORE_{in} := 0.610$

$LARGE\_COIL\_ID_{in} := 74.04$

$SMALL\_COIL\_ID_{in} := 63.93$

$INS\_COND_{in} := 1.01$

$INTERLAYER\_INS_{in} := 0.045$

$GROUND\_INS_{in} := 0.125$

AXIAL_COND_SPACES := 27

$COIL\_LENGTH_{in} := 27.56$

$END\_RING\_THK_{in} := 0.125$

NO_TURNS_PER_PATH := 12.75

PATHS_PER_COIL := 4

DIMENSIONAL COMPUTATIONS

$AX\_COND\_SPACE_{in} := AXIAL\_COND\_SPACES \cdot INS\_COND_{in}$

$AX\_COND\_SPACE_{in} = 27.27$

$COIL\_BUILD_{in} := 2 \cdot (INS\_COND_{in} + GROUND\_INS_{in}) + INTERLAYER\_INS_{in}$

$COIL\_BUILD_{in} = 2.315$

$LARGE\_COIL\_OD_{in} := LARGE\_COIL\_ID_{in} + 2\,COIL\_BUILD_{in}$ $LARGE\_COIL\_OD_{in} = 78.67$

$SMALL\_COIL\_OD_{in} := SMALL\_COIL\_ID_{in} + 2 \cdot COIL\_BUILD_{in}$ $SMALL\_COIL\_OD_{in} = 68.56$

$COND\_OD_{mm} := 25.4 \cdot COND\_OD_{in}$ $COND\_OD_{mm} = 24.13$

$COND\_BORE_{mm} := 25.4 \cdot COND\_BORE_{in}$ $COND\_BORE_{mm} = 15.494$

$MEAN\_DIA_0 := SMALL\_COIL\_ID_{in} + 2 \cdot GROUND\_INS_{in} + INS\_COND_{in}$ $MEAN\_DIA_0 = 65.19$

$MEAN\_DIA_1 := MEAN\_DIA_0 + 2 \cdot (INTERLAYER\_INS_{in} + INS\_COND_{in})$ $MEAN\_DIA_1 = 67.3$

$MEAN\_DIA_2 := LARGE\_COIL\_ID_{in} + 2 \cdot GROUND\_INS_{in} + INS\_COND_{in}$ $MEAN\_DIA_2 = 75.3$

$MEAN\_DIA_3 := MEAN\_DIA_2 + 2 \cdot (INTERLAYER\_INS_{in} + INS\_COND_{in})$ $MEAN\_DIA_3 = 77.41$

i := 0.. 3

$PATH\_LENGTH_i := \pi \cdot MEAN\_DIA_i \cdot NO\_TURNS\_PER\_PATH$

$$L_i := \frac{PATH\_LENGTH_i}{12}$$

$L_0 = 217.6$ $L_1 = 224.644$ $L_2 = 251.347$ $L_3 = 258.39$

MUON PISTON COILS
CONFIRMING COMPUTATIONS
A. R. HARVEY JULY 4, 1993

$SMALL\_COIL\_CON\_LGT_{ft} := 2 \cdot (L_0 + L_1)$ $SMALL\_COIL\_CON\_LGT_{ft} = 884$

$LARGE\_COIL\_CON\_LGT_{ft} := 2 \cdot (L_2 + L_3)$ $LARGE\_COIL\_CON\_LGT_{ft} = 1019$

$SMALL\_COIL\_CON\_LGT_{m} := 0.3048 \cdot SMALL\_COIL\_CON\_LGT_{ft}$ $SMALL\_COIL\_CON\_LGT_{m} = 270$

$LARGE\_COIL\_CON\_LGT_{m} := 0.3048 \cdot LARGE\_COIL\_CON\_LGT_{ft}$ $LARGE\_COIL\_CON\_LGT_{m} = 311$

$CON\_AREA_{in} := COND\_OD_{in}^2 - 0.25 \cdot \pi \cdot COND\_BORE_{in}^2$ $CON\_AREA_{in} = 0.61$

ELECTRICAL AND PHYSICAL COMPUTATIONS

$TOTAL\_TURNS := 8 \cdot NO\_TURNS\_PER\_PATH$ $TOTAL\_TURNS = 102$

$$AMPERES := \frac{AMP\_TURNS}{TOTAL\_TURNS}$$ $AMPERES = 2941$

$$RESIST\_20_i := \frac{8.15 \cdot 10^{-6} \cdot L_i}{CON\_AREA_{in}}$$

$$GPM_i := 68.5 \cdot \left(\frac{PRESSURE\_DROP}{L_i}\right)^{0.56} \cdot COND\_BORE_{in}^{2.67}$$

$$FT_i := \left(\frac{16.28}{AMPERES}\right)^2 \cdot \frac{GPM_i}{RESIST\_20_i}$$

$$WATER\_OUT\_TEMP_i := \frac{0.9214 + WATER\_IN\_TEMP \cdot (FT_i + 0.001965)}{FT_i - 0.001965}$$

$$AVE\_TEMP_i := 0.5 \cdot (WATER\_IN\_TEMP + WATER\_OUT\_TEMP_i)$$

$$OP\_RESIST_i := RESIST\_20_i \cdot [1 + 0.00393 \cdot (AVE\_TEMP_i - 20)]$$

$$SMALL\_COIL\_OP\_RESIST := 2 \cdot (OP\_RESIST_0 + OP\_RESIST_1)$$

$$LARGE\_COIL\_OP\_RESIST := 2 \cdot (OP\_RESIST_2 + OP\_RESIST_3)$$

$SMALL\_COIL\_VOLTS := AMPERES \cdot SMALL\_COIL\_OP\_RESIST$

$LARGE\_COIL\_VOLTS := AMPERES \cdot LARGE\_COIL\_OP\_RESIST$

$TOTAL\_VOLTS := SMALL\_COIL\_VOLTS + LARGE\_COIL\_VOLTS$

$POWER_{kw} := TOTAL\_VOLTS \cdot AMPERES \cdot 0.001$ $POWER_{kw} = 225$

$LPF_i := L_i$ $TAVE_i := AVE\_TEMP_i$ $TOUT_i := WATER\_OUT\_TEMP_i$

$SMALL\_COIL\_RT\_RESIST := 2 \cdot (RESIST\_20_0 + RESIST\_20_1)$

$LARGE\_COIL\_RT\_RESIST := 2 \cdot (RESIST\_20_2 + RESIST\_20_3)$

$SMALL\_COIL\_WT_{lb} := 3.88 \cdot CON\_AREA_{in} \cdot SMALL\_COIL\_CON\_LGT_{ft}$

$LARGE\_COIL\_WT_{lb} := 3.88 \cdot CON\_AREA_{in} \cdot LARGE\_COIL\_CON\_LGT_{ft}$

MUON PISTON COILS
CONFIRMING COMPUTATIONS
A. R. HARVEY JULY 4, 1993

COIL	LAYER	LPF_i	GPM_i	$TAVE_i$	$TOUT_i$	
		ft				
SMALL	1	218	8.9	25.4	30.9	$2\cdot(GPM_0 + GPM_1) = 35.3$
	2	225	8.74	25.7	31.5	
LARGE	1	251	8.21	26.9	33.7	$2\cdot(GPM_2 + GPM_3) = 32.6$
	2	258	8.08	27.2	34.3	

SMALL_COIL_OP_RESIST = 0.012072 **Ohm**

LARGE_COIL_OP_RESIST = 0.01399 **Ohm**

SMALL_COIL_VOLTS = 35.5

LARGE_COIL_VOLTS = 41.1

SMALL_COIL_RT_RESIST = 0.011812

LARGE_COIL_RT_RESIST = 0.013615

$POWER_{kw} = 225.5$

$SMALL\_COIL\_CON\_LGT_{ft} = 884$ $\quad SMALL\_COIL\_CON\_LGT_m := 0.3048 \cdot SMALL\_COIL\_CON\_LGT_{ft}$

$LARGE\_COIL\_CON\_LGT_{ft} = 1019$ $\quad LARGE\_COIL\_CON\_LGT_m := 0.3048 \cdot LARGE\_COIL\_CON\_LGT_{ft}$

$SMALL\_COIL\_WT_{lb} = 2094$ $\quad SMALL\_COIL\_WT_{kg} := 0.454 \cdot SMALL\_COIL\_WT_{lb}$

$LARGE\_COIL\_WT_{lb} = 2414$ $\quad LARGE\_COIL\_WT_{kg} := 0.454 \cdot LARGE\_COIL\_WT_{lb}$

$SMALL\_COIL\_WT_{kg} = 951$ $\quad SMALL\_COIL\_CON\_LGT_m = 270$

$LARGE\_COIL\_WT_{kg} = 1096$ $\quad LARGE\_COIL\_CON\_LGT_m = 311$

$TOTAL\_GPM := 2 \cdot \sum_i GPM_i$ $\quad TOTAL\_GPM = 67.8$

FABRICATION NOTES - (ø2) LARGE PISTON COIL ASSEMBLY

(IN SEQUENCE AS APPLICABLE)

7. EACH COIL SHALL CONSIST OF TWO CONDUCTORS, SPIRAL WOUND, IN A CYLINDRICAL, DOUBLE LEAD, TWO-LAYER FASHION TO PROVIDE FOUR 12.9 TURN PARALLEL WAVE COOLANT PATHS CONNECTED ELECTRICALLY IN SERIES FOR A TOTAL OF 24 TURNS PER COIL ASSEMBLY.

   THE COIL WINDING MANDREL SHALL BE AN INTEGRAL PART OF THE POTTING MOLD UNLESS OTHERWISE APPROVED BY LLNL.

   THE MANUFACTURER SHALL INSURE THAT THE WINDING MANDREL IS SUITABLE FOR THE WINDING OPERATION AND CAPABLE OF BEING VACUUM SEALED PRIOR TO POTTING. IT SHALL BE CONSTRUCTED TO FACILITATE EASY REMOVAL AFTER THE POTTING OF THE COIL TO ITS FINISHED SIZE.

   A POSITIVE TOLERANCE HAS BEEN PROVIDED (DIMENSIONALLY) TO ALLOW FOR CONDUCTOR AND INSULATION TOLERANCES, CONDUCTOR TWISTS AND MISALIGNMENTS DURING THE WINDING OPERATION. APPROVAL SPACE HAS ALSO BEEN ALLOTTED TO RELOCATE TRANSITIONS (ITEM 9) AND LEADS TO PASS SUBSEQUENT INTERFERING WINDINGS IN THE OUTER LAYER. THE WINDINGS ARE TO BE DISTRIBUTED ALONG THE ALLOTTED SPACE, SHOULD TOLERANCES BE NEGATIVE OR NOT NECESSARY.

8. INTERLAYER SPACERS AND END SURFACE PROTECTION SHEETS (ITEMS 9 AND 10) SHALL BE RANDOMLY PUNCHED WITH 0.5 IN. DIA. HOLES ON APPROXIMATELY 2 IN. CENTERS TO PERMIT RESIN FLOW THROUGH DURING IMPREGNATION. SURFACES SHALL BE LIGHTLY SANDBLASTED OR OTHERWISE ABRADED TO ENHANCE BONDING. SPACERS AND SHEETS MAY BE SEGMENTED, BUTTED AND TAPED TOGETHER.

9. CLEAN ALL EXPOSED CONDUCTOR SURFACES AND BRAZE JOINTS OF DIRT, GREASE, OIL, CHIPS, EXCESS BRAZE, ETC. PRIOR TO TAPING AND SLEEVING.

10. THE CONDUCTOR SHALL BE INSULATED BY A LAYER OF 29-49 % OVERLAPPED MYLAR TAPE (ITEM 2) , FOLLOWED BY THE APPLICATION OF A SLEEVE (ITEM 9) . SLEEVE ENDS MAY BE SECURED BY ADHESIVE TAPE OR OTHER MEANS TO PREVENT SLIPPING. SLEEVE JOINTS MAY BE SEWN OR OTHERWISE SECURED TO PREVENT SLEEVE JOINT PARTING. USE A SIMILAR METHOD TO INSULATE COIL TRANSITIONS (ITEM 9) . IN THE TRANSITION AREA CUSTOM INSULATE TO PROVIDE AN LLNL APPROVED EQUIVALENT PROTECTION. FILL ALL VOID AREAS LARGER THAN .125 INCH WIDE WITH SHAPED FIBROUS GLASS MATERIALS (ITEM 11) AS NEEDED.

11. FILL LARGE VOID VOLUMES IN LEAD AREA WITH CONTOURED EPOXY-FIBERGLASS BLOCKS (ITEM 15) FOLLOWED BY GROUND WRAP (ITEM 4) OVERWRAP.

12. CONDUCTOR JOINTS SHALL BE MADE IN ACCORDANCE WITH LLNL ENGINEERING NOTE TP29-22-MTC AND CONDUCTOR SPLICE DETAIL (SHEET 4) OR AN LLNL APPROVED EQUAL PROCEDURE.

13. PLACEMENT OF BUS FLAGS (ITEM 18 & ITEM 19) SHALL BE DONE WITH ADEQUATE FIXTURING TO CONFORM WITH POSITIONING TOLERANCES SPECIFIED IN DRAWING. BUS FLAGS WILL SUBSEQUENTLY BE SECURED TO, BUT ELECTRICALLY ISOLATED FROM THE VACUUM IMPREGNATION MOLD TO INSURE THAT THESE TOLERANCES ARE MAINTAINED.

14. APPROXIMATE COIL CONDUCTOR LENGTH IS 1019 FEET (309 METERS) .

15. LLNL SHALL PROVIDE COIL TEST REPORT FORMS TO DOCUMENT TESTING PERFORMED IN NOTE 16. SEE LLNL COIL SPECIFICATION = _____

16. EACH HYDRAULIC CIRCUIT (TWO PER LARGE END COIL ASSEMBLY) SHALL BE TESTED WITH ALL FITTINGS BOTH BEFORE AND AFTER POTTING. ONE 'COIL TEST REPORT' SHALL BE GENERATED FOR EACH SERIALIZED ASSEMBLY. THE FOLLOWING PROCEDURES SHALL CONSTITUTE ONE COMPLETE TEST ON EACH CIRCUIT :

   A) A DRY NITROGEN PURGE MAY BE USED TO EVAPORATE ANY RESIDUAL MOISTURE WITHIN THE COIL. VACUUM TEST PER ASTM E490-73 WITH A MAXIMUM ALLOWABLE LEAK RATE OF 1 X 10**-8 ATM-CC/ SECOND OF HELIUM AT 10**-3 TORR WITH ALL INTAKE VOLUME CONNECTED TO A RESIDUAL GAS ANALYZER (RGA) OR A HELIUM MASS SPECTROMETER LEAK DETECTOR. COVER (BAG) THE ENTIRE COIL ASSEMBLY, INCLUDING LEAD FITTINGS IN A HELIUM FILLED ENCLOSURE PRIOR TO THE LEAK TEST. RECORD RESULTS IN 'COIL TEST REPORT'.

   B) PRESSURE TEST WITH WATER IN ACCORDANCE WITH ASME BOILER AND PRESSURE VESSEL CODE SECTION VIII USING THE TEST PRESSURE DEFINED IN NOTE 31. RECORD RESULTS IN 'COIL TEST REPORT'.

   C) WATER FLOW TEST WITH AN INLET PRESSURE OF 80± 5 PSIG. EXIT FLOW RATE SHALL BE AT LEAST 8.0 US GALLONS PER MINUTE (GPM) . RECORD THE RESULTS IN 'COIL TEST REPORT'.

17. PRIOR TO "ELECTRICALLY" CONNECTING BOTH CONDUCTOR CIRCUITS CONDUCTORS 'A' AND 'B', PERFORM THE FOLLOWING TEST:

   - MEASURE THE COIL RESISTANCE FOR BOTH SEPARATE CIRCUITS AT ROOM TEMPERATURE. RECORD DATA IN "COIL TEST REPORT".

18. "ELECTRICALLY" CONNECT BOTH CONDUCTOR CIRCUITS TOGETHER USING THE 'SHORTING BAR AND PADS' (ITEMS 20 AND 21) . ENCLOSE COIL IN THE MOLD. ENSURE THAT EXPOSED BUS FLAGS, SCREWS AND LEADS ARE 'ELECTRICALLY' ISOLATED FROM THE MOLD. PERFORM THE FOLLOWING TEST:

   - MEASURE THE COIL RESISTANCE OF THE CONNECTED COIL AT ROOM TEMPERATURE. RECORD DATA IN "COIL TEST REPORT".

(CONT'D)

19. PRIOR TO IMPREGNATION, HI-POT COIL ASSEMBLY TO GROUND (IMPREGNATION MOLD) AT 1900 VOLTS. LEAKAGE NOT TO EXCEED 9 MICRO AMPS. MEASURE AND RECORD THE RESISTANCE AND INDUCTANCE OF THE COIL (AT ROOM TEMPERATURE) IN "COIL TEST REPORT".

20. VACUUM IMPREGNATION MOLD SHALL BE OF SUFFICIENT RIGIDITY AND MANUFACTURING TOLERANCES TO MAINTAIN THE COIL DIMENSIONS SPECIFIED. MOLD SHALL BE VACUUM TIGHT UNLESS THE ENTIRE MOLD WILL BE ENCLOSED IN A VACUUM CHAMBER, IN WHICH CASE THE MOLD SHALL BE LIQUID TIGHT.

21. SURFACE COAT ALL AREAS OF VACUUM IMPREGNATION MOLD AND EXPOSED BUS FLAG FACES WITH SUITABLE MOLD RELEASE. COAT THREADED HOLES AND BOLTS WITH SILICONE OR TEFLON GREASE AND PLUG BUS FLAG CLEARANCE AND THREADED HOLES.

22. AFTER SEALING, HEAT AND EVACUATE MOLD FOR 12 HOURS MINIMUM PRIOR TO VACUUM IMPREGNATION TO FULLY DEGAS MOLD OF MOISTURE AND AIR FROM THE PORES OF THE FIBROUS MATERIAL (TAPE, SLEEVE, ETC.) . ENSURE THAT SUFFICIENT HEATING IS PRESENT TO FULLY CURE THE RESIN AFTER IMPREGNATION. IF HOT WATER IS USED THROUGH THE CONDUCTOR BORE, AUXILIARY HEATING MAY BE REQUIRED IN AREAS REMOTE FROM THE CONDUCTOR (SUCH AS IN THE TERMINAL AREA) .

23. VACUUM IMPREGNATE COIL ASSEMBLY PER LLC/LLNL MECHANICAL ENGINEERING SPECIFICATION MOLD.

24. AFTER COOL DOWN AND PRIOR TO REMOLDING, HI-POT COIL ASSEMBLY TO GROUND (IMPREGNATION MOLD) AT 3000 VOLTS. CURRENT LEAKAGE NOT TO EXCEED 2 MICRO AMPS. MEASURE AND RECORD THE RESISTANCE OF THE COIL AT ROOM TEMPERATURE IN 'COIL TEST REPORT'.

25. AFTER REMOLDING, REMOVE FLASHING AND SHARP EDGES OF COIL ASSEMBLY. CLEAN BUS FLAG FACES OF MOLD RELEASE AND SILVER PLATE USING A "BRUSH-ON" CHEMICAL SILVER PLATE, SUCH AS 'COOL-AMP' ® OR LLNL APPROVED EQUAL. REMOVE PLUGS AND GREASE FROM THREADED AND BOLT ACCESS HOLES. DO NOT PEEL OR BREACH WRAP ON ANY EXTERIOR SURFACE OR EDGE. CHASE AND CLEAN ALL EXCESS PLATING FROM THREADED HOLES.

26. AFTER REMOLDING, PERFORM THE FOLLOWING ELECTRICAL TESTS:
   A. IMPULSE TEST COIL TO 30000 VOLTS PEAK.
   B. MEASURE COIL RESISTANCE AND TEMPERATURE.
   C. MEASURE COIL INDUCTANCE.
   RECORD DATA IN 'COIL TEST REPORT'.

27. INSTALL THERMOSTATS (ITEM 12) WHERE SHOWN. AFTER EPOXY IMPREGNATION HAS BEEN COMPLETED.

28. AFFIX A PERMANENT LABEL ON THE OUTER EDGE OF THE FINISHED LARGE END MUON COIL ASSEMBLY. USE ANY SUITABLE PERMANENT ADHESIVE TO BE APPROVED BY LLNL. IMPRINTED IN 9 / 8" HIGH CHARACTERS WITH THE FOLLOWING DATA AS SHOWN : (LABEL SIZE = 24"+L0 X 2"H X .020"THK. MAX)

PRESSURE TEST FOR MANNED AREA	TEST PRESSURE : 150 PSIG
LLNL DWG. AAA93-101857 LARGE MUON #2	TEST DATE : (MO./DAY/YR)
COIL SERIAL NO. : (PER MANUFACTURER)	INSP'D BY : (INSPECTORS' NAME)

DO NOT BREACH FINISHED POTTED ASSEMBLY WITH ANY EXTERNAL FASTENER.

ALSO MARK ON THE SIDE OF THE LEAD AREA NEAR LABEL, "COIL WEIGHT = 2400 LBS. (1088 KG)" IN 1.5" HIGH LETTERS USING A PERMANENT INDELIBLE INK. FINAL PROTECTIVE CLEAR COAT OVER INK IS ALLOWABLE.

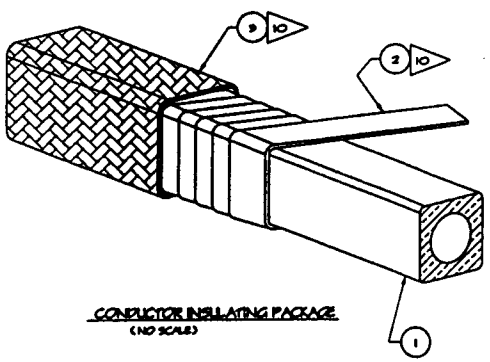
29. FLUSH ALL COIL PASSAGES OF LOOSE DIRT AND FOREIGN PARTICLES WITH ISOP WATER. BLOW PASSAGES DRY FOR APPROXIMATELY 9 MINUTES WITH LOW PRESSURE DRY NITROGEN. SUFFICIENTLY CAP COIL ENDS FOR TRANSPORTATION. HANDLE FINISHED COIL ASSEMBLY WITH EXTREME CARE. PACKAGE AND CRATE COIL TO PROTECT SURFACES AND LEADS FROM EXTERNAL DAMAGE DURING SHIPPING. SEE LLNL COIL SPECIFICATION = _____

30. APPROXIMATE FINISHED ASSEMBLY WEIGHT = 2400 LBS. (1.088 MTONS)

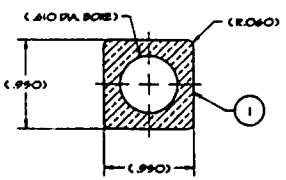
31. THE COIL ASSEMBLY 'MAXIMUM OPERATING PRESSURE' (MOP) SHALL BE 80 PSIG. RELIEF VALVE SETTING DURING NORMAL OPERATION, OR 'MAXIMUM ALLOWABLE WORKING PRESSURE' (MAWP) SHALL BE 100 PSIG. TEST PRESSURE SHALL BE 150 PSIG.

32. THE FOLLOWING DOCUMENTATION SHALL BE DELIVERED WITH THE FINISHED COIL ASSEMBLY.
   A) ALL 'COIL TEST REPORTS'
   B) DIMENSIONAL INSPECTION REPORTS
   C) MATERIAL CERTIFICATIONS FOR ALL COIL, FITTINGS, AND BRAZE FILLER METALS.

33. NO MACHINING ON ANY PORTION OF THE COIL IS PERMISSIBLE AFTER VACUUM IMPREGNATION.



CONDUCTOR INSULATING PACKAGE
(NO SCALE)



CONDUCTOR CROSS-SECTION
(2X SIZE)

UNLESS OTHERWISE SPECIFIED:

1. ALL DIMENSIONS ARE IN INCHES.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
3. SURFACE TEXTURE PER ANSI B46.1-1978.
4. LLNL / AutoCAD® Release 12 USER FILENAME: 3XC0591.DWG
5. WELD SYMBOLS ARE PER ANSI/ AWS A2.4-79.
6. USE EXTREME CARE DURING HANDLING OF FINISHED COIL. CRATE FOR SHIPPING. SEE LLNL SPEC. ø _____

ITEM	SPEC NO	DESCRIPTION / MATERIAL	PART / LLNL SEE NO	NO REQD
27		O-RING, PARKER SERIES ø2-219, 1-9/16" OD X 1/8"W (VITON)		4
26		O-RING, PARKER SERIES ø2-116, 1" OD X 3/32"W (VITON)		4
25		SHORTING BLOCK	93-104191	1
24		SHORTING PAD	93-104190	2
23		WASHER, PLAIN, 3/8" SIZE (CRES)	9310-21666	8
22		SCREW, SOC. HD. CAP, .375-24UNF X 1.75"L (CRES)	9309-41160	8
21		BUS FLAG - OUTER LEAD		
20		BUS FLAG - INNER LEAD		
19		BUS FLAG - OUTER LEAD		
18		BUS FLAG - INNER LEAD		
17		TUBE, .750 O.D. X .062"W (CPHC)		AR
16		THERMOSTAT, NC, 190ºF±6ºF, 'KLIXON' (bm)		3
15		F/N 4344-19 (TEXAS INTRUMENTS)		
14		EPOXY-FIBERGLASS SHEET, VARIOUS SIZES, NEMA GRADE	(FR-4/G40)	AR
13		EPOXY-FIBERGLASS SHEET, .060" THICK, NEMA GRADE	(FR-4/G40)	AR
12		EPOXY-FIBERGLASS SHEET, .019" THICK, NEMA GRADE	(FR-4/G40)	AR
11		INLET CONDUCTOR FITTING	93-101898	2
10		OUTLET CONDUCTOR FITTING	93-101897	2
9		THERMOSTAT MOUNT	93-101878	2
8		COIL TRANSITION	93-101896	2
7		TAPE, BACKING CLOTH, 4" WIDE X .012" THK.		AR
6		SLEEVE, BACKING, WOVEN TUBE, 1.25" O.D. X .015"W		AR
5	SCOTCH TYPE 27	MYLAR TAPE, .75"W X .0059"THK., ADH. BACKED, 3M®		AR
4		CONDUCTOR, .990" X .990" X .410" BORE, APPROX.		AR
3		WEIGHT = 1908 LBS / CU. IN. (CDA 101 / 102 COPPER)		1

DWN	W. J. MOSS	7/99	
CHK	W. J. MOSS	7/99	
APVD	E. H. WAKAMOTO	7/99	
CLASSIFIED BY:			
TITLE		DATE	

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MECHANICAL ENGINEERING DEPT
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CLASSIFICATION

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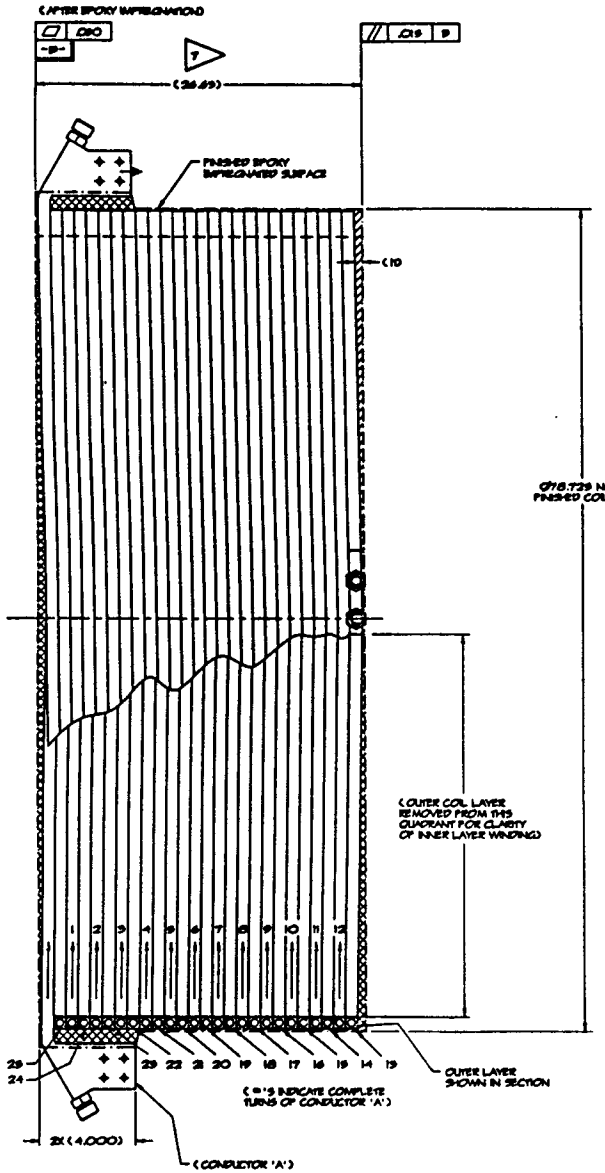
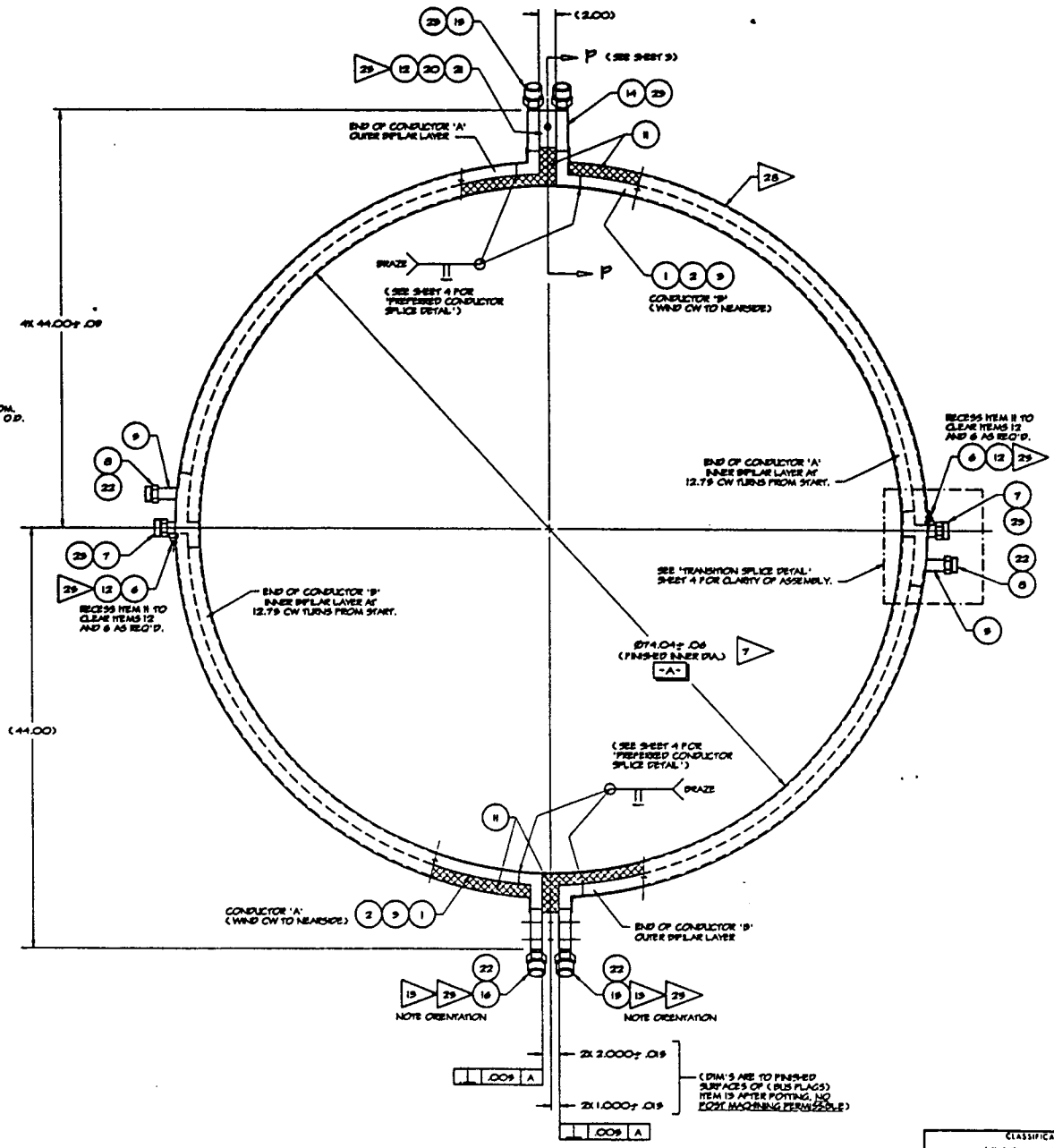
PHENIX	
LARGE MUON PISTON COIL	
COIL ø2 ASSEMBLY	
DRAWING NO	AAA93-101857-00
SCALE N/A	SHEET 1 OF 4

LTR	DWN	CHK	APVD	DATE	JOB#	CHANGE

GENERAL NOTES (SEE SHEET 1)

1. U.N.L. / AutoCAD Release 12 FILENAME: 9103972.DWG

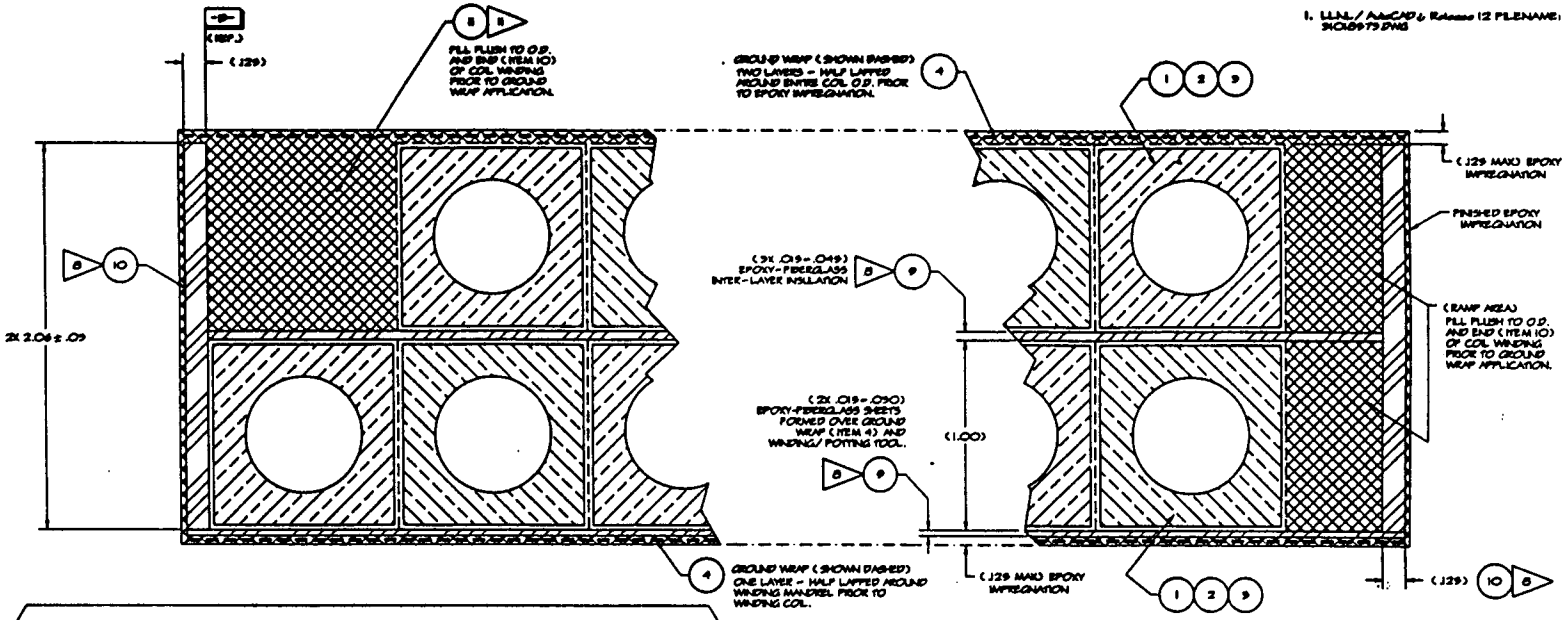




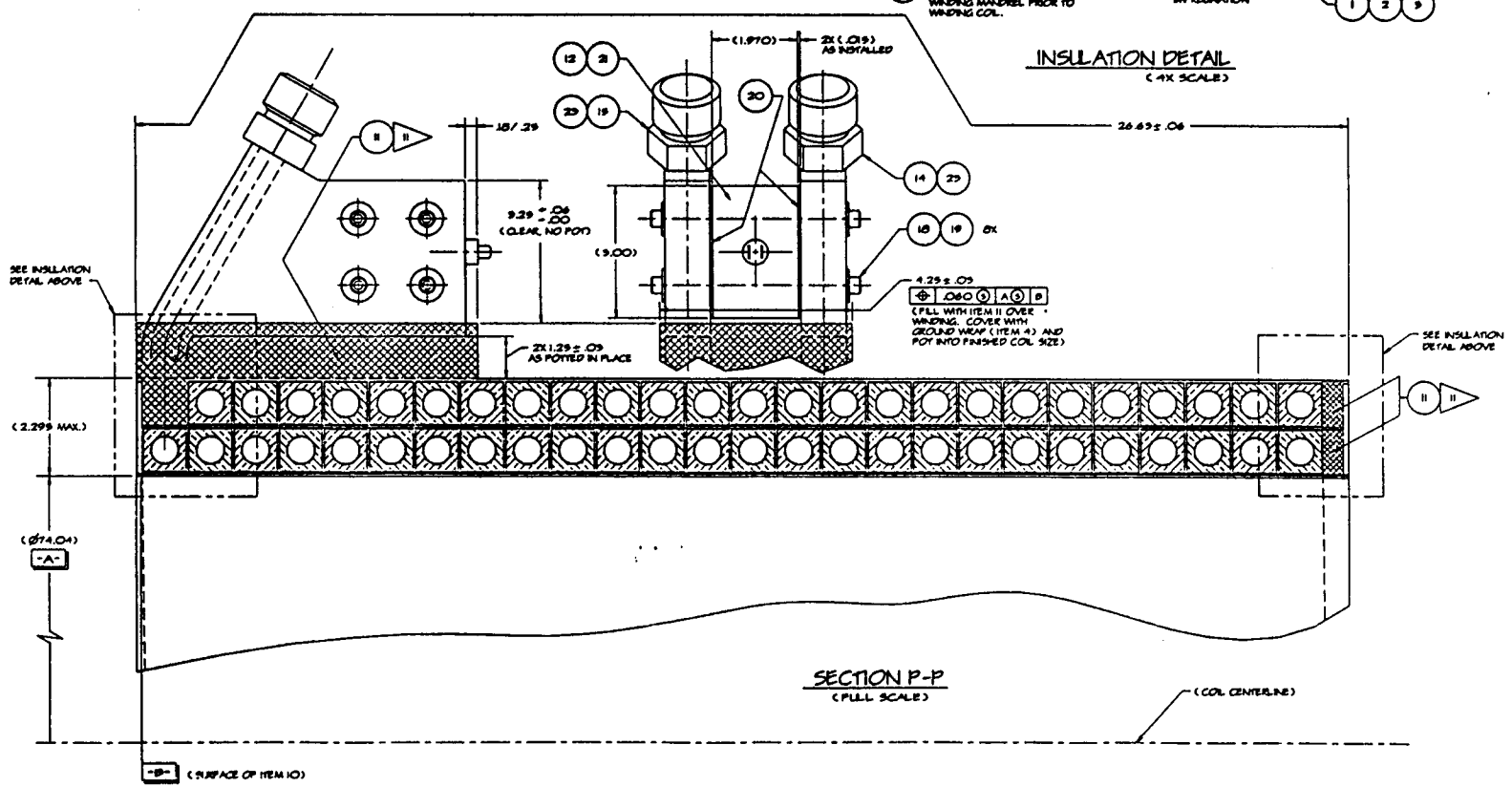
CLASSIFICATION	
UNCLASSIFIED	
DRAWING NO	COPY
AAA93-101857-00	
SCALE — N/A —	SHEET 8 OF —

GENERAL NOTES (SEE SHEET 1)

1. U.N.L. / AutoCAD 14 Release 12 FILENAME: SHOL6979.DWG



INSULATION DETAIL
(4X SCALE)

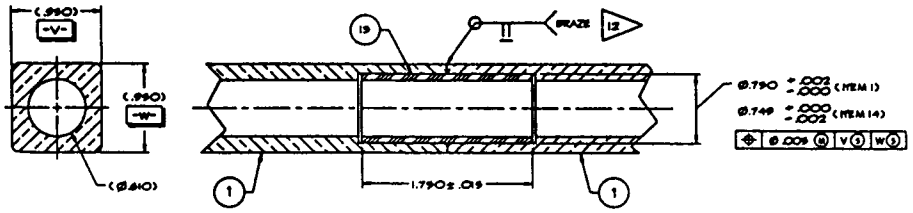


SECTION P-P
(FULL SCALE)

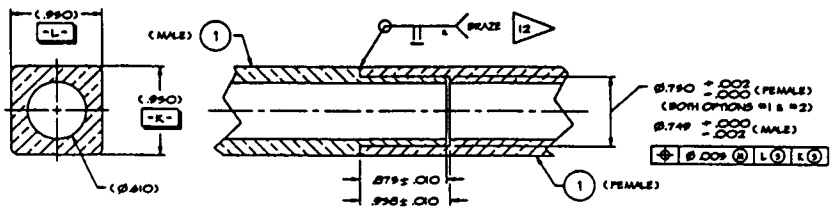
CLASSIFICATION	
UNCLASSIFIED	
DRAWING NO	COPY
AAA93-101857-00	
SCALE N/A	SHEET 9 OF 9

GENERAL NOTES (SEE SHEET 1)

1. LLNL / AutoCAD 12 RELEASE 12 FILENAME: 9103974.DWG

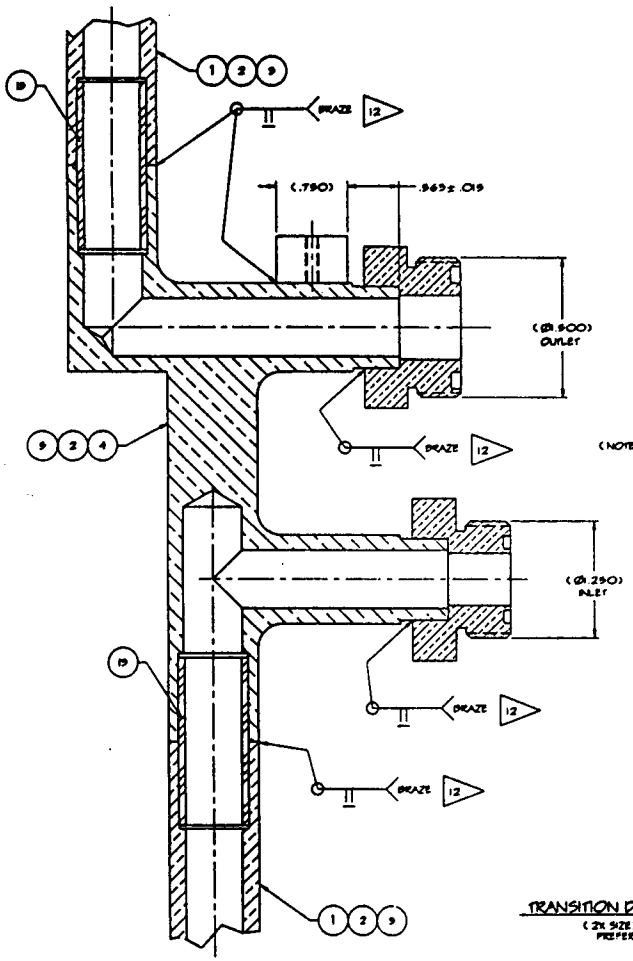


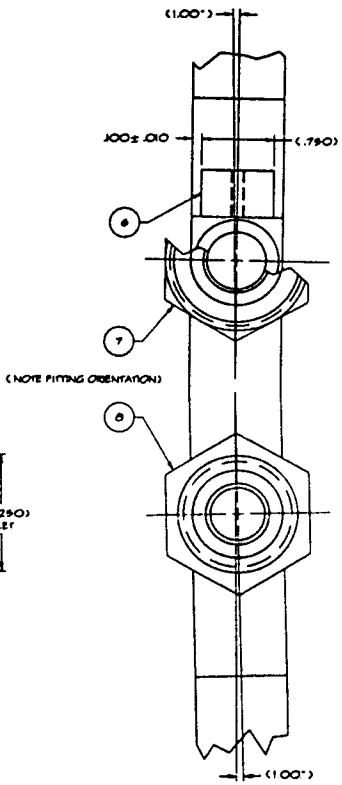
(OPTION #1: FERRULE SPLICE)
** PREFERRED **



(OPTION #2: MACHINED MALE/FEMALE)

CONDUCTOR SPLICE DETAIL (AS REQ'D)
(2X SIZE) - BEFORE INSULATING WRAP AND FORMING

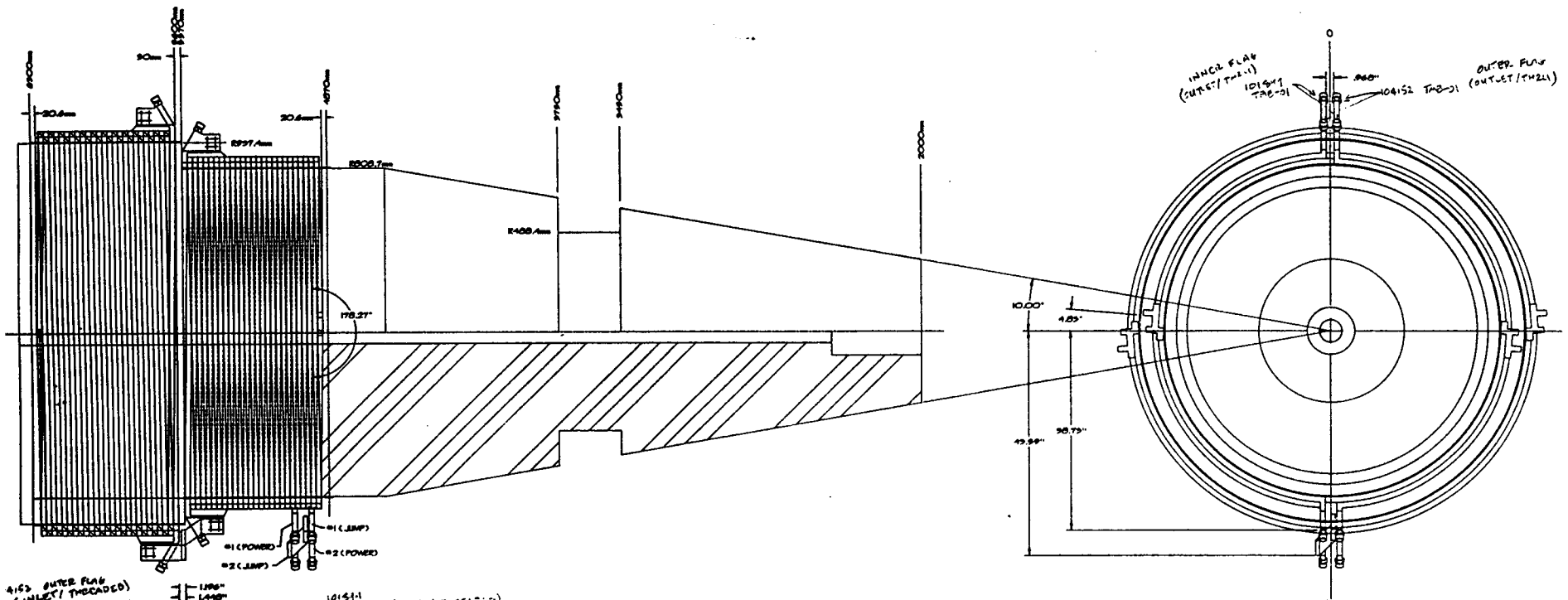


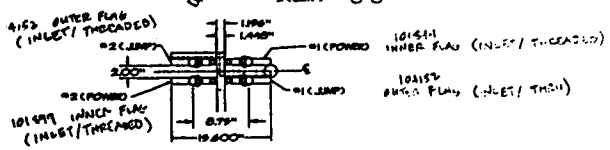


TRANSITION DETAIL (AS REQ'D)
(2X SIZE) - BEFORE TAPE AND WRAP
PREFERRED SPLICE DETAIL SHOWN

CLASSIFICATION	
UNCLASSIFIED	
DRAWING NO	COPY
AAA93-101857-00	
SCALE	SHEET 2 OF 2

	#2	#1	# REQ'D	
101999 -	INNER FLAG	(OUTLET/THRU) - (#1, #2)	1	- (TAB-01)
	" "	(INLET/THREADED) - #2	1	- (TAB-02)
	" "	(" ") #1		
104152 -	OUTER FLAG	(OUTLET/THRU) - (#1, #2)	1	- (TAB-01)
	" "	(INLET/THREADED) - #2	1	- (TAB-03)
	" "	(INLET/THRU) - #1	1	- (TAB-02)

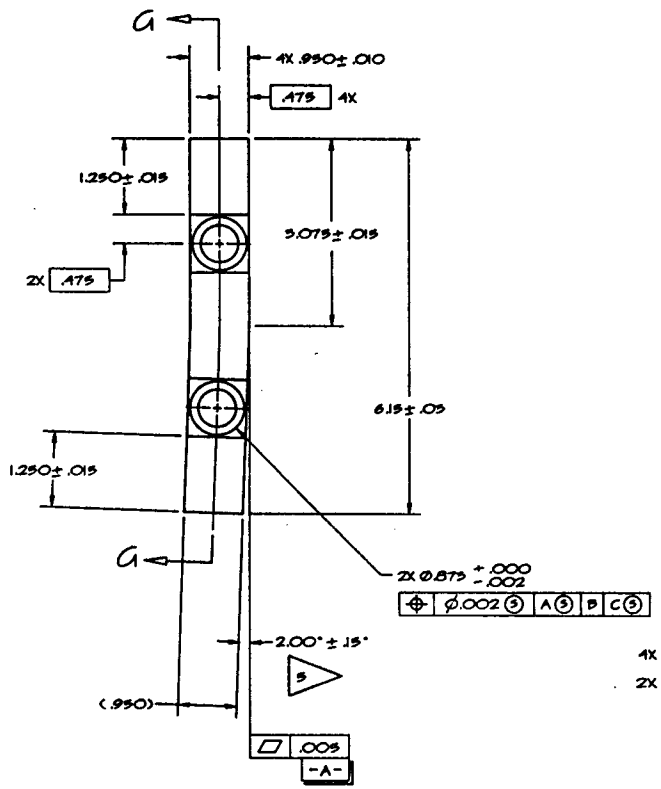


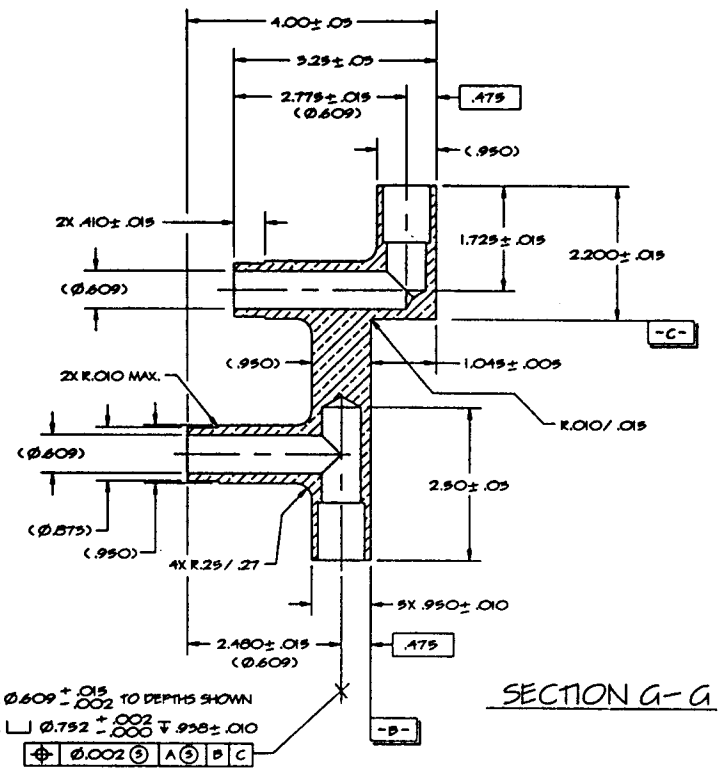


PHENIX
MUON LAYOUT
W² 7-20-93
7-26-93

NOTES
UNLESS OTHERWISE SPECIFIED:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
2. SURFACE TEXTURE PER ANSI B46.1-1978.
3. 63 √ FINISH ALL MACHINED SURFACES.
4. LLNL / AutoCAD® REL. 12 FILENAME: 3101856I.DWG
5. PART SHALL BE BENT TO ANGLE SHOWN.
6. BAG AND TAG WITH LLNL DWG.
7. REMOVE BURRS AND BREAK SHARP EDGES .009 / .010 IN. MAX.
8. FINISHED PART TO BE CLEAN AND FREE OF ALL GREASE, OIL, DIRT, ETC.





SECTION A-A

NO REQD	PART/LLNL STK NO	BAR OR PLATE, CDA 101/102 (COPPER)		
		DESCRIPTION/MATERIAL	SPEC NO	ITEM

DWN	W. J. WONG	4/95
CHK	W. J. WONG	4/95
APVD	R. M. YAMAMOTO	4/95
CLASSIFIED BY:		
TITLE		DATE

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MECHANICAL ENGINEERING DEPT
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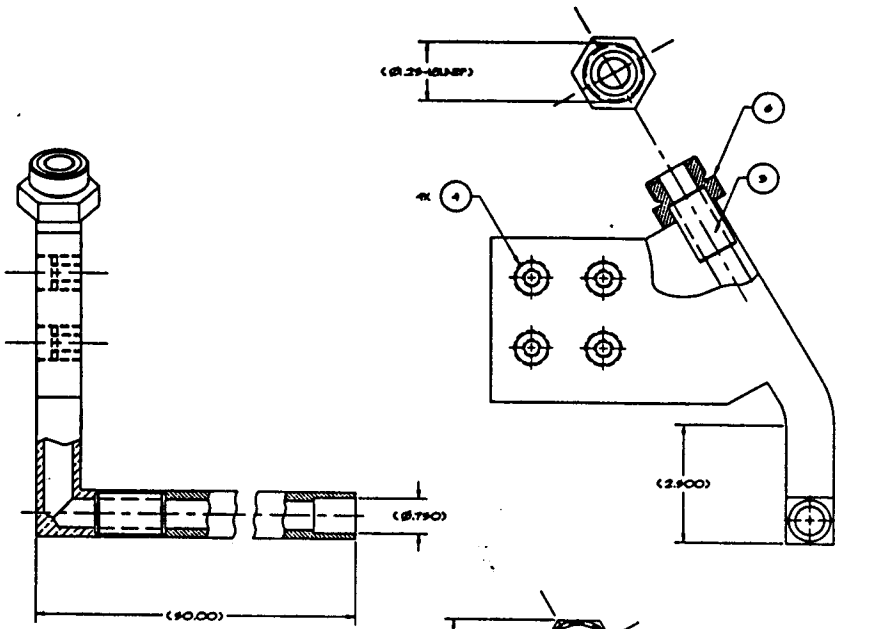
MAJOR UNIT: PHENIX
SUBASST: MUON PISTON COIL
DETAIL: COIL TRANSITION
SHOWN ON AAA: 93-101857
ACT 8865-25
DRAWING NO: AAA 93-101856-00
COPY
SCALE: 2.00" — SHEET 1 OF 1

LTR	DWN	CHK	DATE	ZONE	CHANGE

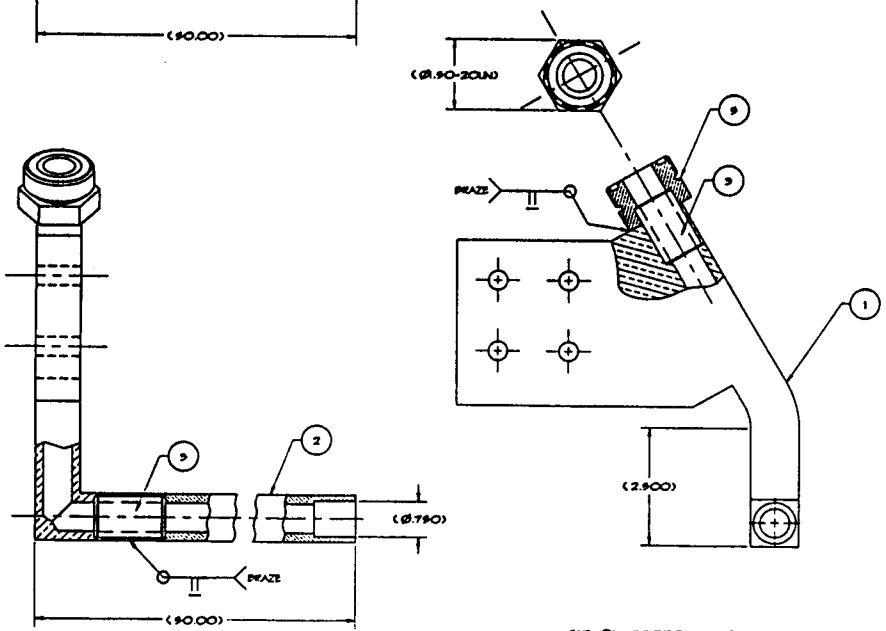
8 7 6 5 4 3 2 1

NOTES
UNLESS OTHERWISE SPECIFIED:

1. ALL DIMENSIONS ARE IN INCHES.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
3. SURFACE TEXTURE PER ANSI B46.1-1978.
4. U.I.S./AutoCAD® Release 12 USER FILENAME: 9IC10PP1.DWG
5. WELD SYMBOLS ARE PER ANSI/AWS A2.4-76.
6. USE CARE DURING HANDLING OF FINISHED PARTS DURING MACHINING AND BRAZING.
7. SEE SHEET 2 FOR PART DETAILS.



TAB-02 - INNER FLAG (INLET/ THREADED)



TAB-01 - INNER FLAG (OUTLET/ THRU)

TAB NO.	DESCRIPTION
TAB-01	INNER FLAG (OUTLET/ THRU)
TAB-02	INNER FLAG (INLET/ THREADED)

NO REQD	PART / ITEM STK NO	DESCRIPTION / MATERIAL	SPEC NO	ITEM
1	93-101898	INLET CONDUCTOR FITTING		6
1	93-101897	OUTLET CONDUCTOR FITTING		5
4		INSERT, FLOATING, .375-24UNF-3B, EXT THD .790-16UN		4
		P/N HELICOIL (.) 824J, TRIDAIR KEENSERTS (tm) (SS/L)		
2	2	BAR OR ROD, (CDA 101/ 102 COPPER)		3
1	1	CONDUCTOR, .950" X .950" X .610" BORE, APPROX.		2
		WEIGHT = .3908 LBS/ CU. IN. (CDA 101/ 102 COPPER)		
1	1	BAR OR PLATE, (CDA 101/ 102 COPPER)		1

DWN	W. J. MOHS	7/99	
CHK	W. J. MOHS	7/99	
APVD	E. M. YAMAMOTO	7/99	

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MECHANICAL ENGINEERING DEPT
UNIVERSITY OF CALIFORNIA

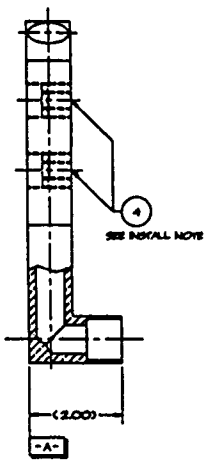
PHENIX

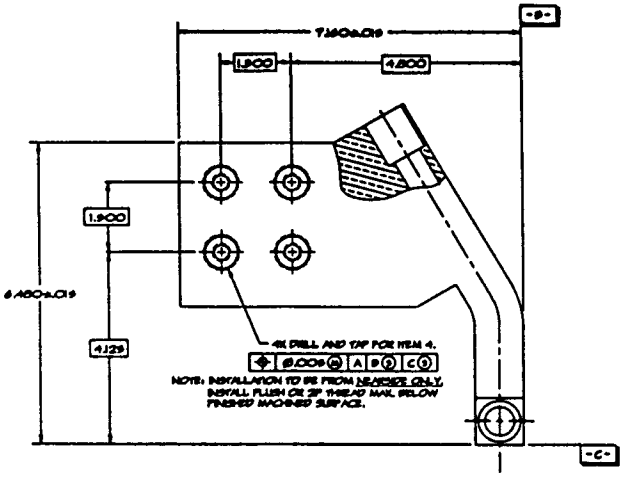
LARGE MUON PISTON COIL

BUS FLAG - INNER LEAD

DRAWING NO
AAA93-101899-00

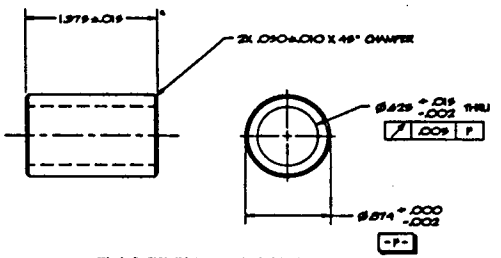
SCALE .200 | SHEET 1 OF 9



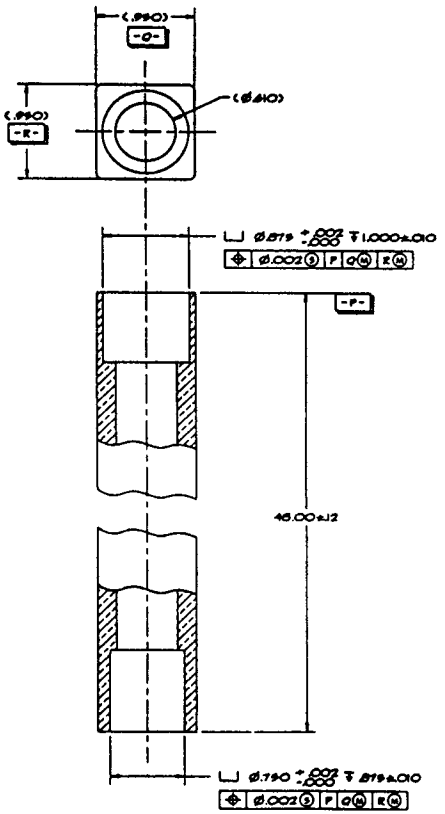


"THREADED" FLAG DETAIL - (TAB-02)
FULL SIZE

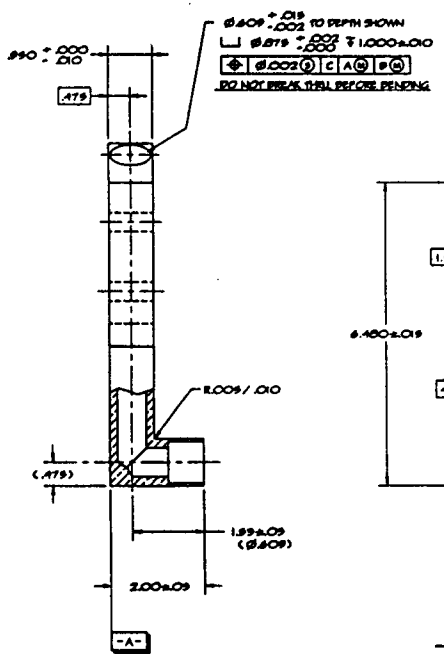
** NOTE: ALL DIMENSIONS APPLY TO PART FROM TAB-01.

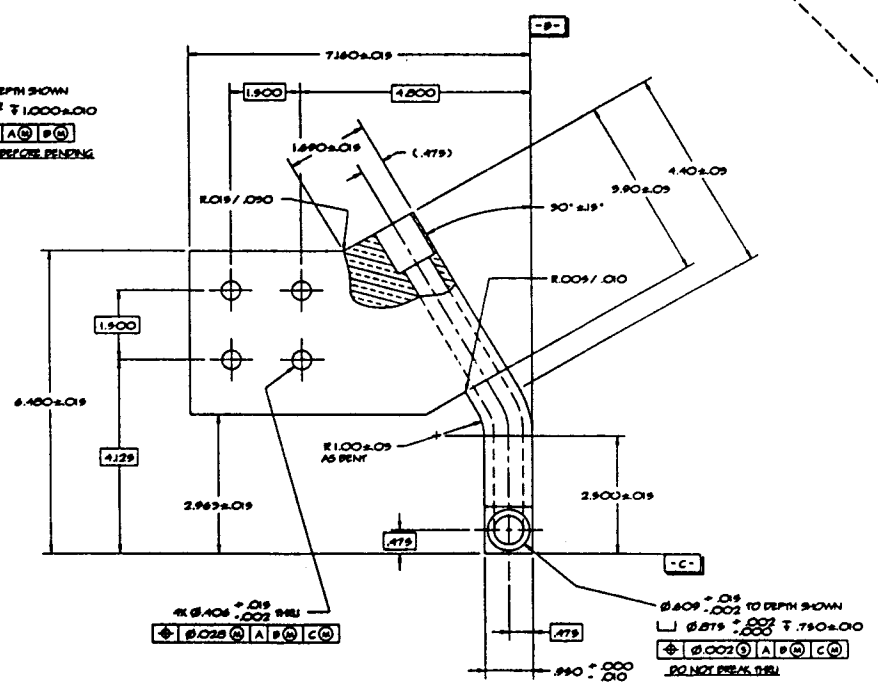


FLAG SPICE FERRULE (ITEM 3)
2X SIZE



CONDUCTOR EXTENSION (ITEM 2)
2X SIZE





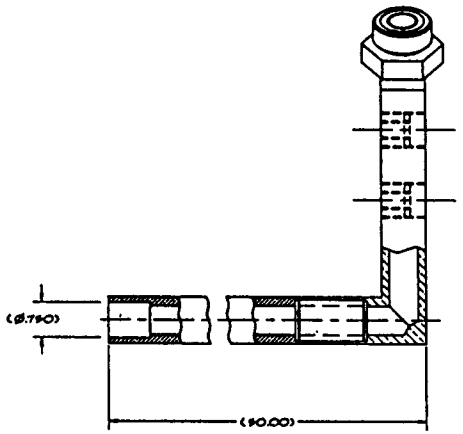
"THRU" FLAG DETAIL - (TAB-01)
FULL SIZE

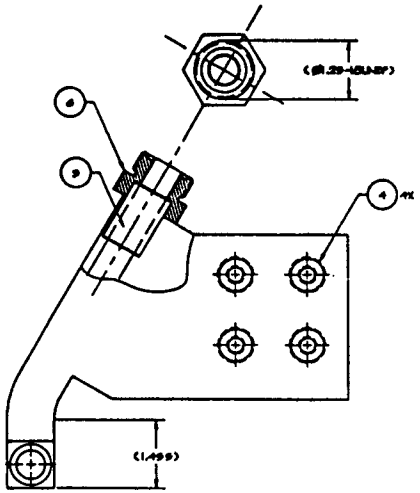
CLASSIFICATION
UNCLASSIFIED

DRAWING NO AAA93-101899-00
COPY
SCALE — SHEET 2 OF 2

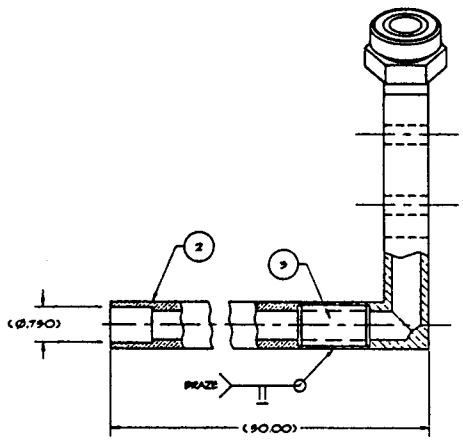
NOTES
UNLESS OTHERWISE SPECIFIED:

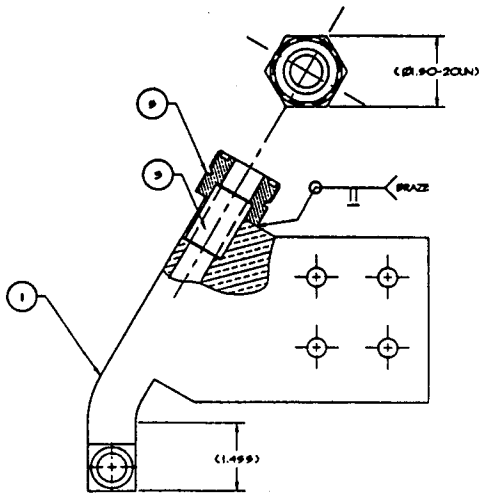
1. ALL DIMENSIONS ARE IN INCHES.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M–1982.
3. SURFACE TEXTURE PER ANSI B46.1–1978.
4. LLNL / AutoCAD® Release 12 USER FILENAME: 940493.DWG
5. WELD SYMBOLS ARE PER ANSI / AWS A2.4-76.
6. USE CARE DURING HANDLING OF FINISHED PARTS DURING MACHINING AND BRAZING.
7. SEE SHEET 2 FOR PART DETAILS.



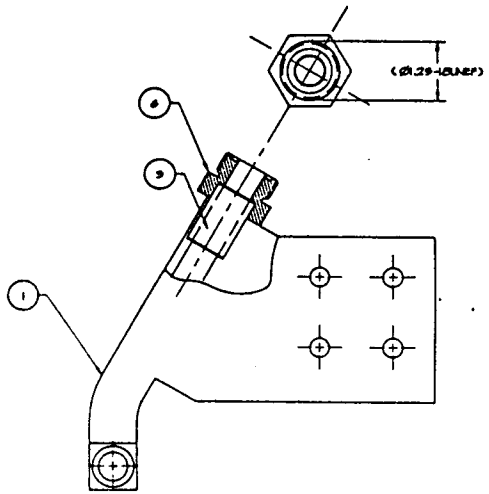


TAB-02 - OUTER FLAG (INLET/ THREADED)





TAB-01 - OUTER FLAG (OUTLET/ THRU)



TAB-02 - OUTER FLAG (INLET/ THRU)

TAB NO.	DESCRIPTION
TAB-01	OUTER FLAG (OUTLET/ THRU)
TAB-02	OUTER FLAG (INLET/ THRU)
TAB-03	OUTER FLAG (INLET/ THREADED)

NO REQD			PART / LLNL STK NO	DESCRIPTION / MATERIAL	SPEC NO
1	1		93-101698	INLET CONDUCTOR FITTING	
		1	93-101697	OUTLET CONDUCTOR FITTING	
4				INSERT, FLOATING, .375-24UNF-3B, EXT TH'D .790-16UN	
				P/N KNEE(L) 6241, TRIDAIR, KEENSERTS (tm) (SS(L))	
2	2	2		BAR OR ROD, (CDA 101/102 COPPER)	
1	1	1		CONDUCTOR, .990" X .990" X .810" BORE, APPROX.	
				WEIGHT = .3908 LBS/ CU. IN. (CDA 101/102 COPPER)	
1	1	1		BAR OR PLATE, (CDA 101/102 COPPER)	

TAB-03 TAB-02 TAB-01

DWN	W. J. WONG	7/99
CHK	W. J. WONG	7/99
APVD	E. M. YAMAMOTO	7/99
CHANGED BY		
TITLE		DATE

LAWRENCE LIVERMORE NATIONAL LABORATORY
MECHANICAL ENGINEERING DEPT
UNIVERSITY OF CALIFORNIA

CLASSIFICATION
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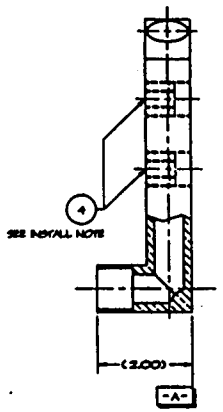
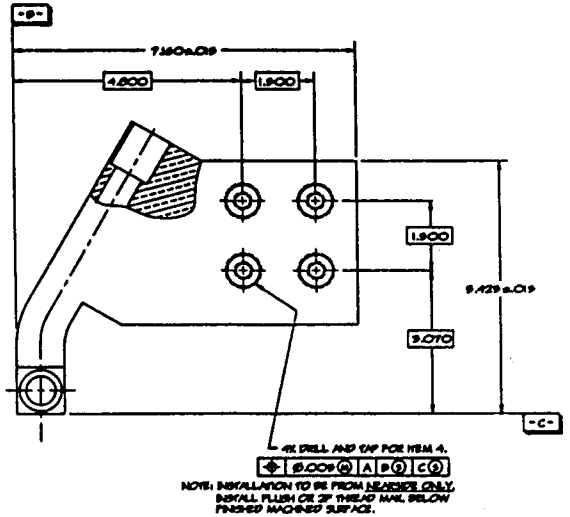
MAJOR UNIT: PHENIX
SUBASSY: LARGE MUON PISTON COIL
DETAIL: SUB FLAG - OUTER LEAD
DRAWING NO: AAA93-104152-00
SCALE: 2.000" | SHEET 1 OF 2

LTR	DRWN	CHK	APVD	DATE	ZONE	CHANGE

GENERAL NOTES (SEE SHEET 1)

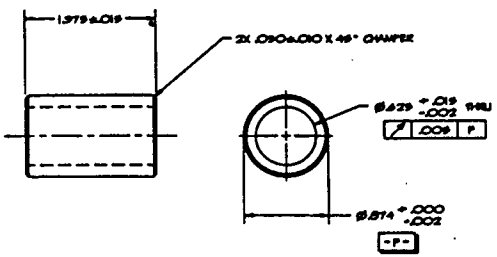
1. U.N.L. / AutoCAD® Release 12 FILENAME: 910-6922.DWG



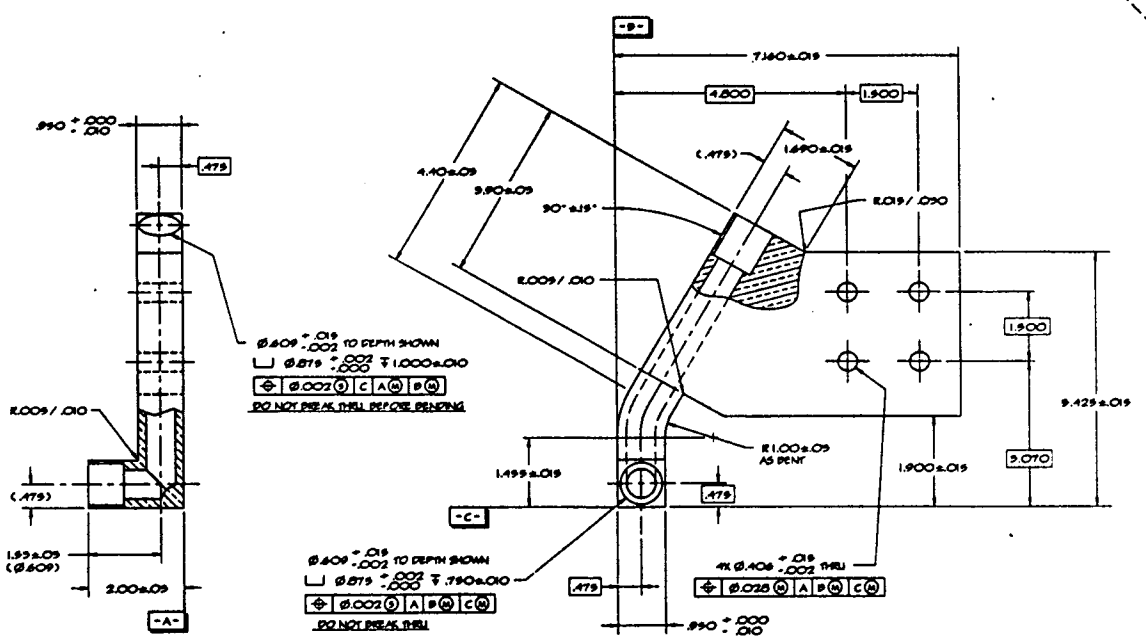


"THREADED" FLAG DETAIL - (TAB-02)
FULL SIZE

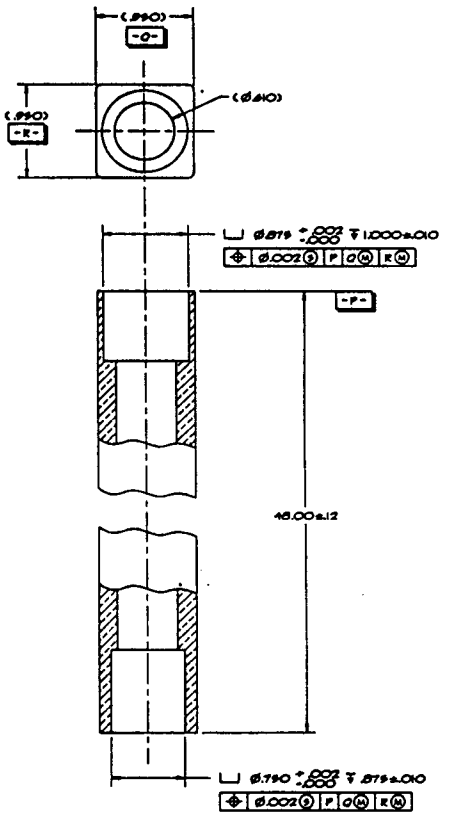
== NOTE: ALL DIMENSIONS APPLY TO PART FROM TAB-01.



FLAG SPICE FERRULE (ITEM 3)
2X SIZE



"THRU" FLAG DETAIL - (TAB-01/-02)
FULL SIZE

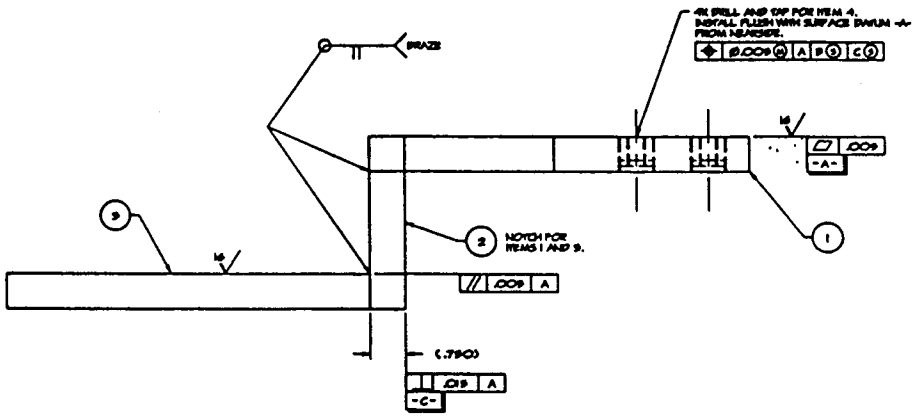


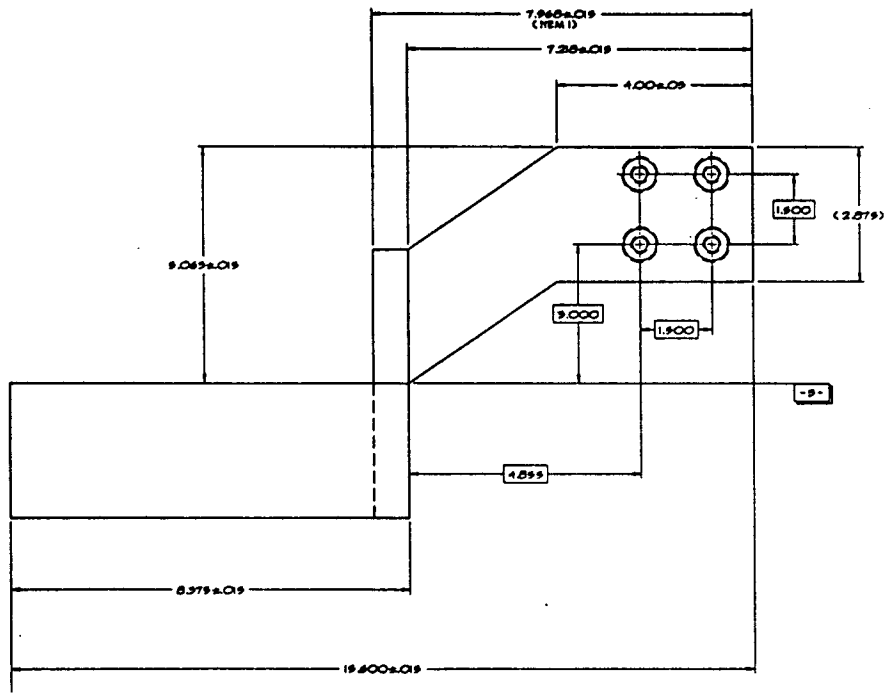
CONDUCTOR EXTENSION (ITEM 2)
2X SIZE

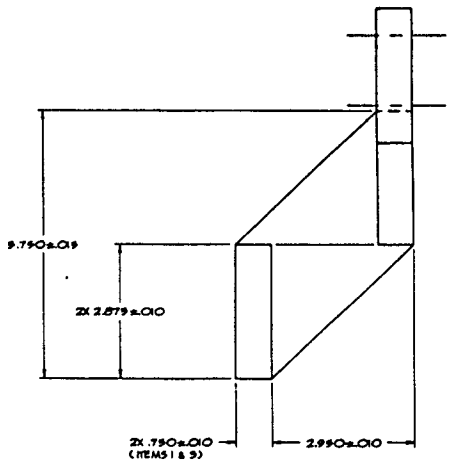
CLASSIFICATION	
UNCLASSIFIED	
DRAWING NO	COPY
AAA93-104152-00	
SCALE ——— 300% ———	SHEET 2 OF 2

NOTES
UNLESS OTHERWISE SPECIFIED:

1. ALL DIMENSIONS ARE IN INCHES.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M–1982.
3. SURFACE TEXTURE PER ANSI B46.1–1978.
4. 63 FINISH ALL MACHINED SURFACES.
5. REMOVE BURRS AND BREAK SHARP EDGES .006/.010.
6. BAG AND TAG FINISHED PART WITH LLNL DRAWING NUMBER.
7. APPROX. WEIGHT = 19.22 LBS.
8. LLNL / AutoCAD (tm) Release 12 USER FILENAME: 940193N.DWG







NO REQD	PART / ITEM SYS NO	DESCRIPTION / MATERIAL	SPEC NO
4		INSERT, FLOATING, .375-24UNF-3B, EXT THD .790-16LN	
		P/N KNEDC(L)624J, TRIDAIR KEENSERTS (tm) (99%L)	
1		BAR OR PLATE CDA 101 / 102K COPPER)	
1		BAR OR PLATE, .750" THICK CDA 101 / 102K COPPER)	
1		BAR OR PLATE CDA 101 / 102K COPPER)	

DWN W. J. MORE 7/99
CHK W. J. MORE 7/99
APVD E. H. WANNIOU 7/99
CHECKED BY
DATE

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MECHANICAL ENGINEERING DEPT
UNIVERSITY OF CALIFORNIA

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PHENIX
MUON PISTON COIL
COIL JUMPER

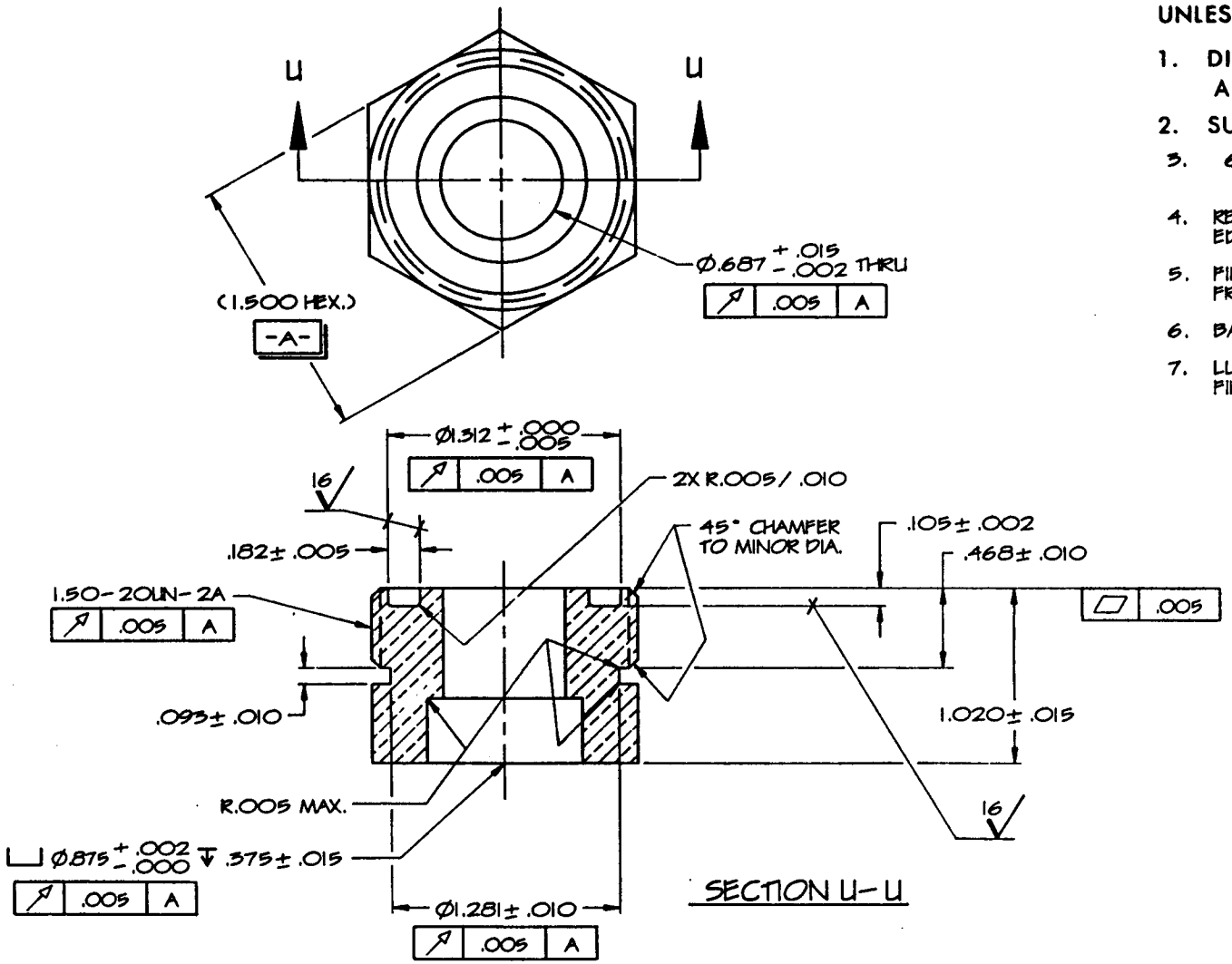
DRAWING NO AAA93-104153-00

SCALE 8/10 SHEET 1 OF 1

NOTES

UNLESS OTHERWISE SPECIFIED:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
2. SURFACE TEXTURE PER ANSI B46.1-1978.
3. 63 √ FINISH ALL OVER.
4. REMOVE BURRS AND BREAK SHARP EDGES .005/.010.
5. FINISHED PART TO BE CLEAN AND FREE OF OIL, GREASE, DIRT, ETC..
6. BAG AND TAG WITH LLNL DWG. NO.
7. LLNL / AutoCAD® RELEASE 12 USER FILENAME: 31018971.DWG



SECTION U-U

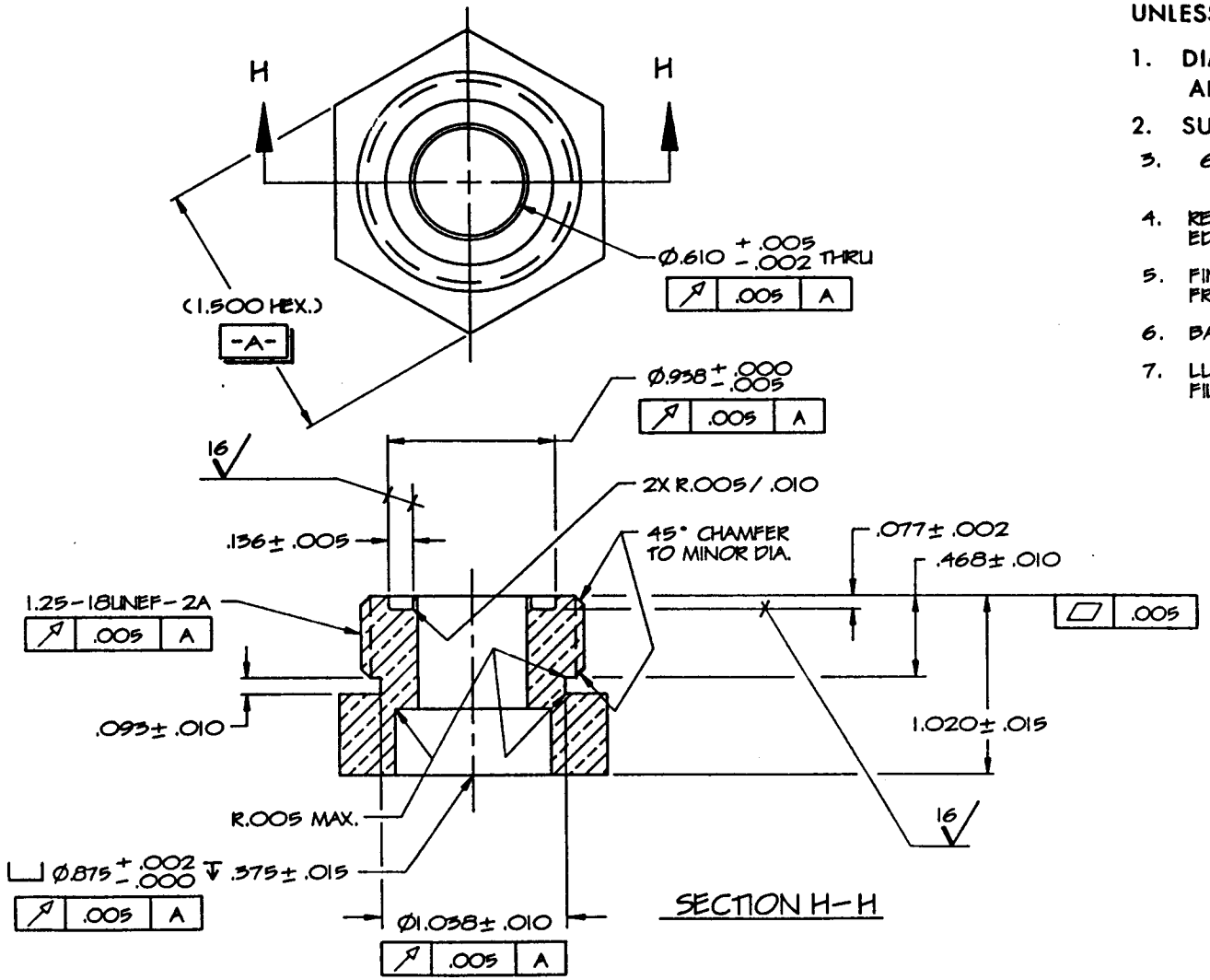
			BAR, 1.500" HEX. (CRES 304)			
NO REQD	PART/LLNL STK NO		DESCRIPTION/MATERIAL		SPEC NO	ITEM
	DWN WJWONG	6/93	CLASSIFICATION	MAJOR UNIT: PHENIX		
	CHK WJWONG	6/93	THIS DOCUMENT IS THE PROPERTY OF THE UNIVERSITY OF CALIFORNIA LAWRENCE LIVERMORE NATIONAL LAB. REPRODUCTION PROHIBITED WITHOUT PERMISSION OF THE MECHANICAL ENGINEERING DEPARTMENT.	SUBASSY: HYDRAULIC CONDUCTOR INTERFACE		
	APVD RMYAMAMOTO	6/93		DETAIL: OUTLET CONDUCTOR FITTING		
	CLASSIFIED BY:			SHOWN ON AAA 93-101857	DRAWING NO AAA 93-101897-00	COPY
	TITLE	DATE		ACT 8863-25		
	LAWRENCE LIVERMORE NATIONAL LABORATORY MECHANICAL ENGINEERING DEPT UNIVERSITY OF CALIFORNIA			SCALE 1.00"	SHEET 1 OF 1	

LTR	DWN	CHK	DATE	ZONE	CHANGE

NOTES

UNLESS OTHERWISE SPECIFIED:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
2. SURFACE TEXTURE PER ANSI B46.1-1978.
3. 63 √ FINISH ALL OVER.
4. REMOVE BURRS AND BREAK SHARP EDGES .005/.010.
5. FINISHED PART TO BE CLEAN AND FREE OF OIL, GREASE, DIRT, ETC..
6. BAG AND TAG WITH LLNL DWG. NO.
7. LLNL/AutoCAD® RELEASE 12 USER FILENAME: 31018981.DWG



NO REQD	PART/LLNL STK NO	DESCRIPTION/MATERIAL	SPEC NO	ITEM
		BAR, 1.500" HEX. (CRES 304)		

DWN	WJWONG 黃瑋星	6/93
CHK	WJWONG	6/93
APVD	RMYAMAMOTO	6/93
CLASSIFIED BY:		
TITLE		DATE

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UNIVERSITY OF CALIFORNIA

CLASSIFICATION

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MAJOR UNIT: PHENIX

SUBASSY: HYDRAULIC CONDUCTOR INTERFACE

DETAIL: INLET CONDUCTOR FITTING

SHOWN ON AAA 93-101857

ACT 8863-25

DRAWING NO: AAA 93-101898-00

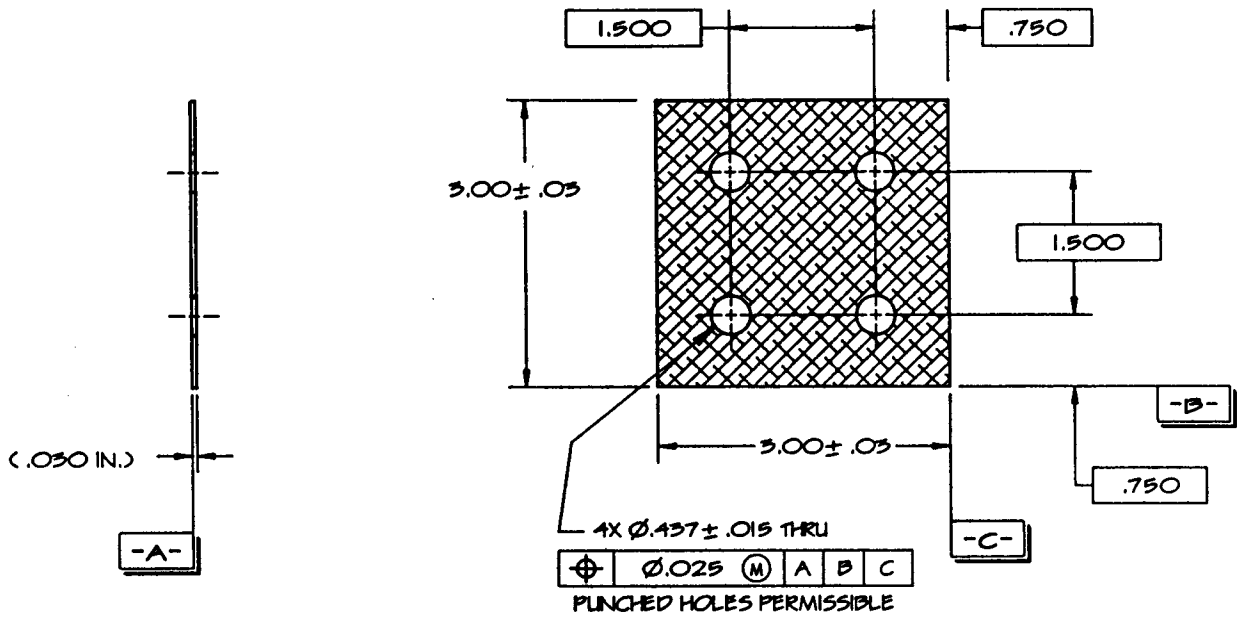
COPY

SCALE 1.00" SHEET 1 OF 1

LTR	DWN	CHK	DATE	ZONE	CHANGE

NOTES
UNLESS OTHERWISE SPECIFIED:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
2. SURFACE TEXTURE PER ANSI B46.1-1978.
3. DIMENSIONS ARE IN INCHES.
4. STOCK FINISH ALL OVER.
5. ALL DIMENSIONS APPLY TO PART IN AN UNRESTRAINED CONDITION.
6. SUGGESTED VENDOR:
   HI TECHMETAL GROUP
   1101 EAST 55th STREET
   CLEVELAND, OHIO 44103
   PH: (216) 881-8100
7. FINISHED PART TO BE CLEAN AND FREE OF OIL, GREASE, DIRT, ETC..
8. BAG AND TAG WITH LLNL DWG. NO.
9. LLNL AutoCAD(tm) Release 12 USER FILENAME: 31041501.DWG
10. CAUTION: DO NOT CRUSH MATERIAL DURING FABRICATION OR HANDLING PROCESSES.



NO REQD	PART/LLNL STK NO	DESCRIPTION/MATERIAL	SPEC NO	ITEM
6		FOAMETAL (tm), .030" THICK, .008"-.012" FILAMENT DIA., 37-42 CELLS/IN., .022"-.026" PORE DIA., PORE TYPE 30 (COPPER)		

DWN	WJWONG	7/93
CHK	WJWONG	7/93
APVD	RMYAMAMOTO	7/93
CLASSIFIED BY:		
TITLE		DATE

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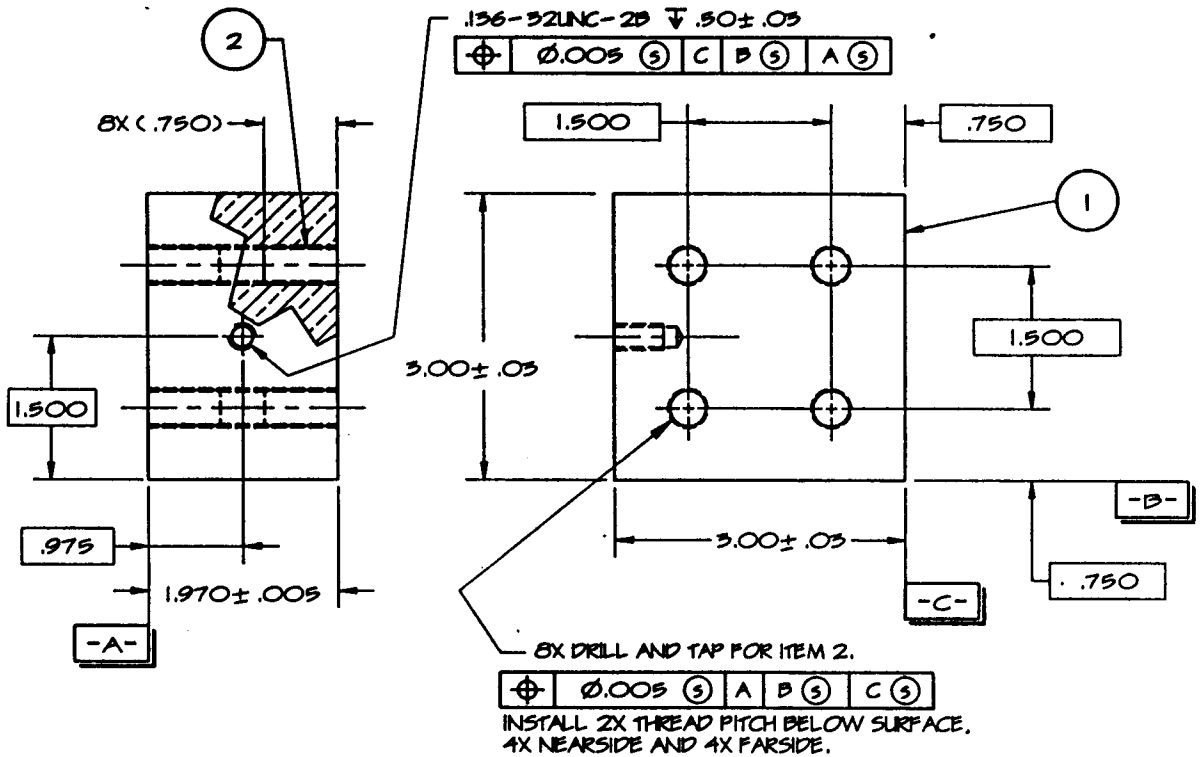
MAJOR UNIT: PHENIX
SUBASSY: MUON PISTON COIL
DETAIL: SHORTING PAD
SHOWN ON AAA: 93-101857
DRAWING NO: AAA 93-104150-00
COPY
ACT 8063-25
SCALE 2.00"
SHEET 1 OF 1

LTR	DWN	CHK	DATE	ZONE	CHANGE

NOTES
UNLESS OTHERWISE SPECIFIED:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1982.
2. SURFACE TEXTURE PER ANSI B46.1-1978.
3. DIMENSIONS ARE IN INCHES.
4. STOCK FINISH ALL OVER.
5. FINISHED PART TO BE CLEAN AND FREE OF OIL, GREASE, DIRT, ETC..
6. BAG AND TAG WITH LLNL DWG. NO.
8. LLNL AutoCAD(tm) Release 12 USER FILENAME: 31041511.DWG
9. CAUTION: DO NOT CRUSH MATERIAL DURING FABRICATION OR HANDLING PROCESSES.



		8	5340-22484	INSERT, HELICOIL®, 3/8-24UNF X .750"L (CRES AMS-7245)		2
		1		BAR OR PLATE, CDA 101/102 HIGH PURITY (COPPER)		1
NO REQD			PART/LLNL STK NO	DESCRIPTION/MATERIAL	SPEC NO	ITEM

DWN	WJWONG	7/93
CHK	WJWONG	7/93
APVD	RMYAMAMOTO	7/93
CLASSIFIED BY:		
TITLE		DATE

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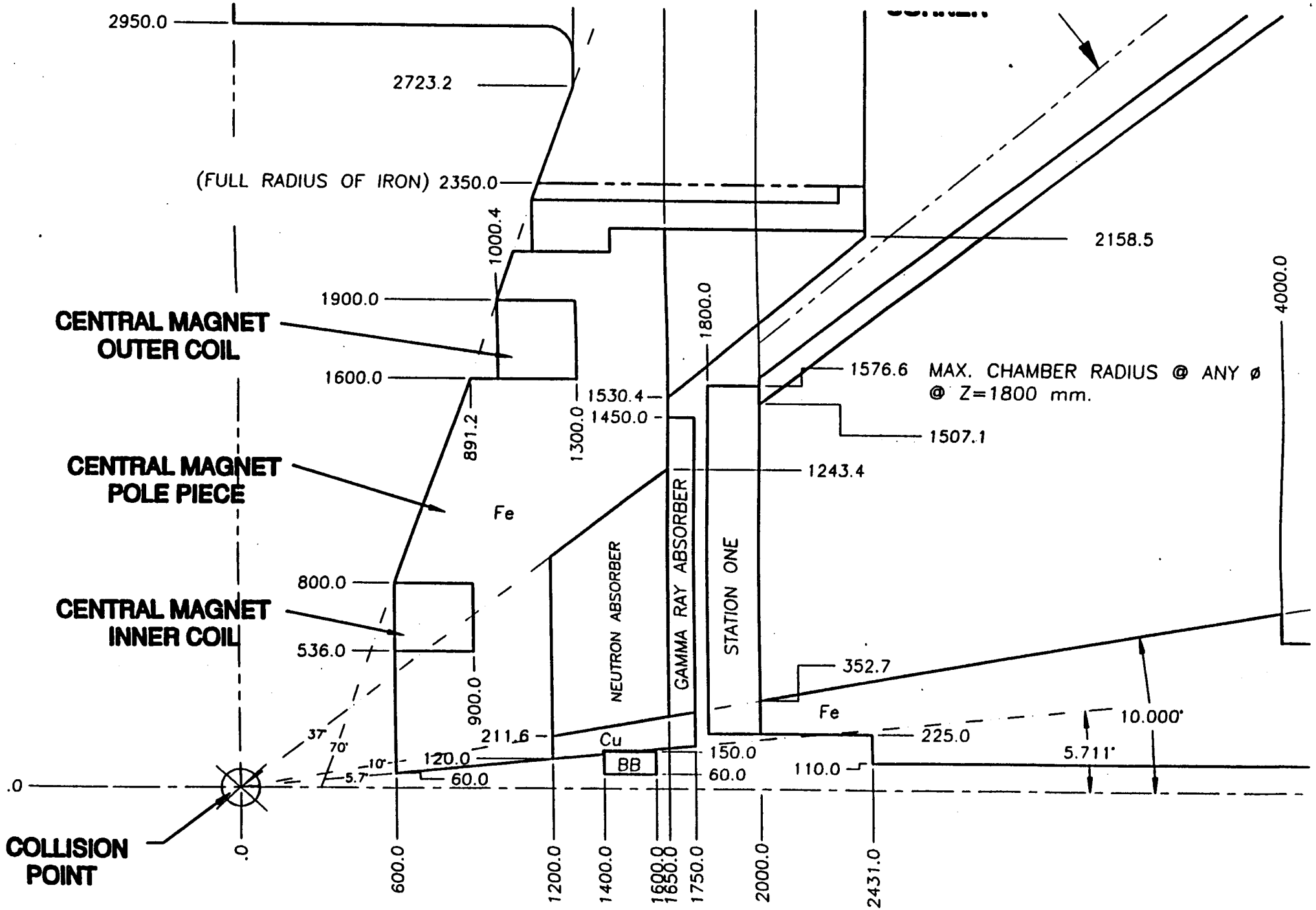
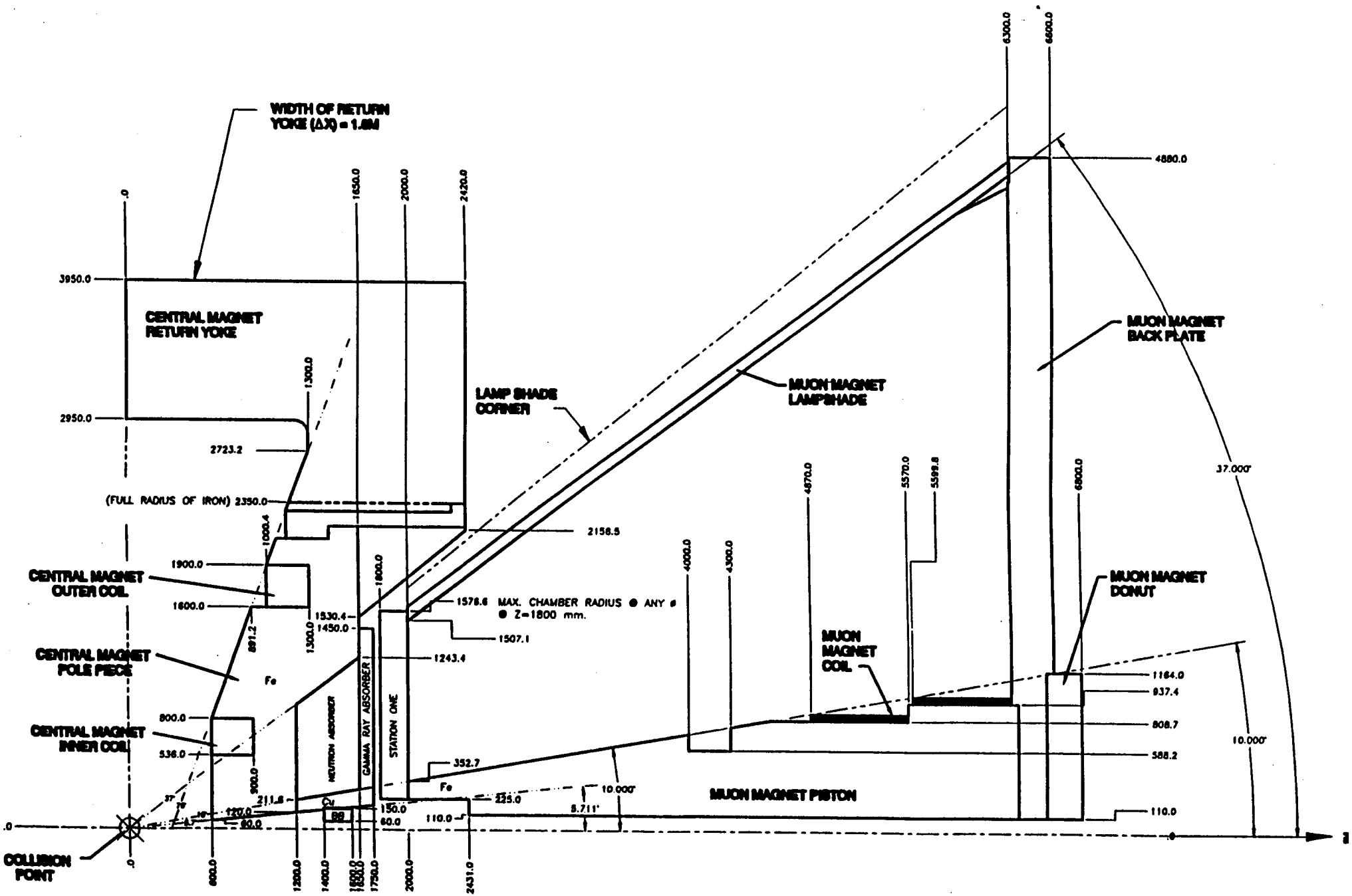
MAJOR UNIT: PHENIX
SUBASSY: MUON PISTON COIL
DETAIL: SHORTING BLOCK
SHOWN ON AAA 93-101057
ACT 8869-25
DRAWING NO: AAA 93-104151-00
COPY
SCALE 2.00"
SHEET 1 OF 1

LTR	DWN	CHK	DATE	ZONE	CHANGE

A 4 3 2 1


2950.0
2723.2
(FULL RADIUS OF IRON) 2350.0
1000.4
2158.5
1900.0
CENTRAL MAGNET OUTER COIL
1600.0
1800.0
1576.6 MAX. CHAMBER RADIUS @ ANY ø @ Z=1800 mm.
1530.4
1450.0
1300.0
891.2
1507.1
CENTRAL MAGNET POLE PIECE
1243.4
Fe
NEUTRON ABSORBER
GAMMA RAY ABSORBER
STATION ONE
4000.0
800.0
CENTRAL MAGNET INNER COIL
536.0
352.7
900.0
Fe
10.000°
37°
70°
211.6
Cu
225.0
5.711°
10°
120.0
150.0
BB
5.7°
60.0
60.0
110.0
.0
COLLISION POINT
.0
600.0
1200.0
1400.0
1600.0
1650.0
1750.0
2000.0
2431.0


WIDTH OF RETURN YOKE (ΔX) = 1.6M
CENTRAL MAGNET RETURN YOKE
CENTRAL MAGNET OUTER COIL
CENTRAL MAGNET POLE PIECE
CENTRAL MAGNET INNER COIL
LAMP SHADE CORNER
MUON MAGNET LAMPSHADE
MUON MAGNET BACK PLATE
MUON MAGNET DONUT
MUON MAGNET COIL
MUON MAGNET PISTON
1578.6 MAX. CHAMBER RADIUS @ ANY ϕ @ Z=1800 mm.
(FULL RADIUS OF IRON) 2350.0
2158.5
1507.1
1243.4
352.7
NEUTRON ABSORBER
GAMMA RAY ABSORBER
STATION ONE
Fe
37.000°
10.000°
5.711°
COLLISION POINT