Princeton Plasma Physics Laboratory
Procedure

Procedure Title: **Modular Coil Fabrication-Winding Station Activities**

Number:	Revision:	Effective Date: 11/19/04
D-NCSX-MCF-002	**00**	Expiration Date: 11/19/06 *(2 yrs. unless otherwise stipulated)*

Procedure Approvals

Author: James H. Chrzanowski James H Chrzanowski	Date: 11/19/04
ATI: James H. Chrzanowski James H Chrzanowski	Date: 11/19/04
RLM: Larry Dudek	Date: 11/19/04

Responsible Division: **NCSX Project**

Procedure Requirements
Designated by RLM

LABWIDE:

X	Work Planning Form # **WP-1125 & 1138** (ENG-032)		Lockout/Tagout (ESH-016)
	Confined Space Permit (5008,SEC.8 Chap 5)		Lift Procedure (ENG-021)
	Master Equip. List Mod (GEN-005)	X	ES&H Review (NEPA, IH, etc.) **NEPA 1283**
	RWP (HP-OP-20)		Independent Review
	ATI Walkdown	X	Pre-Job Brief
X	Post-job Brief *		

D-SITE SPECIFIC:

X	D-Site Work Permit (OP-AD-99)		Door Permit (OP-G-95)
	Tritium Work Permit (OP-AD-49)		USQD (OP-AD-63)
X	Pre-Job Brief (OP-AD-79)		T-Mod (OP-AD-03)
	** DCA/DCN (OP-AD-104) #		

* Required for installations involving internal vacuum, installations, critical lifts, and for the initial installation of repetitive work.

** OP-AD-104 was voided by procedure ENG-032. However, DCA's that were open at the time of adoption of ENG-032 are still considered valid for work approval purposes.

REVIEWERS (designated by RLM)	**Rec'd/ Incorp. Comments**
Accountable Technical Individual. .....**J. Chrzanowski**	
Test Director	
Independent Reviewer	
D-Site Shift Supervisor	
Independent	
NCSX	
Vacuum	
Project Engineer for Stellerator Systems (WBS 1) Manager.....**Brad Nelson (ORNL)**	X
WBS Manager for Modular Coils (WBS14).. .....**Dave Williamson (ORNL)**	
Quality Assurance/Quality Control. .....**Judy Malsbury**	X
Maintenance and Operations Division	
Energy Conversion System/Motor Control Division	
Engineering	
Environmental Restoration & Waste Management Division	
Environmental, Safety & Health.....**Jerry Levine**	X
Industrial Hygiene..... **Bill Slavin**	X
Health Physics.....	
RLM .....**Larry Dudek**	X

TRAINING (designated by RLM)

No training required _____ Instructor **Jim Chrzanowski**

Personnel (group, job title or individual name)	Read Only	Instruction **Pre-job Briefing**	Hands On
Lead Tech.		X	
Technicians performing task		X	
Field Supervisors		X	
Quality Control Representative		X	
Training Rep.			
RLM **Larry Dudek**			

RECORD OF CHANGE

Revision	Date	Description of Change
00	11/19/04	Initial release

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1 Scope

1.1 Introduction

The Modular Coil Manufacturing Facility is divided into 6 workstations. Each workstation has a specific set of tasks that will be performed as part of the overall fabrication process. This procedure addresses the manufacturing, inspection, test and QC inspection points for a specific workstation.

- Station No. 1... Winding Form Preparation & Post VPI Activities
- **Station No. 2... Winding Station A/Molding and VPI Preparation**
- **Station No. 3... Winding Station B/Molding and VPI Preparation**
- **Station No. 4... Winding Station C/Molding and VPI Preparation**
- Station No. 5... VPI and Autoclave Activities
- Station No. 6... Coil Testing

1.2 Scope

This procedure is used to wind the compacted copper rope conductor onto the modular coil winding forms. It includes:

- Installing the WF in the turning fixture
- Installation of Groundwrap insulation
- Winding of coils
- Termination of coil leads
- Metrology measurements
- Installation of Diagnostic probes
- Application of outer chill plates and cooling tubes
- Application of Bag Mold

1.3 Identification of Coil being manufactured:

Station Number: _____

Winding Form Type: _____ (A, B, C or Twisted [TRC])

MC Winding Form ID No: _____

Modular ID Coil Number: _____

2 Applicable Documents

2.1 NCSX-MIT/QA-142-01:

All applicable documents associated with this procedure, are identified in the MIT/QA Plan, document number **NCSX-MIT/QA-142-01**.

2.2 NCSX-PLAN-MCWFOP-00:

All Modular Coil work processes are governed by the "Modular Coil Manufacturing Facility Operations Plan", document number **NCSX-PLAN-MFOP-00**.

3 Safety Requirements:

All work will be performed in a safe manner in accordance with PPPL Environmental Safety & Health Directives **ES&H 5008** and the "Integrated Safety Management" (ISM) policy.

3.1 Job Hazard Analysis:

A JHA will be generated for each winding stations, identifying existing or potential workplace hazards and to evaluate the risk of worker injury or illness associated with job tasks. (Reference document **ESH-004 "Job Hazard Analysis"**) The IH representative will review the JHA's for accuracy as well as completeness. It will be reviewed with all activity participants at the Pre-Job briefings.

4 Prerequisites & Conditions:

4.1 Pre-Job Briefing:

A pre-job briefing will be held, describing the processes and safety issues prior to starting any part of this procedure. Attendance shall be documented via training sign-in sheet.

Pre job Briefing complete: _____ _____

MC Field Supervisor **Date**

4.2 Daily Operations Startup and Shutdown:

Each working day, it is required to complete and initial the daily operations startup log to ensure that the station is ready to commence work activities for the day. The signoff log is located in the back of this procedure. See section 6.1 and 6.2 for details.

4.3 Torque Values:

The following torque values shall be used for securing hardware unless otherwise specified in the procedure. (Low carbon steel hardware)

3/8-16UNC ..... 18 ft-lbs	3/8-24UNF ..... 19 ft-lbs
½-13 UNC ..... 38 ft-lbs	½ -20 UNF ..... 40 ft-lbs
5/8-11 UNC.... 83 ft-lbs	5/8-18 UNF..... 95 ft-lbs
¾-10 UNC..... 105 ft-lbs	¾-16 UNF ..... 102 ft-lbs
1-8 UNC ..... 236 ft-lbs	1-14 UNF ..... 212 ft-lbs

5 Materials and Parts for this station

The following materials and/or equipment will be used with this procedure.

General Description	Material	Reference Document/Product No.
Conductor	CDA 101 compacted copper rope	NCSX-CSPEC-142-03-01
Turn Insulation- glass tape	S-2 Dry glass 0.004 in. thick	
Ground insulation-glass tape	S-2 Dry glass	
Ground insulation	Kapton- 5mil Type HN	
Ground insulation	Kapton- 2mil Type HN	
Shim Insulation	S-2 Dry glass 0.010 in. x 1.7 in. wide	
Solvent	Chlor-Free Degreaser	CRC Product No. 03185 [MSDS #05032]
Solvent	Acetone	MSDS# 00561
Fillers	G-11	Drawing list to be added as addendum for each coil as approved
Chill Plates	Copper	Drawing list to be added as addendum for each coil as approved
Cooling tubes	Copper	Drawing list to be added as addendum for each coil type as approved

Lead support structures	G-11	Drawing list to be added as addendum for each coil type as approved
Lead terminals	Copper	Drawing list to be added as addendum for each coil type as approved
Braze material	Sil-Fos	MSDS # 03437
Turning Fixture	Equipment	Drawing no. SE144-008
Conductor payout spool	Equipment	Drawing no. SE144-120
Winding clamps	Equipment	Drawing SE144-080
Bag sealing agent	2-part RTV 11 (white)	MSDS #02214
Bag mold material	Self-fusing Tape	Product no.7643A24 2 in. wide gray silicone tape
Bag mold shell material	Nomex Felt	Stk. No. NX 08-6 Nomex fabric 1/8 in. thick x 6 in.
Epoxy system for shell mold	Resin/hardener 3561/2039	MSDS # 03516 & 03515
Bag sealing	RTV 108 (caulking)	MSDS #01525

6 Fabrication Process

This fabrication procedure is to be used as guide to complete the station no. 2, 3 & 4 activities. Deviation from this procedure can be made during the winding process with the concurrence of the MC Field Supervisor. All deviations shall be documented in the procedure and initialed by the MC Field Supervisor.

6.1 Daily Startup Activities:

6.1.1 Check all daily supplies needed:
6.1.2 Verify operation of all equipment needed that day.
6.1.3 Check station for cleanliness
6.1.4 Check that the day's travelers and procedures are in their document holder.
6.1.5 Date and initial daily log at the back of procedure

6.2 Daily Shutdown Activities:

6.2.1 Turn off power to equipment not in use.
6.2.2 Clean entire workstation area.
6.2.3 Verify that all Traveler and data sheet information is complete.
6.2.4 The Lead Technician shall verify that the Station's Log Book has been completed and signed for the day.
6.2.5 Date and initial daily log at the back of procedure

6.3 Transport of Winding Form to Winding Station:

6.3.1 Transport the MCWF to winding station no. 2, 3 or 4 using Lift Procedure D-L-NCSX-984. Install the MCWF into the turning fixture via the ceiling hatch.

Note: During the installation of the MCWF into the turning fixture, to minimize risk of potential dirt contamination, the rooms must be isolated from each other using a plastic curtain. This only applies if a coil is already in the adjacent winding station.

Verified by: _____ **Date:** _____
Field Supervisor

6.4 Install MCWF in Turning Fixture:
Secure the MCWF and ring assembly to the turning fixture.

6.4.1 Install the upper guide rollers and align all of the guide rollers to the support ring.

6.4.2 Verify that the support ring gear rack is engaged with the drive unit.

Verified by: _____ **Date:** _____
Lead Technician

6.4.3 Verify that the upper support/lift beam is in proper position and secured with appropriate hardware that is torqued to the proper value.

Verified by: _____ **Date:** _____
Lead Technician

6.4.4 Remove the upper support plates between the support ring and lift beam. This operation must be verified prior to operating turning fixture.

Verified by: _____ **Date:** _____
Lead Technician

6.4.5 To ensure proper alignment and operation of the turning fixture, rotate the MCWF a full revolution using the foot-pedal control. Re-adjust the alignment rollers as required. Alignment of MCWF to the turning fixture is complete.

Verified by: _____ **Date:** _____
Lead Technician

6.5 Conductor Payout Spool:
Load (4) spools of copper conductor into the conductor payout spool fixture. Position the spools in the fixture with the upper spools (1 and 2) being fed from the bottom side and lower spools (3 & 4) being fed from the topside (See Figure 1- Orientation of Copper spools)

6.5.1 The height, angle and pitch of the conductor payout spool relative to the winding station shall be modified during the winding operation. This will help to minimize any twisting or excessive keystoning of the conductor prior to be layed in position.

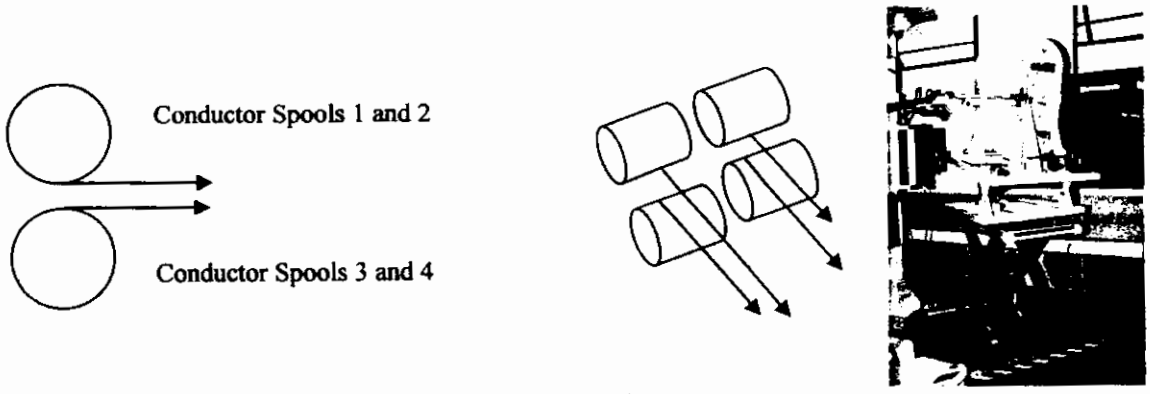

Figure 1- Orientation of Copper spools

6.6 Installation of Inner Groundwrap Insulation

Position the inner ground wrap insulation onto the MCWF winding surfaces. Store the excess rolled Groundwrap above the winding form. (See Figure 3- Winding Clamp-Groundwrap Storage)

Note: Ensure that personnel handling the insulation are wearing either cotton and/ or latex surgical gloves

6.6.1 Apply pre-cut layers of ground wrap insulation Figure 2- Groundwrap scheme

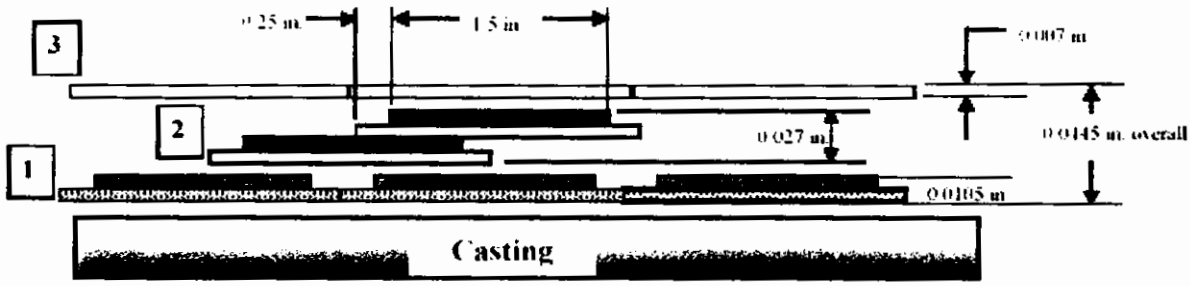

Figure 2- Groundwrap scheme

Layer 1 (Inner):
Apply (1) Butt lapped layer of composite insulation
- 0.007 inch thick S-2 glass [nominal 2 inch wide]
- 0.0035 (HN) Kapton tape [nominal 1.5 inch wide] with adhesive back

Layer 2 (Mid):
Apply (1) half-lapped layer of composite insulation:
- 0.007 in. thick glass [2 inch nom. wide]
- 0.0065(HN) Kapton [1.5 nom. wide] with adhesive

Layer 3 (Outer):
Apply (1) Butt lapped layer of S-2 glass tape
- 0.007 in. thick S-2 glass [2 inch nom. wide]

6.6.2 Application of the inner ground wrap has been satisfactorily completed.

Verified:

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

NOTES:

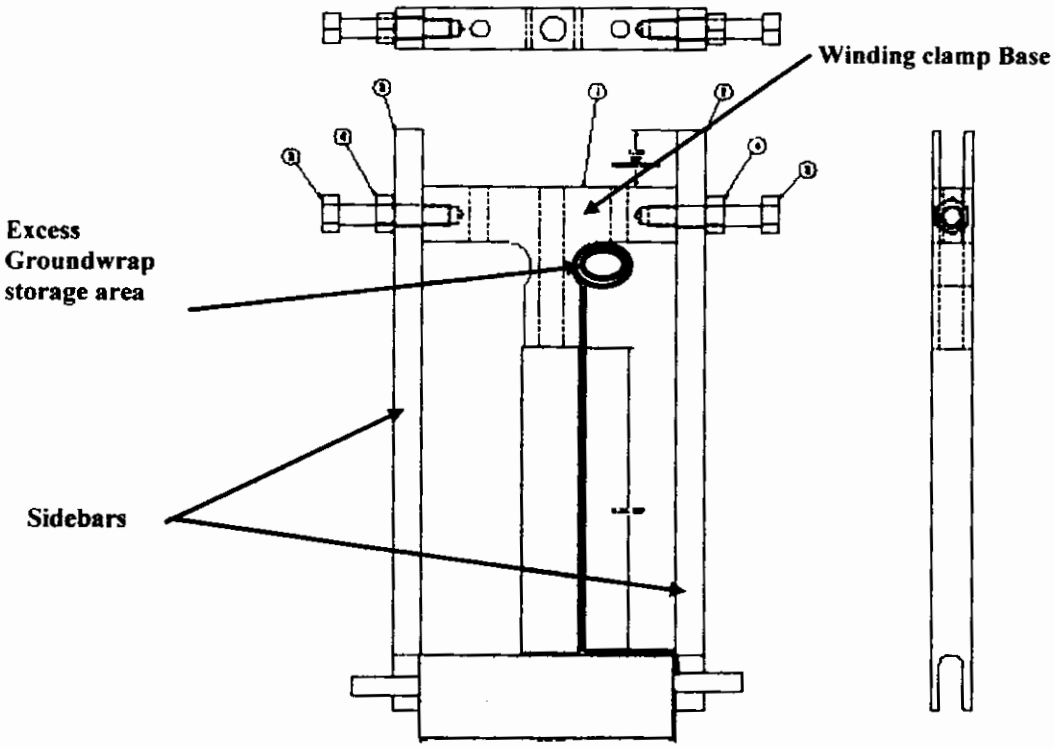

Figure 3- Winding Clamp-Groundwrap Storage

6.7 Position leads for side "A" winding

6.7.1 Mount the lower lead guide block to the MCWF and secure in position.
6.7.2 Figure 4- Lower Lead Guide Block

6.7.3 Feed sufficient copper from each of the (4) conductor spools located on the payout spool fixture until they reach the MCWF. Note: the conductor shall be fully supported between the payout spool and the winding form.

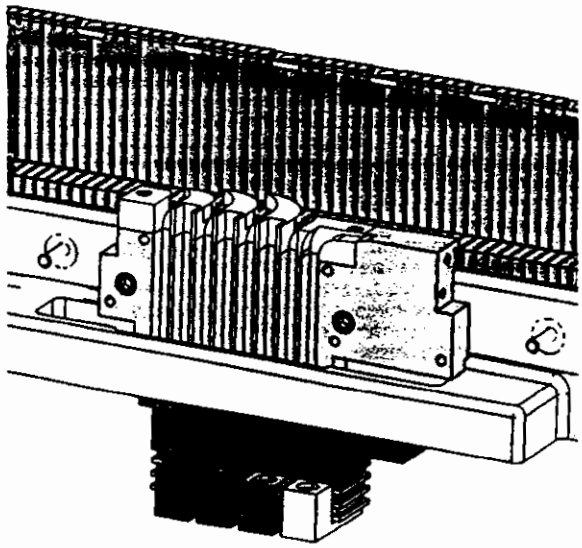

Figure 4- Lower Lead Guide Block

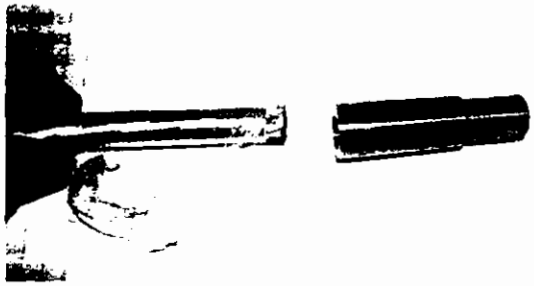

Figure 7- Removing Nylon Serve from conductor

Figure 8- Conductor in Terminal

6.8.9 Using the carbon tongs heat the copper terminal. Once at temperature, feed the Sil-Fos rod through the feedhole at the threaded end of the terminal. Then reposition the tongs and feed the backside of the terminal with Sil-Fos rod. (See Figure 9- Feeding the Lead Terminal w/ Sil-Fos)

6.8.10 Clean the braze area, removing any excess Sil-Fos. Use a special honing block for cleaning the tapered terminal block.

6.8.11 Repeat the process with each of the four inner copper terminals.

Figure 9- Feeding the Lead Terminal w/ Sil-Fos

6.8.12 Inspect each brazed lead terminal following cleanup. If a lead braze is rejected, the terminal must be removed and the terminal braze remade.

Inner Terminal #1 Pancake "A":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Inner Terminal #2 Pancake "A":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Inner Terminal #3 Pancake "A":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Inner Terminal #4 Pancake "A":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

6.9 Insulate Lower Leads- Side "A"

Once the terminals have been brazed, the leads need to be insulated.

6.9.1 Apply by hand (1) half-lapped layer of composite insulation [0.007 in. thick glass tape/ 0.0065(HN) Kapton tape w/ adhesive back] over each of the individual conductors starting from the point that the conductors separate to 6 inches from the conductor end.

6.9.2 Position the first layer of (4) conductors into the conductor slots in the lower lead guide block. The conductors shall be placed in alternating slots. Care must be taken during this operation, to minimize any damage to the over wrap insulation. See figure 10.

Verified:

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

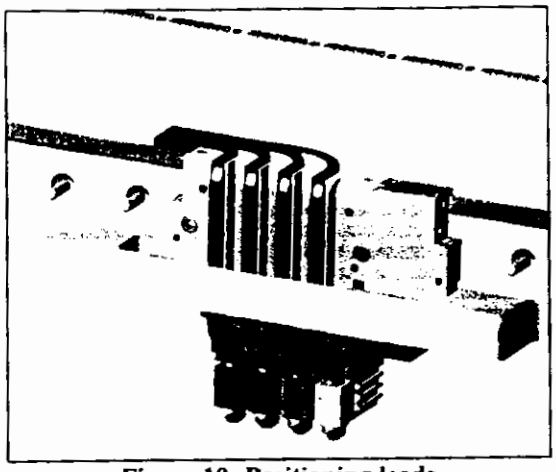

Figure 10- Positioning leads

6.10 General Winding Notes:

Once the first set of coil leads have been positioned and secured, the winding operation can begin.

6.10.1 Using the foot control start the rotation of the turning fixture in the direction that the coil is to be wound. [Determined by coil drawings and guidance of field supervisor] The speed of the turning fixture shall be decided by the Field Supervisor and lead technician as required to suit the coil manufacturing operation.

6.10.2 Wind the 4-in-hand conductors onto the MCWF until the first coil clamp has been cleared. Stop the winder at that point.

6.10.3 Tighten the coil clamps to insure a snug fit between the coil conductors and the winding form. Use a Go/No-Go gauge block to verify the preliminary position of the wound layer.

6.10.4 During the winding process, as a general rule, remove the minimal number of winding clamps necessary to allow sufficient space for the conductors to be wound onto the winding form.

6.10.5 During the winding process, the pre-insulated copper rope conductors will be scanned with a electrical short indicator that will identify any copper fibers that may protrude from the insulation causing turn to turn or turn to ground shorts. Figure 11-Schematic of Turn Insulation Tester

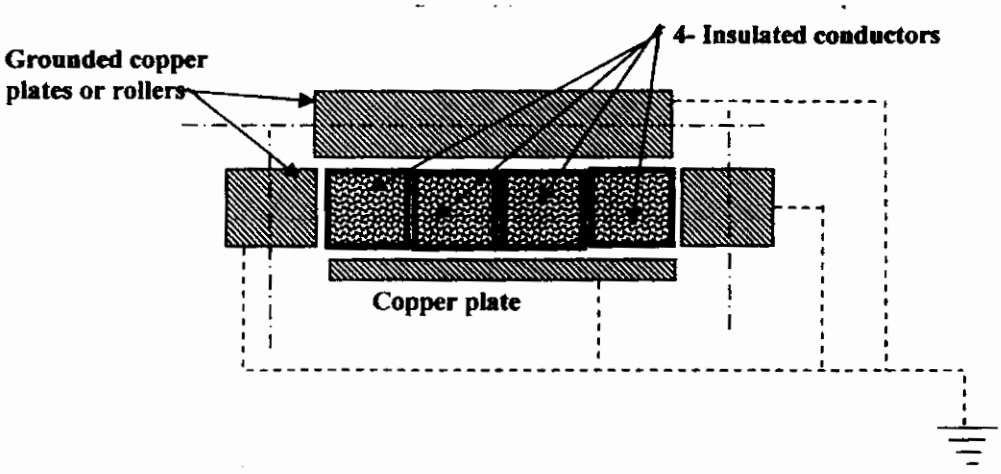

Figure 11-Schematic of Turn Insulation Tester

6.11 Metrology Measurements/Tolerance Control:

6.11.1 During the winding operations, additional measurements will be required to verify the precise vertical and radial builds of the turns. The location and frequency of measurements will be pre-determined by the NCSX Engineering manager and agreed upon by the Field Supervisor and Lead Technician for each coil.

Coil No. _____
Location and frequency of measurements:

Approved: _____ **Date:** _____
NCSX Engr. Manager

Concur: _____ **Date:** _____
MC Field Supervisor

Concur: _____ **Date:** _____
Winding Station Lead Technician

6.11.2 Procedure D-NCSX-MCF-005 describes the use of the "Romer" measuring arm that will be used. All data will be attached to the back of this procedure (D-NCSX-MCF-002).

6.11.3 To maintain tolerance control, glass tape shim packs will be placed between layers as required. The thickness and location of these shim packs will be determined by the measurements made during winding. The addition of glass shims will be noted in the turn winding section. **Figure 12-Glass Shim Packs**

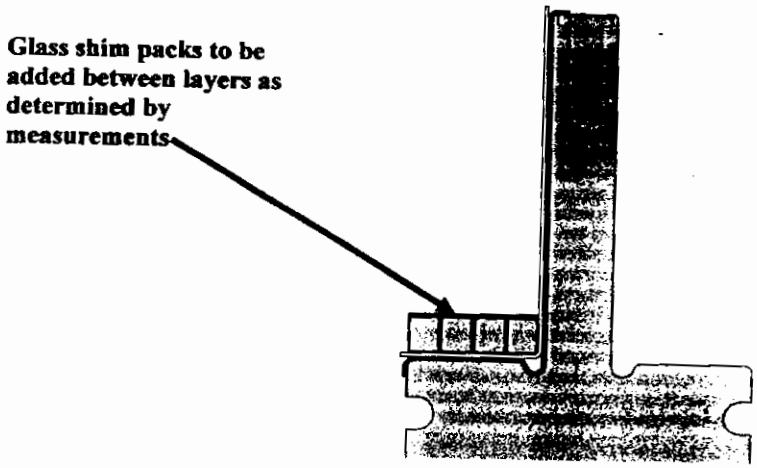

Figure 12-Glass Shim Packs

6.12 Winding Operation

6.12.1 Wind layer number 1

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 1

(Optional) If layer measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.12.2 Wind layer number 2

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 2

(Optional) If measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.12.3 Wind layer number 3

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 3

(Optional) If measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.12.4 Wind layer number 4

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 4

(Optional) If measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.12.5 Wind layer number 5

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 5

(Optional) If measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.12.6 Wind layer number 6

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 6

(Optional) If measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.12.7 Wind layer number 7

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 7

(Optional) If measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.12.8 Wind layer number 8

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 8

(Optional) If measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.12.9 Wind layer number 9 **[Note: Maximum turns in Type C and TRC coils]**
Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 9
(Optional) If measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.12.10 Wind layer number 10 **[Note: Maximum turns in Type A and B coils]**
Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 10
(Optional) If measurements were made, the Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.13 Final Positioning of side "A" leads

6.13.1 Mount the upper guide block assembly to the MCWF and secure in position.

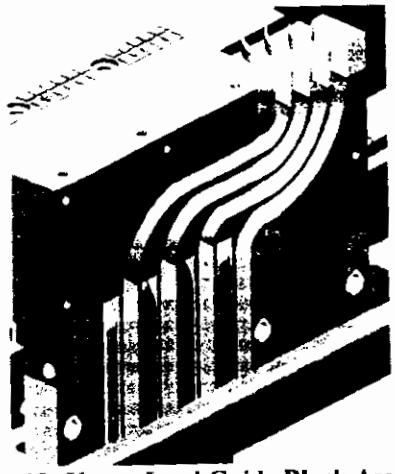

Figure 13- Upper Lead Guide Block Assembly

6.13.2 Pre-determine the length of conductor that will become the coil leads.

6.14 Brazing Side "A" Upper Leads:

The lead terminals will be attached using a flameless "Nibco" resistive heating carbon tongs and Sil-Fos braze material. Only braze qualified individuals can perform the lead brazes and requirements of ES&HD 5008, Section 9, Chapter 15 for safe brazing must be followed.

6.14.1 Notify the ESU and obtain a flame permit prior to starting brazing operation.

Lead Technician verify: _____ Date: _____

6.14.2 Area preparation: Protect the surrounding coil area from any dirt or carbon that may occur as a result of the brazing operation. The area between clean rooms MUST be isolated if a coil is in the adjacent room.

6.14.3 Copper Terminal: Clean the copper terminal using acetone-degreasing agent scotchbrite and clean cotton cloths. Use a wire bottlebrush on the inner bore along with the acetone. Once cleaned, do not touch the components with bare hands.

6.14.4 Conductor Preparation Step 1: Reshape the copper conductor using phenolic form blocks to provide a proper fit between the cable and terminal block. The nylon serve shall remain in place during the rounding operation. See Figure 5- Conductor w/Phenolic Blocks and Figure 6- Conductor in Forming Blocks.

6.14.5 Conductor Preparation Step 2: Once formed, carefully remove the Nylon serve (covering) from the conductor the length of the inner terminal bore. (Figure 7- Removing Nylon Serve from conductor and Figure 8- Conductor in Terminal)

6.14.6 Conductor Preparation Step 3: Strip back approximately 4 inches of the nylon serve starting at the copper terminal.

6.14.7 Position the bare copper conductor into the water chill blocks and position the Argon gas head directly over the copper terminal.

6.14.8 Position the carbon tongs over the solid portion of the copper terminal.

6.14.9 Using the carbon tongs heat the copper terminal. Once at temperature, feed the Sil-Fos rod through the feedhole at the threaded end of the terminal. Then reposition the tongs and feed the backside of the terminal with Sil-Fos rod. (See Figure 9- Feeding the Lead Terminal w/ Sil-Fos)

6.14.10 Clean the braze area, removing any excess Sil-Fos. Use a special honing block for cleaning the tapered terminal block.

6.14.11 Repeat the process with each of the four inner copper terminals.

6.14.12 Inspect each brazed lead terminal following cleanup. If braze a rejected, the terminal lead must be removed and the braze joint remade.

Outer Terminal #1 Pancake "A":

Date Brazed: _____ Qualified Terminal Brazer: _____

QC Inspected by: _____ Date: _____

Notes:

Outer Terminal #2 Pancake "A":

Date Brazed: _____ _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Outer Terminal #3 Pancake "A":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Outer Terminal #4 Pancake "A":
Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

6.15 Insulate Upper Leads- Side "A"

6.15.1 Apply by hand (1) half-lapped layer of composite insulation [0.004 in. thick glass tape/ 0.0065(HN) Kapton tape w/ adhesive back] over each of the individual conductors starting from the point that the conductors separate to 6 inches from the conductor end.

6.15.2 Position the last layer of (4) conductors into the conductor slots in the upper lead guide block. Care must be taken during this operation, to minimize any damage to the over wrap insulation. Figure 14- Upper Lead Guide Block and Leads

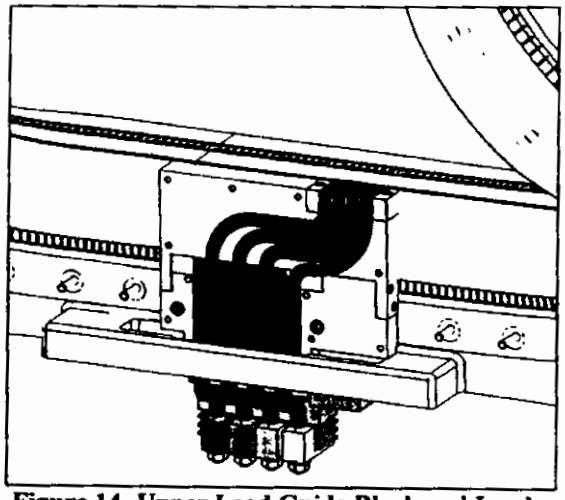

Figure 14- Upper Lead Guide Block and Leads

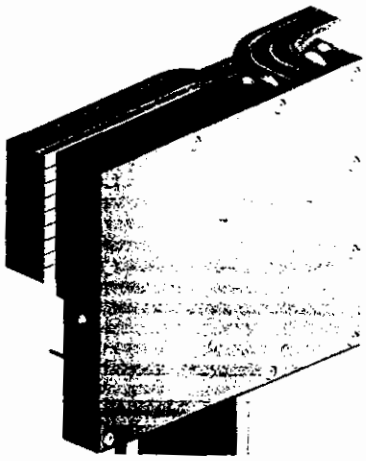

Figure 15- Lead Block Side Plate Installation

6.15.3 Secure the G-10 Side plate to the Lead Guide block with the appropriate hardware. ( )

6.16 Completion of Side "A" pancake:

All activities except final ground wrap associated with side "A" have been completed, and are ready to begin pancake "B".

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

QC shall verify completion of documentation:

Quality Control: _____ **Date:** _____

6.17 Preparation for Winding Side "B"

6.17.1 Reposition modular coil in turning fixture
Once the side "A" turns of the Modular Coil have been wound, the coil needs to be repositioned to enable the side "B" turns to be wound.

Note: To minimize potential dirt or contaminant risk, during the MCWF installation operation, if a coil is being wound in the adjacent station, the rooms must be isolated from each other using a plastic curtain.

6.17.1.1 Re-install the support plates between the lift beam and turning ring assembly.

6.17.1.2 Rig the support/lift beam assembly to the overhead crane.

6.17.1.3 Remove the support/lift beam hardware that locks the lift beam to turning fixture frame. Loosen the alignment rollers from engagement with the turning fixture ring.

6.17.1.4 Verify that all steps 6.17.1 thru 6.17.1.3 have been completed and the coil is are ready for lift.

Lead Technician verify: _____ **Date:** _____

6.17.1.5 Using Lift Procedure **D-L-NCSX-984** (Modular coils only) lift and reposition the modular coil in the turning fixture to allow winding of pancake "B".

Repositioning complete:
Verified by: _____ **Date:** _____
Field Supervisor

6.17.1.6 Align the guide rollers to the support ring.

6.17.1.7 Verify that the support ring gear rack is engaged with the drive unit.

Verified by: _____ **Date:** _____
Lead Technician

6.23.2 Wind layer number 2

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 2

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.3 Wind layer number 3

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 3

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.17.1.8 Verify that the upper support/lift beam is in proper position and secured with appropriate hardware that is torqued to the proper value.

Verified by: _____ **Date:** _____
Lead Technician

6.17.1.9 Remove the upper support plates between the support ring and lift beam. Completion of this activity must be verified prior to operating turning fixture.

Verified by: _____ **Date:** _____
Lead Technician

6.17.1.10 To ensure proper alignment and operation of the turning fixture rotate the MCWF a full revolution using the foot-pedal control. Re-adjust the alignment rollers as required.

6.17.1.11 Alignment of MCWF to the turning fixture is complete.

Verified by: _____ **Date:** _____
Lead Technician

6.17.2 Conductor Payout Spool:
Load (4) spools of copper conductor into the conductor payout spool fixture. Position the spools in the fixture with the upper spools (1 and 2) being fed from the bottom side and lower spools (3 & 4) being fed from the topside (See Figure 1- Orientation of Copper spools)

6.18 Installation of Inner Groundwrap Insulation

Position the inner ground wrap insulation onto the MCWF winding surfaces for side "B". *Note: Ensure that personnel handling the insulation are wearing either cotton and/ or latex surgical gloves*

6.18.1 Apply pre-cut layers of ground wrap as outlined in section 6.6

6.18.2 Application of the inner ground wrap has been satisfactorily completed.

Verified:

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

6.19 Positioning of lower leads for side "B" winding

6.19.1 Mount the lower guide block assembly to the MCWF and secure in position. See Figure 4- Lower Lead Guide Block

6.19.2 Pre-determine the length of conductor that will become the coil leads.

6.20 Brazing Side "B" Lower Leads:

The lead terminals will be attached to the conductor using a flameless "Nibco" resistive heating carbon tongs and Sil-Fos braze material. Only braze qualified individuals can perform the lead brazes and requirements of ES&HD 5008, Section 9, Chapter 15 for safe brazing must be followed.

6.20.1 Notify the ESU and obtain a flame permit prior to starting brazing operation.

Lead Technician verify: _____ Date: _____

6.20.2 Area preparation: Protect the surrounding coil area from any dirt or carbon that may occur as a result of the brazing operation. The area between clean rooms MUST be isolated if a coil is in the adjacent room.

6.20.3 Copper Terminal: Clean the copper terminal using acetone-degreasing agent scotchbrite and clean cotton cloths. Use a wire bottlebrush on the inner bore along with the acetone. Once cleaned, do not touch the components with bare hands.

6.20.4 Conductor Preparation Step 1: Reshape the copper conductor using phenolic form blocks to provide a proper fit between the cable and terminal block. The nylon serve shall remain in place during the rounding operation. See Figure 5- Conductor w/Phenolic Blocks and Figure 6- Conductor in Forming Blocks.

6.20.5 Conductor Preparation Step 2: Once formed, carefully remove the Nylon serve (covering) from the conductor the length of the inner terminal bore. (Figure 7- Removing Nylon Serve from conductor and Figure 8- Conductor in Terminal)

6.20.6 Conductor Preparation Step 3: Strip back approximately 4 inches of the nylon serve starting at the copper terminal.

6.20.7 Position the bare copper conductor into the water chill blocks and position the Argon gas head directly over the copper terminal.

6.20.8 Position the carbon tongs over the solid portion of the copper terminal.

6.20.9 Using the carbon tongs heat the copper terminal. Once at temperature, feed the Sil-Fos rod through the feedhole at the threaded end of the terminal. Then reposition the tongs and feed the backside of the terminal with Sil-Fos rod. (See Figure 9- Feeding the Lead Terminal w/ Sil-Fos)

6.20.10 Clean the braze area, removing any excess Sil-Fos. Use a special honing block for cleaning the tapered terminal block.

6.20.11 Repeat the process with each of the four inner copper terminals.

6.20.12 Inspect each brazed lead terminal following cleanup. If braze a rejected, the terminal lead must be removed and the braze joint remade.

Inner Terminal #1 Pancake "B":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Inner Terminal #2 Pancake "B":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Inner Terminal #3 Pancake "B":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Inner Terminal #4 Pancake "B":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

6.21 Insulating Side "B" Lower Leads

Once the terminals have been brazed, the leads need to be insulated.

6.21.1 Apply by hand (1) half-lapped layer of composite insulation [0.007 in. thick glass tape/ 0.0065(HN) Kapton tape w/ adhesive back] over each of the individual conductors starting from the point that the conductors separate to 6 inches from the conductor end.

6.21.2 Position the first layer of (4) conductors into the conductor slots in the lower lead guide block. The conductors shall be placed in alternating slots. Care must be taken during this operation, to minimize any damage to the over wrap insulation. See Figure 10- Positioning leads.

Verified:

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

6.22 General Winding Notes:

See section 6.10 for "General Winding Notes".

6.23 Side "B" Winding Operation:

6.23.1 Wind layer number 1

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 1

(Optional) If measurements were made; Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.2 Wind layer number 2

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 2

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.3 Wind layer number 3

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 3

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.4 Wind layer number 4

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 4

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.5 Wind layer number 5

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 5

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.6 Wind layer number 6

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 6

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.7 Wind layer number 7

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 7

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.8 Wind layer number 8

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 8

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.9 Wind layer number 9 **[Note: Maximum turns in Type C and TRC coils]**

Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 9

(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.23.10 Wind layer number 10 **[Note: Maximum turns in Type A and B coils]**
Note all observations and/or the addition of shim packs. All Romer data (measurements) shall be added to the back of the procedure.

Notes:

Completion of layer no. 10
(Optional) If measurements were made, Field Supervisor must verify that they were acceptable and the appropriate shims have been added.

Verified by: _____ **Date:** _____
Field Supervisor

If no measurements were made or shims added, the Lead Technician may sign off completion of turn.

Lead Technician verify: _____ **Date:** _____

6.24 Final Position of side "B" Upper leads

6.24.1 Mount the upper guide block assembly to the MCWF and secure in position. See Figure 13-Upper Lead Guide Block Assembly.

6.24.2 Pre-determine the length of conductor that will become the coil leads.

6.25 Brazing Side "B" Upper Leads:
The lead terminals will be attached to the conductor using a flameless "Nibco" resistive heating carbon tongs and Sil-Fos braze material. Only braze-qualified individuals can perform the lead brazes and requirements of ES&HD 5008, Section 9, Chapter 15 for safe brazing must be followed.

6.25.1 Notify the ESU and obtain a flame permit prior to starting brazing operation.

Lead Technician verify: _____ **Date:** _____

6.25.2 Area preparation: Protect the surrounding coil area from any dirt or carbon that may occur as a result of the brazing operation. The area between clean rooms MUST be isolated if a coil is in the adjacent room.

6.25.3 Copper Terminal: Clean the copper terminal using acetone-degreasing agent scotchbrite and clean cotton cloths. Use a wire bottlebrush on the inner bore along with the acetone. Once cleaned, do not touch the components with bare hands.

6.25.4 Conductor Preparation Step 1: Reshape the copper conductor using phenolic form blocks to provide a proper fit between the cable and terminal block. The nylon serve shall remain in place during the rounding operation. See Figure 5- Conductor w/Phenolic Blocks and Figure 6- Conductor in Forming Blocks.

6.25.5 Conductor Preparation Step 2: Once formed, carefully remove the Nylon serve (covering) from the conductor the length of the inner terminal bore. (Figure 7- Removing Nylon Serve from conductor and Figure 8- Conductor in Terminal)

6.25.6 Conductor Preparation Step 3: Strip back approximately 4 inches of the nylon serve starting at the copper terminal.

6.25.7 Position the bare copper conductor into the water chill blocks and position the Argon gas head directly over the copper terminal.

6.25.8 Position the carbon tongs over the solid portion of the copper terminal.

6.25.9 Using the carbon tongs heat the copper terminal. Once at temperature, feed the Sil-Fos rod through the feedhole at the threaded end of the terminal. Then reposition the tongs and feed the backside of the terminal with Sil-Fos rod. (See Figure 9- Feeding the Lead Terminal w/ Sil-Fos)

6.25.10 Clean the braze area, removing any excess Sil-Fos. Use a special honing block for cleaning the tapered terminal block.

6.25.11 Repeat the process with each of the four inner copper terminals.

6.25.12 Inspect each brazed lead terminal following cleanup. If a braze is rejected, the terminal lead must be removed and the braze joint remade.

Outer Terminal #1 Pancake "B":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Outer Terminal #2 Pancake "B":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Outer Terminal #3 Pancake "B":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

Outer Terminal #4 Pancake "B":

Date Brazed: _____ Braze performed by: _____

QC Inspected by: _____ Date: _____

Notes:

6.26 Insulating Side "B" Upper Leads

Once the terminals have been brazed, the leads need to be insulated.

6.26.1 Apply by hand (1) half-lapped layer of composite insulation [0.007 in. thick glass tape/ 0.0065(HN) Kapton tape w/ adhesive back] over each of the individual conductors starting from the point that the conductors separate to 6 inches from the conductor end.

6.26.2 Position the last layer of (4) conductors into the conductor slots in the upper lead guide block. Care must be taken during this operation, to minimize any damage to the over wrap insulation. Figure 14- Upper Lead Guide Block and Leads

6.26.3 The lead installation activities have been completed.

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

Quality Control: _____ **Date:** _____

Notes:

6.27 Completion of Groundwrap Installation

6.27.1 Complete the groundwrap insulation on both coil pancakes on sides A & B. It will necessary to remove the G-11 side plate on side "A". Overlap the layers of Groundwrap and secure in position with adhesive back Kapton.

6.27.2 Secure the G-11 Side plate to the Lead Guide block with the appropriate hardware. ( )

6.27.3 The ground wrapping of the "A" and "B" pancakes has been satisfactorily completed.

Verified:

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

6.28 Completion of Pancakes "A" and "B":

Pancakes "A" and "B" have been completed and are ready for Chill Plate installation.

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

QC shall verify completion of documentation:

Quality Control: _____ **Date:** _____

6.29 Installation of Chill plates:

6.29.1 Select the outer chill plates being used for the coil type being manufactured. The outer chill plates shall be de-burred prior to use. Clean the copper plates with CRC Industrial "Chlor-Free Degreaser and clean cotton cloths. EXTREME CARE must be taken during handling of the cladding because of the sharp edges. It is recommended that Kevlar gloves be worn while handling the chill plates.

6.29.2 Coat the outer surface of the chill plates with Formvar. Allow the coating to dry prior to using.

6.29.3 Check that there are no sharp edges or burrs on any of the chill plates.

6.29.4 Fitup each section of copper chill plates to the outer ground wrap wall of the modular coil using the chill plate mapping drawings. Customizing of each section of copper chill plates may be required. Ensure that there are no sharp edges or burrs as a result of the customizing activities. Reclean if necessary.

6.29.5 The chill plates will interface with the inner copper cladding at point A and B identified on **Figure 16- Outer Chill Plates**.

6.29.6 Once a chill plate is in position, CAREFULLY peen over the cladding tabs at points A and B using a ball peen hammer and center punch (stake) the two plates together (**Figure 17- Joining of Inner Cladding & Outer Chill Plates**). Extreme care must be taken to ensure that the coil bundle is not damaged during this operation.

6.29.7 During the installation of the chill plates, continue to verify that the chill plates are electrically isolated and are not forming a loop using a multi-meter.

Equipment Name & ID Number:_____**Calibration Date:** _____

6.29.8 Continue this process until all of the chill plates have been fitup and secured in position. Add any additional installation notes at the back of the procedure.

Installation of the Outer Chill Plates is complete and plates are electrically isolated:

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

Quality Control: _____ **Date:** _____

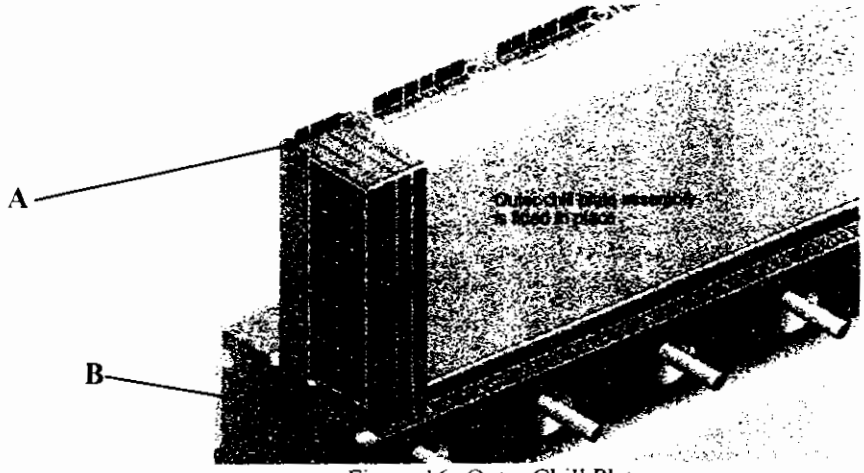

Figure 16- Outer Chill Plates

Figure 17- Joining of Inner Cladding & Outer Chill Plates

6.30 Installation of Cooling Tube/Fringe Assembly

6.30.1 Each of the outer cooling tube/fringe assemblies should be hydrostated to 200 psi prior to being delivered to the Winding Facility for installation in the coils. Attach data sheets to coil book.

Verify: **Field Supervisor:** _____ **Date:** _____

6.30.2 Select the outer cooling tube/fringe assembly being used for the coil type being manufactured. The fringe assembly plates shall be deburred prior to use. Clean the copper plates with CRC Industrial "Chlor-Free Degreaser and clean cotton cloths. EXTREME CARE must be taken during handling of the sub-assemblies because of the sharp edges. It is recommended that Kevlar gloves be worn while handling the chill plates.

6.30.3 Paint the side of the assembly that faces the chill plates with Formvar. Allow to dry before installing.

6.30.4 Check that there are no sharp edges or burrs on any of the plates.

6.30.5 During the installation of the cooling tube sub-assembly, the sidebars of the winding clamps can be removed to allow easy fitup and installation. The top portion of the clamp MUST remain in position securing the copper turns.

6.30.6 Fitup each section of cooling tube sub-assembly to the outer chill plates using the cooling tube mapping drawings and secure in place with adhesive (Figure 18- Cooling Tube Sub-Assembly Installation). Some customizing of each cooling tube sub-assembly may be required. Ensure that there are no sharp edges or burrs as a result of the customizing activities. Reclean if necessary.

Adhesive used to hold sub-assemblies:

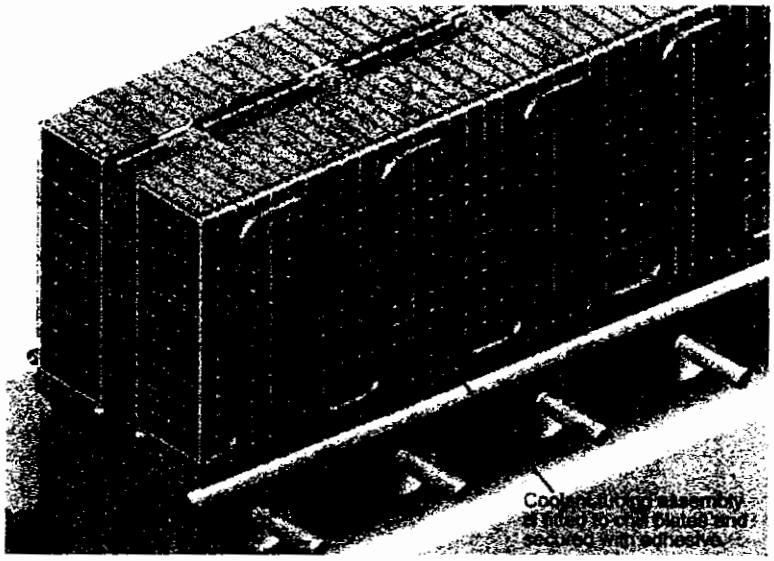

Figure 18- Cooling Tube Sub-Assembly Installation

6.30.7 During the installation of the cooling tube subassembly, continue to verify that the chill plates are electrically isolated and are not forming an electrical loop using a multi-meter.

Equipment Name & ID Number: _____ **Calibration Date:** _____

6.30.8 Continue this process until all of the outer cooling tube sub-assemblies have been fitup and secured in position. Add any additional installation notes at the back of the procedure.

6.31 Hydrostatic Tests:

Cooling tubes will be hydrostat tested to verify the integrity of the cooling tubes.

6.31.1 Place compression fittings on each end of the coolant tubes.

6.31.2 Using engineering procedure **ENG-014** (Guidelines for Hydrostatic and Pneumatic Testing) test the individual conductors.

6.31.3 Fill the coolant tubes in the conductors with water, then pressurize to **200 psi** with nitrogen and isolate from the pressure source.

6.31.4 All safety precautions including the use of PPE's shall be followed as outlined in the Job Hazard Analysis sheet and recommendations made by the PPPL Industrial Hygienist.

6.31.5 Gauges shall have a minimum **2-psi** resolution. **QC verify:** _____ **Date:** _____

6.31.6 **Acceptance criteria:** The test pressure shall be maintained without any detectable drop within the resolution of the gauge for at least ten minutes from the time the system was isolated from the pressure source, during which time there shall be no change in the pressure reading on the calibrated pressure gauge.

6.31.7 Record test data in the table number 4.

Cooling Tube No.	Start/Final Pressure Reading (psi)	Test Duration (Minutes)	QC Inspection (pass/fail)	Cooling Tube No.	Start/Final Pressure Reading (psi)	Test Duration (Minutes)	QC Inspection (pass/fail)

Installation of the Outer Cooling Tube Sub-assemblies is complete:

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

Quality Control: _____ **Date:** _____

6.32 Installation of Diagnostic Loops

6.32.1 Diagnostic flux loops are to be positioned on the outer edges of each coil pancake as identified in Figure 19-Diagnostic Loops. Actual position will be determined by NCSX drawings.

6.32.2 Notify the Diagnostic representative that the installation of the flux loops is ready to begin. Diagnostic group to provide flux loops.

Verify:
Lead Technician: _____ **Date:** _____

6.32.3 Place (1) layer of adhesive backed Kapton on the chill plates in the area that the flux loops will contact the chill plates. This will provide electrical isolation from the chill plates.

6.32.4 Carefully position the flux loop and secure in place with adhesive back Kapton.

6.32.5 Route the Flux loop leads through the area where the coil leads exit the winding form. In the area where the flux loop leads come in proximity of the coil leads, insulate the leads with (1) ½-lapped layer of Kapton.

Verify: **Lead Technician:** _____ **Date:** _____

6.32.6 Once the Flux loops are positioned, measure their position using the "Romer" measuring arm and attach data to procedure. Provide data to the Diagnostic representative.

Notes:

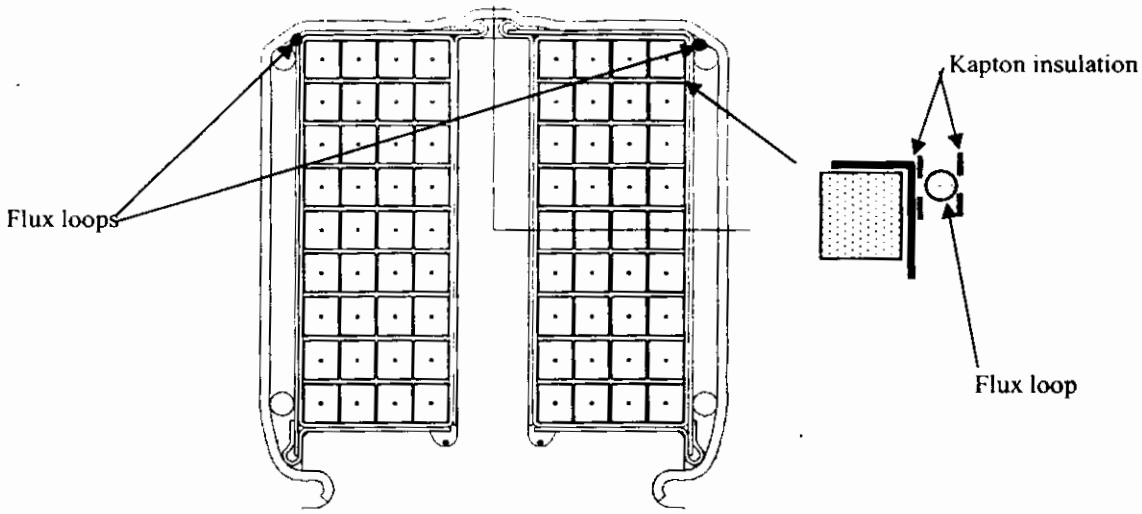

Figure 19-Diagnostic Loops

6.33 Installation of Bag Mold:

6.33.1 Once the chill plates and cooling tubes have been installed, the installation of the "bag mold" is the next operation.

6.33.2 During this procedure, to maintain dimensional control the number of adjacent winding clamps that can be removed should be no more than three.

6.33.3 Install (1) layer of dry glass tape over the chill plates in the areas of the final coil clamps. (Figure 20- Bag Mold Preparation-1)

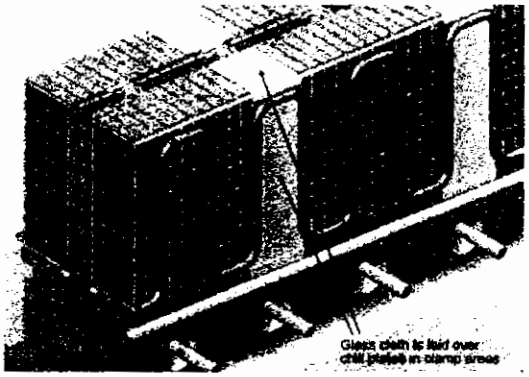

Figure 20- Bag Mold Preparation-1

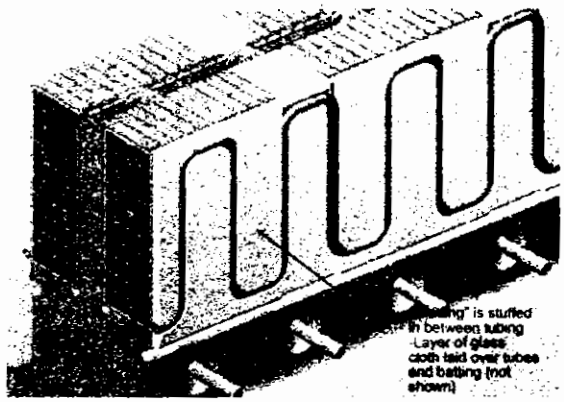

Figure 21- Bag Mold Preparation-2

6.33.4 Install glass or felt batting between the cooling tubes in all areas except where the final coil clamps will be placed. (Figure 21- Bag Mold Preparation-2). The depth of the batting shall equal the diameter of the cooling tubes.

6.33.5 Apply (1) layer of 0.010 inch thick glass cloth over the exposed cooling tubes. Secure glass tape in place with adhesive backed Kapton.

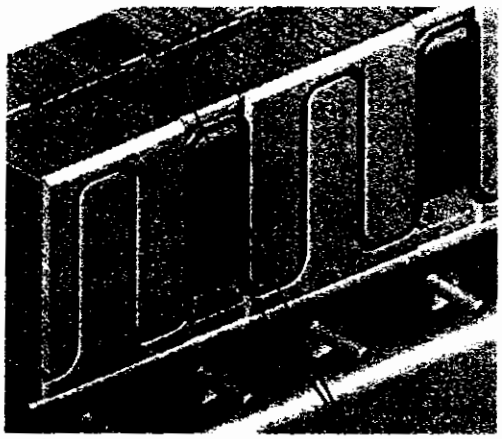

Figure 22- Bag Mold Preparation -3

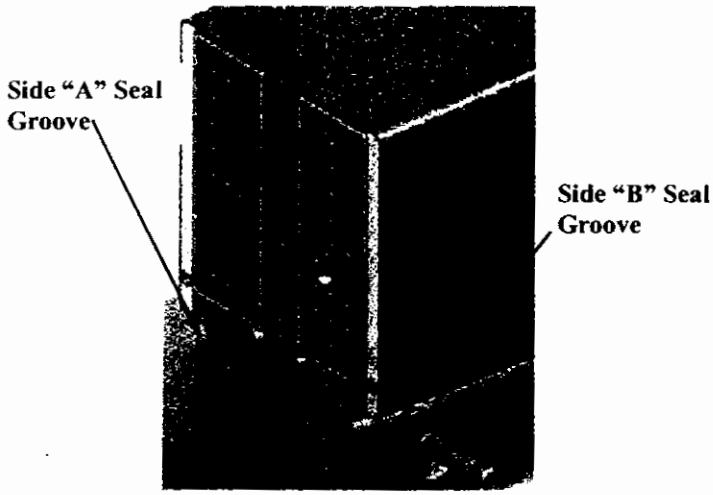

Figure 23- Installation of Bag Mold

6.33.6 Install G-10 pressure pads in the areas where the final coil clamps will be placed. (Figure 22- Bag Mold Preparation -3

6.33.7 During the installation of the bag mold, VPI epoxy sprues will be installed in locations as agreed upon by the lead technician and the field supervisor. Document the location of the sprues.

6.33.8 Apply (2) half-lapped layers of the silicone rubber tape over the modular coil bundle chill plate and cooling tube assembly. The silicone tape extends from the Side "A" seal groove across the top to the Side "B" seal groove. Apply bead of adhesive RTV caulking in the seal groove prior to positioning the silicone tape. (Figure 24-Bag Mold Plan)

6.33.9 Hold the silicone rubber bag mold in the groove using 5/16" refrigeration tubing. Use the winding clamps with spacers to hold the tube in place. (Figure 24-Bag Mold Plan)

6.33.10 It is important to note that the bag mold can only be installed in small sections. Removal of too many clamps will result in possible loosening of turns. Do not remove any more than three adjacent clamps at one time. Once a section of coil is complete, immediately reinstall the winding clamps to the bundle.

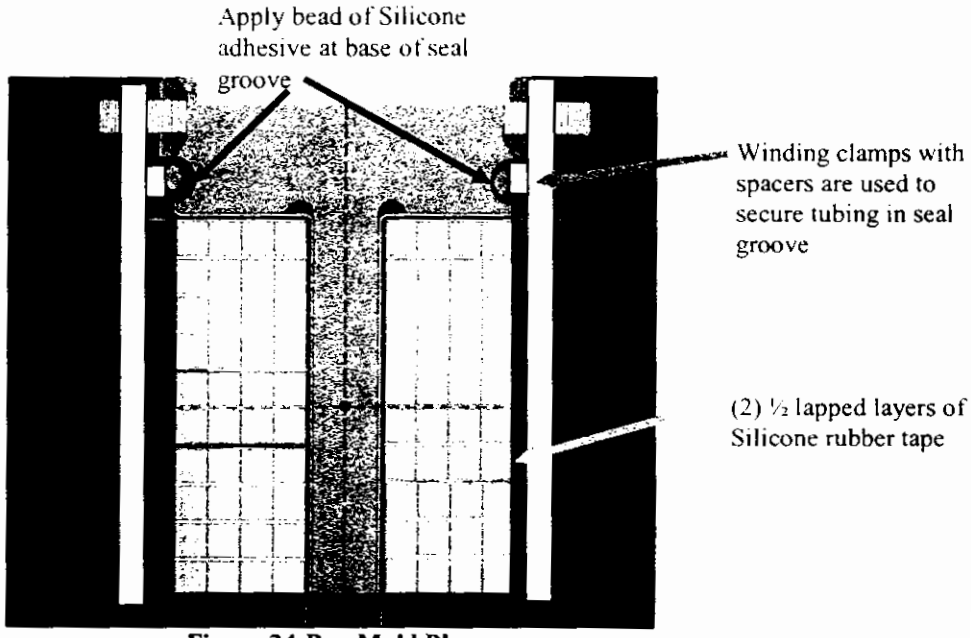

Figure 24-Bag Mold Plan

6.33.11 Once the entire bag has been installed, apply a vacuum to the bag mold. This will help the silicone bag to conform to the bundle.

6.33.12 Check for any gross vacuum leaks. Repair leaks with adhesive RTV108.

Vacuum pressure (achieved):

Notes:

6.33.13 Paint the outer surface of the silicone bag with 2- part RTV 11 (white) to seal any small leaks in the bag. Allow the RTV to dry for minimum 12 hours.

Bag mold has been sealed and is ready for installation of outer shell.
Verified:

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

6.33.14 Install (2) layers of impregnated felt (batting) over the bag mold, between the clamps (6 inch centers).

6.33.14.1 Mix sufficient 2-part Hysol -epoxy system with mix ratio recommended by the epoxy supplier. (Resin 3561 /Hardener 2039) Document all epoxy mixing data

Epoxy mix ratio used:
100 pbw of Resin..... Hysol RE2039
30 pbw of Hardener..... Hysol HD3561

Quantity of epoxy mixed:

Epoxy mix data:

6.33.14.2 Soak the precut felt sections in the Hysol epoxy until well wetted.

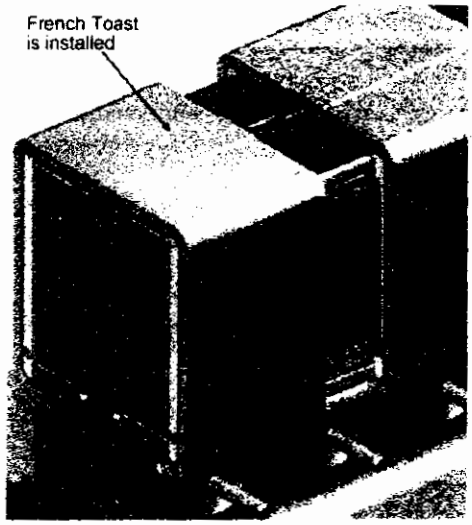

Figure 25- Epoxy/Felt Outer Wall

6.33.14.3 Apply the epoxy soaked sections of felt over the entire coil bundle. Secure the ends of the felt using clamps.

6.33.14.4 Allow 24 hours for the Hysol to totally cure before proceeding with the next activity.

6.33.15 Installation of the "Bag Mold" is complete:

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

Quality Control: _____ **Date:** _____

6.34 Pre-VPI Electrical Tests:

6.34.1 The NCSX Project Engineering Manager shall determine the test level and acceptance criteria for any tests to be performed:

Coil Voltage level: _____ **volts**

Coil Resistance _____ **ohms**

NCSX Engineering Project Manager: _____

6.34.2 The Test Director for this test is: _____

6.34.3 ***The following safety and prerequisites shall be used for performing test of the OH Coil.***

6.34.3.1 Technicians and engineers performing these tests shall be familiar with the hazards and work procedure to minimize accidents that may occur.

6.34.3.2 There shall be present a second person, "safety watch" monitoring the operator, and capable of removing the power in case of an accident. This person shall be CPR qualified.

Qualified CPR Member: _____ **Recert. Date:** _____

6.34.3.3 During the test, the "Test Area" shall be roped-off and suitable "danger high voltage" signs and flashing lights displayed.

Test Director Verify: _____

6.34.3.4 The test operator shall stand on an electrical safety mat during the test operation.

6.34.3.5 Approved rubber electrical safety gloves shall be worn by test members during grounding operations which occur once the test has been completed, and the test equipment turned off.

6.34.3.6 Upon completion of test and before the components are declared safe to touch, the coil being tested shall be properly discharged using a "Ground Hook". After a minimum period of 10 seconds, while the ground hook is still in place, attach a ground cable to the coil. The ground hook may be removed once the ground cable is in place.

6.34.3.7 Electrically ground the winding form, and the adjacent coil pancake not being tested.

6.34.3.8 Measure the insulation resistance of pancake "A". The test results shall be in compliance with the requirements noted in Section 6.34.1.

6.34.3.9 Ground pancake "A" and repeat the test for pancake "B". Measure the insulation resistance of pancake "B". The test results shall be in compliance with the requirements noted in Section 6.34.1.

Test Coil	Test Voltage Level Volts	Measured Resistance Ohms	Remarks
Pancake "A"			
Pancake "B"			

Equipment ID No. _____ **Calibration Date:** _____

Megger Results: ***Acceptable:*** _____ ***Unacceptable:*** _____

Test Director Signoff: _____ **Date:** _____

Quality Control Witness: _____ _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

7 Completion of Activities at Winding Station:

7.1 Document Verification:
Verify that all pertinent data in the procedure and data sheets have been completed.

7.2 Field Package:
Ensure that all data sheets, photographs, QC inspection sheets, etc are included in the Field Package.

7.3 Approval:
Prior to releasing a modular coil to the Vacuum-Pressure-Impregnation station (VPI), it is required that the all-responsible individuals sign the release indicating that all processes at the winding station have been satisfactorily completed. The release will include signatures from the Station Lead Technician, Field Supervisor and the QC representative.

All winding form preparation activities have been satisfactorily completed.

Lead Technician: _____ **Date:** _____

Field Supervisor: _____ **Date:** _____

QC shall verify completion of documentation:

Quality Control Representative: _____ **Date:** _____

The modular coil with "Bag Mold" is ready for transfer to the VPI station no. 5:

Comments:

Daily Start Up Log- Station 2, 3 and 4

Date	Lead Tech Initial	Date	Lead Tech Initial	Date	Lead Tech Initial

Daily Shutdown Log- Station 2, 3 and 4

Date	Lead Tech Initial	Date	Lead Tech Initial	Date	Lead Tech Initial