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AXICELL CONFIGURATION

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TABLE OF CONTENTS

<u>SECTION/TITLE</u>	<u>PAGE NO.</u>
1.0 INTRODUCTION	1-1
2.0 FACILITIES	2-1
3.0 TOOLING PLAN	3-1
4.0 SOLENOID COIL MANUFACTURING	4-1
4.1 Manufacturing Sequence and Flow	4-1
4.2 Coil Winding	4-4
4.3 GDC Coil Closeout	4-9
4.4 CBI Case Closeout	4-11
4.5 Schedule and Performance	4-12
5.0 AXICELL COIL MANUFACTURING	5-1
5.1 Manufacturing Sequence and Flow	5-1
5.2 Coil Winding	5-2
5.3 GDC Coil Closeout	5-7
5.4 CBI Case Closeout	5-12
5.5 Clevis Installation	5-13
5.6 Schedule and Performance	5-14
6.0 TRANSITION COIL MANUFACTURING	6-1
6.1 Manufacturing Sequence and Flow	6-1
6.2 Coil Winding	6-1
6.3 GDC Coil Closeout	6-5
6.4 CBI Case Closeout	6-10
6.5 Clevis Installation	6-12
6.6 Schedule and Performance	6-12
7.0 PRODUCIBILITY	7-1
7.1 Introduction	7-1
7.2 Solenoid Coils	7-2
7.3 Axicell Coils	7-4
7.4 Transition Coils	7-8
8.0 LESSONS LEARNED	8-1
9.0 DEACTIVATION PLAN	8-2
10.0 CONCLUSIONS	10-1
11.0 REFERENCES	11-1

APPENDICESPAGE NO.

A	MFTF-B CAPITAL EQUIPMENT, HAND TOOLS, AND SUPPORT TOOLING LISTS	A-1
B	SOLENOID COIL WINDING TIMES PERFORMANCE LOG	B-1
C	SOLENOID CONDUCTOR SPLICE CHECKLIST	C-1
D	SOLENOID CONDUCTOR SPLICE TIMES PERFORMANCE LOG	D-1
E	MFTF-B AXICELL COIL WINDING TIMES PERFORMANCE LOG	E-1
F	DISPOSITION OF MFTF-B CUSTOMER-OWNED SURPLUS	F-1

LIST OF TABLES

<u>TITLE OF TABLE</u>	<u>PAGE NO.</u>
4-1 MFTF-B Solenoid Magnets Manufacturing Work Plan	4-15
4-2 Solenoid Span Times	4-16
4-3 Solenoid Coil Winding Times	4-17
5-1 MFTF-B Axicell Magnets Manufacturing Work Plan	5-15
5-2 Axicell Span Times	5-16
5-3 Axicell Coil Winding Times	5-17
6-1 Transition Magnets Manufacturing Work Plan	6-14
6-2 Transition Span Times	6-15

LIST OF FIGURES

<u>FIGURE TITLE</u>	<u>PAGE NO.</u>
1-1 MFTF-B Magnet System Axicell Configuration	1-2
2-1 General Dynamics Harbor Drive Facility	2-4
2-2 Manufacturing Facilities	2-5
2-3 Solenoid Coil Winding Lines	2-6
2-4 Axicell Coil Prep Station	2-7
2-5 Axicell Coil Winding Lines	2-8
2-6 Axicell Coil Clevis Installation	2-9
2-7 Transition Coil True-Up	2-10
2-8 Transition Coil Winding Machine	2-11
2-9 Transition Coil Closeout Weld Station	2-12
3-1 Transition Coil Winder/Tensioner Installation and Assembly	3-4
3-2 Transition Coil Winder Modifications	3-5
3-3 Transition Coil Tensioner Modifications	3-6
3-4 Transition Coil Form Adapters	3-7
3-5 Axicell Coil Winding Equipment	3-8
4-1 Solenoid Coil Manufacturing Sequence and Flow	4-18
4-2 Solenoid Coil Prep for Winding	4-19
4-3 Solenoid Coil Winding	4-20
4-4 Solenoid Coil Closeout and Weld	4-21
4-5 Solenoid Coil Assembly and Installation	4-22
4-6 Solenoid Coil Winding Learning Curve	4-23

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE NO.</u>
5-1	Axicell Coil Manufacturing Sequence and Flow	5-18
5-2	Axicell Coil Prep for Winding	5-19
5-3	Axicell Coil Winding	5-20
5-4	Axicell Coil Closeout, Weld, and Clevis Installation	5-21
6-1	Transition Coil Manufacturing Sequence and Flow	6-16
6-2a	Transition Coil Prep for Winding Sequence	6-17
6-2b	Transition Coil Prep for Winding Photos	6-18
6-3a	Transition Coil Winding Photos	6-19
6-3b	Transition Coil Closeout Station	6-20
6-3c	Transition Coil Closeout Station (GDC)	6-21
6-3d	Transition Coil Closeout Photos (GDC)	6-22
6-4a	Transition Coil Case Closeout and Assembly Sequence (CBI)	6-23
6-4b	Transition Coil Case Closeout Photos (CBI)	6-24
7-1	Producibility Photos - Solenoid Coils	7-10
7-2	Producibility Photos - Axicell Coils	7-11
7-3	Producibility Photos - Transition Coils	7-12

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INTRODUCTION

Manufacturing Engineering has provided continuous surveillance and producibility analyses since the start of the design phase of the MFTF-B program. It has been their responsibility to make sure that the magnet designs are producible with today's technology and that the drawings produced are accurate and comprehensive for shop use. Tooling concepts evolved, the Manufacturing Sequence and Flow Plan was developed, and the factory layout for installation of capital and customer-owned equipment and facilities was made. The design and manufacture of tools was accomplished as manufacturing progressed.

Figure 1-1 is an illustration of the entire MFTF-B Magnet System Axicell Configuration. Twenty of the forty-two coils (the two Yin-Yang coil pairs and the sixteen trim coils were manufactured at LLNL) were manufactured at the General Dynamics Harbor Drive Facility.

Manufacture of the twenty coils (twelve solenoid coils, four axicell coils, two T2 transition coils, and two T1 transition coils) was accomplished through the combined skills and experience of Chicago Bridge & Iron Company (CBI) in heavy metal cutting and welding and General Dynamics Convair (GDC) in coil winding and assembly. Structural components consisting of coil forms for the solenoid and transition coils, case closure sections, and clevis fittings were fabricated by CBI at their Salt Lake City, Utah, facility. The axicell coil forms, case closure sections, and clevis fittings were fabricated at the CBI Birmingham, Alabama, facility.

This Final MFTF-B Manufacturing/Producibility Report covers facilities, tooling plan, manufacturing sequence, schedule and performance, producibility, and lessons learned for the solenoid, axicell, and transition coils, as well as a deactivation plan, conclusions, references, and appendices.

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Figure 1-1. MFTF-B Magnet System Axicell Configuration

FACILITIES

Manufacturing of the twenty MTF-B magnets took place at the General Dynamics Harbor Drive Facility (see Figure 2-1). All coil winding was accomplished in Building 52 under protective tents. Figure 2-2, upper illustration, shows a layout of Building 52. The solenoid coils were wound prior to the axicell coils in the same area shown for the axicells. The layouts of Building 37 and the concrete pad adjacent to Building 52 are also shown in Figure 2-2.

Two solenoid lines were installed (see Figure 2-3) due to the challenging delivery schedule for the twelve solenoid coils. An existing GDC winding line design was incorporated to have commonality of winding systems, specifications, and procedures. Using a different system would have complicated maintenance and negated the use of common spare parts. In addition to the winding lines, a prep station was provided in Building 52 for true-up of the solenoid coils and installation of ground and kapton insulation prior to winding. Upon completion of winding, the solenoid coils were moved to Building 37 for GDC plenum closeout and CBI closeout welding.

Figure 2-4 shows the axicell coil form prep station in Building 37. In this station, leak test of the coil form was followed by true-up and installation of ground and kapton insulation. Figure 2-5 shows the solenoid winding lines being converted into two axicell winding lines in Building 52. Following winding, the axicell coils were moved back to Building 37 for GDC closeout, CBI closeout welding, and GDC final leak and electrical tests. The axicell coils were then moved to the concrete pad adjacent to Building 52 for CBI installation of clavis fittings (see Figure 2-6).

Figure 2-7 shows a 12 transition coil form in the Building 37 true-up station. Following coil form true-up, the ground and Kapton insulation was installed. Figure 2-8 shows one of the coil winders with tensioner used to

wind the four transition coils in Building 52. The LLNL coil winder, used to wind the Yin-Yang coils at Livermore, was transported to San Diego and erected beside this winder in Building 52 to permit concurrent winding of two transition coils.

A major facilities task was encountered during the installation of the electrical control system on the LLNL coil winder. Prior to delivery to GDC, the winder and tensioner were stored at LLNL. Many electrical components were missing, wiring stripped, and cable interconnects cut off. It was also found that the winder control system was not the same as the other coil winder already installed in Building 52. A lengthy process of redesign to the present (axicell) configuration was required. It was also necessary to make a complete installation for the LLNL tensioner electrical system. This system was made identical to the existing GDC tensioner and design. Since both coil winders and electrical systems were designed by Teledyne Readco, it was necessary to obtain manuals and electrical schematics to complete this task.

Prior to the setup of a special closeout station in Building 52 (see Figure 6-3c), part of the GDC closeout of the two T2 transition coils was accomplished on the winding machine. The special closeout station enabled the T2 coils to be unloaded from the winders and the winders to be converted for an earlier start on winding of the two T1 coils.

The T2 coils were then moved to the CBI closeout weld station located on the concrete pad outside of Building 52, as shown in Figure 2-9. GDC closeout of the of T1 coils was accomplished on the winding machines and CBI's closeout welding was accomplished in the closeout station inside of Building 52.

In addition to the major facilities described in this section, a complete listing of capital equipment used on MFTF-B is included in Appendix A.

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Figure 2-6. Axicell Coil Clevis Installation

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Figure 2-7. Transition Coil True-Up

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Figure 2-8. Transition Coil Winding Machine/Tensioner

289.333.35

Figure 2-1. General Dynamics Harbor Drive Facility

Figure 2-2. MFTF-B Coil Manufacturing Facilities

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Figure 2-3. Solenoid Coil Winding Lincs

269.333-5

Figure 2-4. Axicell Coil Prep Station

269.333-6

Figure 2-5. Axicell Coil Winding Lines

269.333-10

Figure 2-9. Transition Coil Closeout Weld Station

TOOLING PLAN

Manufacturing Engineering personnel with experience on large magnet programs were selected to establish a tooling philosophy tailored to provide efficient, economical, and flexible fabrication which would meet the delivery schedule for the MFTF-B program.

The tool design concepts were derived from an in-depth analysis of all detail and assembly requirements. The tooling approach was to design, fabricate, proof, and maintain quality tools at minimum cost, to provide optimum utilization of multipurpose tools, to make maximum use of available tooling, and to provide rate tools consistent with schedule requirements.

The most efficient manner for accomplishing tool manufacturing was to utilize skilled operations mechanics to manufacture the tools as a fill-in activity during winder down-time or during other production delays. Tool manufacturing also took place during the changeover from the A-Cell to the Axicell configuration. This action enabled us to retain experienced manufacturing personnel.

The first major tool installed was the A-Cell/Transition coil winder. The LLNL coil-winder design was chosen for this program since the performance requirements were similar to the yin-yang and only a small number of revisions to the design were necessary. These revisions were incorporated into the procurement specification, 71E0001. Figure 3-1 shows the six major steps involved in the original winder installation. Step one shows the winder foundation floor plates and spindle rotation drive. Two-foot studs were installed in the floor and the plates were optically leveled and grouted. Step two shows the winder base table and rollers which provide winder rotation capability. Step three shows the A-frames which provide winder tilt capability. Step four shows the counterbalance/yoke and winder platform.

The counterbalance was required for the original A-cell configuration due to the "off-center" center of gravity. Step five shows the extended work platform, safety rails, scissor lift, and gantry crane. Step six shows the tensioner and stairwell.

Further details of the installation can be found in the "Installation and Maintenance Manual," 71E0057.

As a result of the Axicell configuration change, major coil winder modifications were required. To meet the challenging transition coil delivery schedule, it was also necessary to modify and erect the LLNL winding machine at GDC. The equipment that was removed from each winding machine to accomplish this modification is shown in Figure 3-2. The yoke, yoke adapter, tilt gear, and pinion gear were removed and placed in storage. The pillow blocks were removed and later reinstalled on the modified structure. The platform was also modified to accommodate the new magnet configuration. Figure 3-2 also shows the structure extension made to the A-frames to match the existing platform height of the GDC winder. The pillow blocks were reinstalled and a chain drive was added to the existing drive system. The modifications to the LLNL winder (shown in Figure 3-2) was similar, except the work platform height was reduced six feet to permit location of the machine in the low-bay area of Building 52. The pillow blocks were mounted on the A-frames without the structure extension required on the GDC winder. We also removed six feet from the supporting legs of the LLNL tensioner (see Figure 3-3) and added a powered scissor table to provide for varying button machine heights during coil winding.

The T2 and T1 coil-form adapters (shown in Figure 3-4) which were designed to adapt readily to the modified winder, proved to be very versatile tools. They served as coil-form assembly tools at CBI, adapted to the winding machines for coil winding, and provided a means for handling and transporting the transition coils throughout the entire manufacturing process. The adapters supported the coil-form walls to prevent deformation during winding stresses and provided the base for clamping devices required to perform the

coil-winding operation. An expensive machining operation was avoided by utilizing a tooling stone material called "Velmix" between the adapter and coil-form interface surfaces.

The Axicell configuration also required that the solenoid winding lines shown in Figure 2-3 be modified for the axicell coils following the winding of the twelve solenoid coils. Figure 3-5 shows the changes in tools and facilities made on the two lines to accommodate the axicell coils. To reduce tooling costs, the solenoid spider holding fixtures were modified for use on the axicell coils.

A complete list of the support tooling and hand tools manufactured and used on the MFTF-B program can be found in Appendix A.

A major Manufacturing Engineering task involved developing and writing operating procedures and maintenance manuals for all machines and equipment used on the program. A complete listing of the procedures and manuals is provided in Section 11.0, References.

INSTALL FOUNDATION FLOOR
PLATES & SPINDLE ROTATION DRIVE

INSTALL ROTATION
TABLE & ROLLERS

INSTALL A-FRAMES
WITH TILT DRIVE

INSTALL COUNTERBALANCE/
YOKE & WINDER PLATFORM

INSTALL WORK PLATFORMS,
SCISSOR LIFT, SAFETY RAILS
& GANTRY CRANE

INSTALL TENSIONER
& STAIRWELL

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Figure 3-1. Transition Coil Winder/Tensioner Installation & Assembly

269.333-12

Figure 3-2. Transition Coil Winder Modifications

Figure 3-3. Transition Coil Tensioner Modifications

269.333-13

HANDLING TOOL

TRANSPORT TOOL

ADAPTS TO WINDER

269.333-14

Figure 3-4. Transition Coil Form Adapter

Figure 3-5. Axicell Coil Winding Equipment

4.0

SOLENOID MANUFACTURING

4.1 Manufacturing Sequence and Flow

The manufacturing sequence for the twelve solenoid coils is illustrated in Figure 4-1. The four major manufacturing steps were: the preparation of the coil bobbin for winding, winding the coil, GDC closeout, and CBI closeout welding and assembly.

Figure 4-2 highlights these steps, together with actual photographs of the tasks involved in preparing the coil bobbin for winding. The steps shown in the photos were typical for each of the twelve solenoid coils.

Upon receipt of the coil from CBI's Salt Lake City facility, the bobbin was dimensionally inspected and marked with angular locations. All measurements were checked against those given on a Receiving inspection form (Reference 11-7). The coil bobbin was mated to the spider fixture and positioned on the prep station turntable. The proper alignment in both axes was obtained with leveling bolts. The coil bobbin was aligned so the inner ring was concentric and perpendicular with the turntable. Strongbacks were added to the sideplates to correct the localized out-of-tolerance bending conditions caused by weld distortion. The coil bobbin was then held in a rigid position using tooling paste (VELMIX).

After completing the mating operation, the coil bobbin was helium-leak checked using tooling and equipment per 71E0011 (leak test fixture TSAC 712019, pumping station E0321536, and leak detector E393913) as shown in the first photograph of Figure 4-2. The requirement was to verify that the leak rate between the inner ring/side plate welds was no greater than 1×10^{-9} torr-liters/sec. at room temperature. We obtained a lesser rate of 1×10^{-10} torr/liters/sec., which was the maximum sensitivity of the GDC equipment. In the second photo, the side plates of the coil bobbin were trued-up to the inner ring using a mixture by

weight of 50 parts EPON 828 epoxy, 50 parts versamid hardener, and 11 parts 1/4-inch long-milled fiberglass fill. Mixing was a time-consuming process requiring three men to perform task manually. A producibility item was incorporated on coil number nine in the form of a heavy-duty portable mixer which reduced the manpower from three to one and also accelerated the mixing process. To maintain the proper depth for the entering lead, the machined pocket was trued to the side wall.

The inner ring was trued using a true-up mold. The mold provided a flat surface between the side plates and conformed to a radius when checked circumferentially. The side wall true-up fixture consists of aluminum plates clamped down against machined nylon true-up buttons on the outer peripheral surface, as shown. Jack screws are used at the inner surface. The nylon true-up buttons were glued to the side plates and machined to the correct height using a portable mill as the bobbin was rotated. As a producibility item, these buttons were replaced with jack screws at both the inside and outside surfaces of the true-up plates. They were located optically and positioned with the jack screws starting with coil number 7. The proper depth for the entering lead was obtained by a mold attached to the true-up plates. The mold conformed to the shape of the entering lead. A coil bobbin centerline was established and the high/low locations, parallelism, and flatness of the side plates were determined as the coil bobbin was rotated on the turntable. The high points controlled the resulting thickness of epoxy required to fill the low areas. This epoxy provided a controlled surface for the installation of the ground insulation and the conductor winding. For coil number 1, machining of the side walls was required due to an out-of-tolerance condition caused by weld distortion. In these areas, no epoxy was needed to achieve the minimum dimension between the side walls. The trued-up bobbin was then dimensionally inspected to assure the dimensions were within the minimum and maximum range between the side plates. This data was recorded on the Bobbin True-Up Form (Reference 11-7).

At completion of true-up, the entering lead pocket holes were drilled and tapped. The coil was then moved from the true-up station onto the coil winder for installation of the ground layer insulation and Kapton. Kapton installation was required to be done under a protective tent to protect against overhead or airborne contamination. As a producibility item, a portable Kapton tent was designed, built, and installed for the true-up station, so Kapton installation for subsequent coils could be accomplished off the coil winder. An additional true-up station was also installed so preparation for winding of two coil forms could be accomplished simultaneously.

Two layers of solid G-10CR insulation were used at the coil side plates. The inner ring has a single layer of solid G-10CR and the channel insulation. The G-10CR insulation and channel insulation were trimmed and fitted to the bobbin side plates and inner ring. The second layer of G-10CR insulation had local trimming cut-outs for the instrumentation leads. The original solenoid design required three of the six layers to be installed over the trued-up bobbin. A corner groove/recess was to be routed between the side plates and inner ring for Kapton access. Since the first coil form was out of tolerance, bare metal was already exposed. A design change was incorporated for all twelve solenoids to install the first layer of G-10CR insulation over the trued-up bobbin with the edges beveled for Kapton access.

The first layer of 0.062-inch thick solid G-10CR insulation was bonded to the coil side plates, followed by the six layers of 0.005-inch thick Kapton strips with 3M 74 adhesive, as shown in the third photo of Figure 4-2. The edges of each strip are staggered relative to the last layer to provide a longer electrical path-to-ground. The second layer of solid G-10CR insulation with cut-outs was bonded over the Kapton. The inner-ring channel insulation was installed directly over the Kapton. The channel insulation is not bonded to the Kapton, but held in place with nylon tension straps. The channel insulation is allowed to creep during winding. The butt joints on the channel insulation have a gap with the tension straps pulled down tight so the winding may further

compress the insulation. At completion of installing all the insulation, an insulation voltage breakdown test in helium gas was performed. The electrical test was done per 71E0011.

4.2 Coil Winding

Winding of the twelve solenoid coils was done in accordance with the Solenoid Coil Winding Procedure, 71E0021. A winding checklist was also maintained to ensure that all steps were accomplished in the correct sequence. Figure 2-3 in the Facilities Section shows a photo of the major equipment required for winding the axicell coils. As the conductor was wound, it passed from the conductor reel on the reel support through an automatic clean station, tensioner, button insulation applicator, and finally onto the coil bobbin mounted on the coil winder. The conductor reel support stands (TOAC 711914) supported two spools of conductor. The conductor was received in two lengths, prewound side by side using shipping-reel conductor supports, HDT0 SK-Q32, on spools provided by Argonne National Laboratory (Drawing No. Q3-810-44-3). Each spool of conductor could be independently loaded. The support stands were mounted in tracks to facilitate using either of the spools. As the conductor came off the spool, it passed through an automatic clean station that cleaned the conductor on all four sides with stainless steel wire brushes powered by air motors. The conductor was then washed with freon prior to passing through a length meter-counter, a set of straightened rollers, and onto the tensioner. After passing through the tensioner, the conductor was again washed with freon and the "button-on-a-string" (turn-to-turn) insulation was applied by the button dispenser. The button machine assembly was always positioned so that the conductor had an induced angle (pretwist) of ± 5 degrees prior to reaching the bobbin to facilitate winding compaction. The tensioner was mounted on a scissor-type list to provide correct attitude for winding each turn.

The coil winder consisted of a winding turntable. The coil bobbin was placed on the coil winder and positioned so the side plates had the minimum runout when the winder was rotated. Also, the inner ring of the bobbin was positioned so its center coincided with the turning center of

the winder. The control circuitry was integrated to operate the winding turntable and the tensioner.

Figure 4-3 shows an illustration of the winding steps and equipment involved, along with actual photos of the entering lead installation, coil winding and compaction, and installation of shims, filler, and layer insulation. All bobbins had a machined pocket for conductor entering lead installation. Portions of the entering lead insulation was installed simultaneously with the ground insulation for the inner ring and side plate. Also, a portion of the insulation was installed along with the entering current lead. Three layers of 3.0-inch wide by 0.005-inch thick Kapton tape was installed in the pocket. The Kapton was installed with a minimum of 1.0-inch overlap on each layer. The second and third layers were staggered so maximum path-to-ground was obtained. Formed polyurethane insulation film was then applied over the Kapton tape in the machined pocket. Adhesive 3M 74 was used locally to hold the polyurethane insulation during the ground insulation assembly. A 0.050-inch thick solid G-10CR insulation was placed over the polyurethane sheet and base of the machined pocket.

The entering lead and entering lead splice were then installed in the machined pocket in the coil side plate. The entering lead consisted of two large cross-section stabilizer components with a mechanical-lock splice fitting for joining the entering lead component. The mechanical-lock feature was found necessary after tests showed the soldered joint method could not take the above-yield loading. The primary entering lead component was a contour-machined copper plate, .15 x 3.0 inches, with grooves in the upper end for the superconductor and in the lower end for the mechanical-lock splice fitting. The splice fitting cross section was identical to the conductor stabilizer except for the increased width at the mechanical-lock location.

To prepare for splicing, the end of the conductor was heated to 450°F +/- 20°F. While the conductor was at that temperature, the superconductor insert was peeled out for a 76-inch length. The copper stabilizer was then cut 60 inches from its end so that a 16-inch (+/- .5 inches)

length remained, along with the 76-inch length of peeled-out superconductor. A solder stripper was then used to remove all solder from the copper stabilizer and exterior surfaces from the cut end back to the point where the superconductor left the slot. This was followed by a thorough cleaning with dionized water.

The clamp end of the conductor and the clamp end of the entering lead splice were placed in the Koldweld press and cold welded together. All flash was removed and the stabilizer dressed down to its original size. A liberal amount of 63/37 solder paste was applied into the cleaned superconductor groove in the stabilizer, entering lead splice, and entering current lead. The superconductor was placed in the groove and soldered in place. Additional 63/37 solder was added to make a quality solder bond between the copper pieces and superconductor. All flux and scale residue was removed from the lead using freon and Scotch Brite. The soldered area was visually and ultrasonically inspected per procedure 71E0028.

The splice fitting was riveted to the primary lead component at the locking area. The lead section was riveted to the G-10CR machined insulation with helium flow channels and bearing pads to satisfy the thermostructural requirements. The machined insulation was bolted to the case sidewall. To prevent shorting between the lead and case, several layers of Kapton were applied.

Following installation of the entering lead, a conductor-to-ground Hi-Pot test was conducted and an electrical test was performed per 71E0011.

Sidewall turn insulation was installed in the area of the machined pocket prior to start of winding of turn one. It was bonded in place using Loctite 414 adhesive. The button-on-a-string insulation was applied starting at the end of the pocket tapered insulation.

Prior the start of winding, a 300-lb tension load was applied on the conductor per the coil winder/tensioner operating procedure 71E0022.

The winding crew consisted of a winder/tensioner controls operator and an operator to tap the conductor tight using a compaction tool and to install and remove wedges and clamps. Until a producibility improvement in the form of an automatic cleaning station was designed, built, and installed, a third member was required to clean the conductor as it came off the reel.

Each coil required 24 layers of conductor fabricated per 71E0005 with 25 turns per layer. The first turn of winding was against the side wall turn insulation. The second and subsequent turns were wound with the conductor parallel and against the previously wound turn. The joggle for the first turn was incorporated in the machined pocket side wall insulation. The opposite side of the first layer required a joggle insulation where the end of turn 24 became the start of turn 25. Prior to turn 25 rising to the next layer, the conductor joggled over to the side wall. All turns wound straight except turn 25. A shim was installed upon completion of turn 25 between the ventilated post insulation and the conductor button-on-a-string insulation. The shim is required around the perimeter of the coil. The shim holds the layer winding tight in a lateral direction. Measurements were taken progressively to assure there was no sidewall spreading. A riser was installed on turn 25 where the conductor had to rise to the next layer. In-process inspection was conducted progressively after each layer was wound. This included inspection for layer flatness of not greater than .005 and bottom flatness against the layer-to-layer insulation no greater than .002. The maximum allowable gap between winding turns was also .002. An electrical test per 71E0011 was also made following the winding of each layer. Layer insulation was then installed over the first layer.

The conductor was procured in lengths long enough to wind two layers. At the end of turn 24 of the second layer, and every subsequent even layer, a splice was installed just before the conductor joggled to become turn 25. A redesign of the solenoid conductor splice was required prior to start of winding of the first solenoid coil. The original conductor splice doubler design failed tension tests at LLNL.

Only one cold weld joint was required in the original design. The redesigned splice bar required two cold welds to join the conductor stabilizer ends. The superconductor was overlapped and soldered into the copper splice bar after cold welding the splice bar ends to the conductor stabilizer ends. The 12.76-inch central portion of the splice bar had an increased width from .197 inches to .379 inches, which allowed for superconductor joggle and overlap (6.2 inches), plus another 3.0 inches at each end for transitioning of splice loading.

To start the conductor splicing operation the superconductor was peeled back out of the stabilizer to provide the required overlap and to clear the Koldweld press dies. The stabilizer ends were carefully squared up and cold welded to the splice bar. The flash was removed and the superconductor reinstalled in the slotted splice bar with the required joggle and overlap. The superconductor was then soldered in place using a torch with pyrometer monitoring of the heat. In conjunction with the original splice design, it was planned to use a clam-shell furnace for melting the solder. This plan was abandoned when the splice failed testing at LLNL.

The joggle and riser insulation pieces and their installation were identical in preparation for winding of the odd-numbered layers 3 through 23. The even-numbered layers were also identical except for layer 24. On layer 24, turn 25 became the exiting lead.

Voltage taps were installed at the conductor splice assembly on each even layer starting with layer four. The voltage taps were installed per specification 71E0029 after soldering the superconductor in the splice assembly. Soldering tools HDT0 SK-056 and HDT0 SK-057 were used for voltage tap installation. Electrical tests of each voltage tap were performed per 71E0011 after winding three turns of the next odd layer to cover the voltage tap. Prior to plenum installation, a conductor-to-ground Hi-Pot test was performed per 71E0011. This test was repeated following plenum installation.

4.3 GDC Closeout

After completion of coil winding the entering lead was bent 90 degrees using form mandrel FMMD 712569. The bend radius was 1.75 inches. The entering lead coil-to-stack angle was then installed. The faying surfaces were tinned with 63/37 eutectic solder. A 0.003-inch thick solder foil was placed in the faying surface and the nine Hi-Lok fasteners installed. The faying surface was heated and the Hi-Lok fasteners retorqued. The installation of the existing lead coil-to-stack angle was the same as the entering lead. Kapton insulation was installed below and above the entering lead, along with ventilated G-10CR insulation. The exiting lead was then attached to turn 25, layer 24. The conductor stabilizer was trimmed to the length matching the groove length in the exiting current lead. The superconductor was not trimmed since it ran continuous from the conductor through the current lead to the stack. The superconductor was left approximately four feet longer than the conductor stabilizer. The exiting lead and the entering current lead splices were similar in construction. The superconductor was inserted in the lead/coil-to-stack angle assembly. The solder operation was the same as described for the entering lead, except soldering fixture SK-042 was used. The exiting lead was installed under a winding tension of 300 pounds using a tether-post weight stand to pull the winding tight. The location of the clamp plate was determined by fitting up and bolting together the exiting lead and the G-10CR tension block. While holding tension, the clamp plate was welded to the coil side plates. The welds were ground flush to the side plates and dye-penetrant inspected per MIL-1-6806, Type 1, Method A. (The coil was covered with a silicone-rubber sheet plus an asbestos pad to prevent weld splatter and grinding material from coming in contact with the conductor or insulation.) The lower-left-hand photo in Figure 4-4 shows a completed entering and exiting lead installation. Following this operation, two voltage taps were installed on each of the entering and exiting leads. Each voltage tap was installed per specification 71E0029 and tested per 71E0011.

A 0.250-inch thick plenum insulation consisting of four panels of 0.062-inch thick punched G-10CR was laid up and bonded on the coil to match the winding contour. Trimming of the panels in the entering and exiting lead area was done using mark template MKTP 762764. The plenum insulation was installed radially without gaps between the panels and the winding. A 0.002-inch thick feeler gauge was used to check for gap. During the bonding operation, the plenum panels were held in place with bar clamps. A 0.060-inch gap was provided at the butt joint of adjacent panels to allow compression during outer ring installation. As the panels were laid up, the 48 degree punch pattern was alternated every other panel. The wire-run insulation extended around the entire perimeter of the coil to protect the voltage tap wires. The wires were laid and bonded in the grooves provided and routed to the stack location (see upper-left photo in Figure 4-4). A solid G-10CR cover was then installed over the wire-run panel. The remaining plenum punched insulation was then installed, followed by wrapping of the Kapton. The Kapton film was double overlapped from one side plate to the other side plate and vice versa. An angle-shaped fiberglass insulation cover was installed and taped in place over the Kapton to protect it. (See the lower-center photo in Figure 4-4). Before installation, a hole was cut in the Kapton protectors at the top of the coil (0 degrees) to accommodate the lead-to-vent insulator, and an oblong hole was cut in the bottom (180 degrees) to accommodate the helium inlet. To prevent the current leads from shorting to the outer ring in the vent area, the formed fiberglass lead-to-vent insulator was installed next. The insulator assembly was wrapped in Kapton and installed over the leads and onto the coil pack in the cut-out at the top of the coil (0 degrees). Tension straps were applied around the coil circumference to hold the fiberglass covers in place. A 1.0-inch wide heavy-duty filament tape was then installed around the circumference and the tension straps removed. This fiberglass also served as thermal insulation, protecting the Kapton during closeout welding. To provide additional protection of the conductor pack during closeout welding, a 2.0-inch wide Hitco tape (UT96) was applied in the areas of the back-up bars on both sides of the

coil. Finally, a .025-inch thick solid laminated closeout panel, made by bonding G-10CR sheets, was bonded to the outer-ring section using 3M 74 adhesive. Through localized compression tests, it was determined that the 0.25-thick G-10CR material would compensate for the sponginess of the plenum pack. It was originally planned that the 0.25-inch thick material be installed directly on the coil pack. It was determined from the first coil, however, that the outer ring could not be installed without damage to the G-10CR material and that there was interference with the vertical back-up bars on the rings. Since the backup bars were also 0.25 inches thick, the decision was made to install the G-10CR material on the outer ring between the back-up bars. This also resulted in uniform pressure on the plenum pack during outer-ring installation. The coil was moved from the winding machine to the closeout weld station, also in Building 52. Before start of the outer ring installation by CBI, electrical tests were conducted per 71E0011.

4.4 CBI Case Closeout

The outer ring was received in two segments from CBI, Salt Lake City. During closeout of the first solenoid coil it was found that the half-section with the stack adapter could not be installed over the leads and onto the coil form due to the height of the leads. The outer ring was then cut into three segments, providing a short segment containing the stack adapter to fit over the leads. The lower segment contained a helium fill pipe which was welded in place by CBI prior to closeout welding and helium leak tested by GDC using leak test fixture HDT0 SK-067. The stack adapter was also welded in place on the high-point ring segment by CBI and leak tested by GDC in the same manner prior to closeout welding. The weld back-up bars were also installed on the outer ring segments prior to fit-up. During outer ring fit-up by CBI, great care was taken to be sure that the fiberglass cover flanges were against both side plates around the entire circumference of the coil to prevent damage to the kapton. The gap between the back-up bars and the bobbin was also carefully checked to assure there was no gap greater than 0.06 inches. When this occurred, the back-up bar was

battered with weld metal or ground to eliminate the excess gap. During installation of the outer ring, pneumatic-powered tools were used to compress the plenum pack to remove sponginess and to obtain the proper weld gap. Large C-clamps were welded to the rings and the coil form to hold the rings in place. (See lower-center and upper-right photos in Figure 4-4.) After fit-up of all three ring segments, the outer-ring-to-bobbin width was checked and recorded and the three butt joints of the outer ring were checked. Electrical tests were then conducted per 71E0011.

Closeout welding was accomplished by CBI. The strongbacks and spider fixture were removed from the coil by CBI and the coil set on blocks using a heavy-duty crane. GDC followed with final electrical and leak tests (see lower-right photo in Figure 4-4). A producibility improvement on the method of leak testing the solenoid coils will be covered in Section 7.0, Producibility. Finally, GDC located and installed the alignment targets in preparation for shipping the coil to LLNL.

Figure 4-5, upper-right photo, shows a solenoid loaded on a transporter ready for shipment to LLNL. Substantial savings was realized by subcontracting the solenoid coil transporting to Ennis Crane Service in San Diego. They had the holding rack available and they also loaded the coil without charge when the loading coincided with other heavy-duty crane moves. Installation of box beams, stiffeners, link plates, and clevis fittings, as well as installation of the double-coil assemblies in the vacuum-vessel modules (shown in Figure 4-5) was accomplished by CBI at LLNL following delivery of the coils.

4.5 Schedule and Performance

The manufacturing schedule and performance-to-schedule for the twelve solenoid coils is provided in Table 4-1. During manufacturing four schedule revisions were made. The point and time at which these four revisions were incorporated are indicated by the small numbers 0 through

4 shown at the upper left of the effective dates as shown in Table 4-1. The reasons for the schedule revisions are as follows:

(0) Original (Master) Schedule (4/28/82)

The original schedule included fourteen solenoid coils designed for the "A"-Cell magnet configuration.

(1) Schedule Revision (9/14/82)

- a) The number of solenoid coils was reduced from fourteen to twelve.
- b) Late delivery by CBI of the first two coil forms.
- c) Coil form number 1 was out of tolerance -- required machining prior to true-up.
- d) Engineering change -- added leak test requirements prior to coil form true-up.
- e) The first eight layers of the conductor received from Supercon required cleaning during winding of the first solenoid coil.

(2) Schedule Revision (3/17/83)

Conductor shortage from Supercon -- stopped winding on the eighth solenoid coil for five manufacturing days.

(3) Schedule Revision (4/29/83)

- a) Held for spider fixtures from CBI -- delayed true-up on solenoid coils 9, 10, 11, and 12 for thirty-eight manufacturing days.
- b) GDC delayed the start of plenum closeout for twenty-four manufacturing days. This delay permitted concentration of manpower on getting solenoid coils five and six prepared on schedule for start of winding.
- c) Weld closeout tasks by CBI were stretched out to level manpower requirements due to cancellation of the A-cell coils by CBI which were to have been accomplished concurrent with the solenoids.

(4) Schedule Revision (6/13/83)

Supercon conductor damage -- required an extra splice on solenoid coil 11 and delayed the line four manufacturing days. This delay resulted from waiting for disposition and design of a midlayer splice.

The actual span-time experience for the six major manufacturing tasks is shown in Table 4-2. The average span times for the twelve solenoid coils were as follows:

	<u>Man-Days</u>
Align on spider fixture	8
True-up	15
Kapton/ground layer insulation	11
Coil Winding	36
Plenum/Closeout (GDC)	17
Closeout Welding (CBI)	32

Since coil winding was our major activity, additional performance data was monitored and recorded during production. This data is provided in Table 4-3. The average cycle times (splice-to-splice) for the twelve solenoid coils were as follows:

	<u>Hours</u>
Wind odd layer (Up)	6:36
Filler and shim (Top)	5:14
Wind Even Layer (Down)	5:46
Splice and Shim (Bottom)	17:18

Appendix B contains the "Solenoid Coil Winding Time Performance Log" for each of the twelve coils. From this data, learning curves were plotted as shown in Figure 4-6. The plot points represent the actual manhours for each two-layer cycle (72 data points) for the six coils wound on the west winding line. An 89.6 percent learning curve was achieved. This performance trend was typical for both winding lines.

The splice check list in Appendix C, which also provided target hours per step, was used for training and for measuring performance. The actual hours per step were documented as shown in Appendix D.

From this data it was determined that too much time was being expended by the crew in obtaining conductor reels when a reel change was required. This problem was solved by requiring personnel to be available for short periods of time from either winding line to select the next reels of conductor and place them in position for loading.

This data also revealed that splicing with a three-piece splice-soldering fixture was a very time-consuming process. This led to a producibility study which resulted in a one-piece splice-soldering fixture which substantially reduced this time.

TABLE 4-1
MFTF-B SOLENOID MAGNETS - MANUFACTURING WORK PLAN

COIL NO.	RECEIVE COIL FORM	LEAK TEST COMPLETE	ALIGN ON SPIRER	TRUE-UP COMPLETE	KAPTON GR LAYER COMPLETE	START WINDING	LAYER 12	WINDING COMPLETE	PLENUM CLOSEOUT COMPLETE	CGI WELD COMPLETE	SHIP TO LLNL
1	⁰ (5/07/82) 5/12/82	-- 6/22/82	(5/21/82) 6/09/82	(6/04/82) 7/09/82	(6/11/82) 7/27/82	(6/30/82) 8/10/82	¹ (10/14/82) 10/02/82	(11/05/82) 11/05/82	(1/14/83) 2/11/83	(1/31/83) 4/13/83	(5/15/83) 6/28/83
2	⁰ (6/01/82) 6/09/82	-- 7/01/82	(6/04/82) 6/30/82	(6/17/82) 7/23/82	(6/24/82) 8/20/82	(7/15/82) 8/26/82	¹ (10/18/82) 10/11/82	(11/09/82) 11/09/82	(1/28/83) 3/03/83	(2/14/83) 4/13/83	(5/15/83) 6/28/83
3	⁰ (7/27/82) 7/27/82	-- 8/06/82	(7/29/82) 8/17/82	(8/09/82) 9/13/82	¹ (9/23/82) 9/24/82	(11/08/82) 11/08/82	(12/03/82) 12/21/82	(12/23/82) 12/22/82	(2/11/83) 3/28/82	(2/28/83) 5/11/83	(5/15/83) 8/15/83
4	¹ (8/27/82) 7/27/82	-- 8/11/82	(10/06/82) 9/22/82	(10/17/82) 10/15/82	(11/09/82) 10/27/82	(11/10/82) 11/12/82	(12/07/82) 12/03/82	(1/04/83) 12/21/82	(2/25/83) 3/28/83	(3/14/83) 5/11/83	(5/15/83) 8/15/83
5	¹ (9/30/82) 9/28/82	-- 10/04/82	(11/14/82) 11/08/82	(11/23/82) 12/01/82	(12/13/82) 1/07/83	(1/03/83) 1/08/83	(1/26/83) 1/27/83	(2/15/83) 2/21/83	(3/11/83) 4/22/83	(3/28/83) 6/07/83	(8/15/83) 7/05/83
6	¹ (10/22/82) 9/28/82	-- 11/22/82	(11/24/82) 12/04/82	(12/15/82) 12/18/82	(1/03/83) 1/07/83	(1/05/83) 1/06/83	(1/28/83) 1/27/83	(2/15/83) 2/22/83	(3/25/83) 4/22/83	(4/11/83) 6/07/83	(8/15/83) 7/05/83
7	¹ (11/15/82) 11/22/82	-- -- 11/30/82	(12/16/82) 1/14/83	(1/12/83) 1/26/83	(1/28/83) 2/12/83	(2/16/83) 2/23/83	(3/11/83) 3/17/83	(3/31/83) 4/05/83	(4/08/83) 5/25/83	(4/25/83) 7/08/83	(8/15/83) 8/18/83
8	¹ (12/08/82) 11/22/82	-- 12/02/82	(1/13/83) 1/27/83	(1/31/83) 2/19/83	(2/16/83) 2/25/83	(2/16/83) 3/01/83	² (3/17/83) 3/21/83	(4/05/83) 4/21/83	(4/29/83) 5/11/83	(5/16/83) 7/13/83	(8/15/83) 8/18/83
9	¹ (1/10/83) 1/13/83	-- 1/21/83	(2/01/83) 3/28/83	(2/14/83) 4/01/83	(3/04/83) 4/07/83	(4/01/83) 4/07/83	³ (5/06/83) 5/09/83	(5/31/83) 5/27/83	(6/14/83) 6/16/83	(6/30/83) 7/31/83	(11/15/83) 8/29/83
10	¹ (1/31/83) 1/13/83	-- 1/24/83	(2/15/83) 4/14/83	(3/03/83) 4/26/83	³ (5/03/83) 5/02/83	(5/04/83) 5/04/83	(5/26/83) 5/23/83	(6/20/83) 6/15/83	(7/05/83) 7/28/83	(8/23/83) 7/28/83	(11/15/83) 8/29/83
11	³ (4/04/83) 4/25/83	-- 4/29/83	(5/03/83) 5/05/83	(5/12/83) 5/19/83	(5/24/83) 5/31/83	(6/01/83) 6/03/83	⁴ (6/29/83) 6/29/83	(7/22/83) 7/21/83	(8/05/83) 8/05/83	(9/14/83) 9/08/83	(11/15/83) 9/27/83
12	³ (4/25/83) 4/25/83	-- 5/11/83	(5/17/83) 5/16/83	(5/27/83) 6/02/83	(6/07/83) 6/10/83	(6/21/83) 6/17/83	(7/14/83) 7/11/83	(8/05/83) 8/08/83	(8/19/83) 8/17/83	(9/27/83) 9/12/83	(11/15/83) 9/27/83

() - Schedule Date

TABLE 4-2. SOLENOID SPAN TIMES (M-DAYS)

COIL NO.	ALIGN ON SPIDER	TRUE-UP	KAPTON/ GROUND INSTL.	WINDING	CLOSEOUT	WELD	TOTAL
1	22	24	16	62	21	43	188
2	17	18	22	52	25	29	163
3	13	21	8	30	31	32	135
4	3	19	8	25	21	32	108
5	9	15	22	31	21	31	129
6	8	12	8	33	21	31	113
7	2	9	17	29	14	30	101
8	7	21	5	37	12	38	120
9	4	4	5	36	13	31	93
10	3	8	4	29	13	41	98
11	3	10	8	33	9	23	86
12	2	13	6	35	7	17	80
Avg. Span M-Days	8	15	11	36	17	32	118

TABLE 4-3. SOLENOID COIL WINDING TIMES

COIL	(1)	(2)	(3)	(4)	(5)	(6)
Odd Layer (Up)	9:57	9:08	6:03	5:08	7:26	6:28
Filler and Shim	6:52	5:39	4:33	5:27	5:52	5:10
Even Layer (Down)	7:25	6:51	5:42	5:25	6:11	5:58
Splice and Shim	23:58	25:23	15:39	16:21	17:57	15:53
Totals	48:12	47:01	31:57	32:21	37:26	33:29

COIL	(7)	(8)	(9)	(10)	(11)	(12)
Odd Layer (up)	6:38	6:16	6:14	5:34	5:21	5:04
Filler and Shim	5:23	6:04	4:20	4:54	3:48	4:42
Even Layer (Down)	5:44	6:10	5:43	4:53	4:34	4:36
Splice and Shim	16:51	16:31	15:05	17:17	12:31	14:06
Totals	34:36	35:01	31:22	32:38	26:14	28:28

SOLENOID AVERAGES

Odd Layer (Up)	6:36
Filler and Shim	5:14
Even Layer (Down)	5:46
Splice and Shim	<u>17:18</u>
Total	34:54

Figure 4-1. Solenoid Coil Manufacturing Sequence & Flow

LEAK TEST COIL FORM

TRUE-UP COIL FORM

INSTALL GROUND, KAPTON & CHANNEL INSULATION

Figure 4-2. Solenoid Coil Prep for Winding

269.333-17

* THE COLD WELD DIE AND PRESS ARE ON LINE DURING CONDUCTOR SPLICING OPERATION ONLY.

INSTALL POCKET & ENTERING CONDUCTOR LEAD

COIL WINDING & COMPACTION

SOLENOID CONDUCTOR PACK

INSTALL SHIMS, FILLER & LAYER INSULATION

Figure 4-3. Solenoid Coil Winding

269.333-18

**INSTALL PLENUM & WIRE
RUN INSULATION**

**FIT & INSTALL CLOSEOUT INSULATION,
LOCATE OUTER RINGS IN POSITION
(COMPRESS PACK) & WELD (CBI)**

**INSTALL ENTERING
& EXITING LEADS**

**COMPLETE CLOSEOUT, WRAP
KAPTAN & INSTALL INSULATION
COVERS**

**PERFORM FINAL ELECTRICAL & LEAK
TESTS. LOCATE ALIGNMENT TARGETS**

269.333-19

Figure 4-4. Solenoid Coil Closeout and Weld

SHIP TO LLNL

STIFFENERS, BOX BEAMS, LINK PLATES & CLEVIS FITTING INSTALLATION

MODULE ASSEMBLY & INSTALLATION

269.333-20

Figure 4-5. Solenoid Coil Assembly and Installation

269.333.21

Figure 4-6. Solenoid Coil Winding Learning Curve

AXICELL MANUFACTURING

5.1 Manufacturing Sequence and Flow

The manufacturing sequence for the four axicell coils is illustrated in Figure 5-1. The four major manufacturing steps were: the preparation of the coil bobbin for winding, winding the coil, GDC closeout, and CBI closeout welding and clevis installation.

Figure 5-2 highlights these steps, along with actual photographs of the tasks involved in preparing the coil bobbin for winding. The steps shown in the photos were typical for each of the four axicell coils (two A2 outer coils and two A1 inner coils).

Upon receipt of the coil bobbin from CBI's Birmingham, Alabama, facility, the bobbin was dimensionally inspected and marked with angular locations. All measurements were checked against those given on a Receiving Inspection Form (Reference 11-14). The coil bobbin was mated to the holding fixture and positioned with the pancake sidewall down against the prep station turntable. The proper alignment in both axes was obtained with leveling bolts. The coil bobbin was aligned so the inner ring was concentric and perpendicular with the turntable. The coil bobbin was held in a rigid position using tooling paste (VELMIX).

After completion of the bobbin-to-holding-fixture mating operation, the coil bobbin was helium leak checked using tooling and equipment as shown in the first photo in Figure 5-2. In the second photo, the side plates of the coil bobbin were trued up to the inner ring using a by-weight mixture of 50 parts EPON 828 epoxy, 50 parts versamid hardener, and parts 1/4-inch milled fiberglass fill. No epoxy was required on the inner ring since it was machined at CBI. The sidewall true-up fixture consists of aluminum plates with a mold for the lead anchor blocks. In a manner similar to that used during solenoid manufacturing, the plates

were located optically and positioned with jack screws as shown. To maintain the proper depth, the machined pockets for the lead anchor blocks were trued to the side walls. The high/low locations, parallelism, and flatness of the side plates were determined as the coil bobbin was rotated on the turntable. This epoxy provided a controlled surface for the installation of the ground insulation and the conductor winding. The trued-up bobbin was then dimensionally inspected and the data recorded on the "Bobbin True-up Form" (Reference 11-14).

At completion of true-up, the entering and exiting lead anchor block holes were drilled and tapped. The anchor blocks, one for each side plate, and shims with liners were bolted flush with the trued-up side walls. Finally, solid ground (G-10CR) insulation was bonded to the inner ring and six (6) layers of 0.005-inch thick Kapton strips were glued onto the epoxy surfaces as shown in the third photo. In order to achieve the minimum shorting path of three (3) inches, the seams are staggered both as shown here and for the adjacent layers. Two sheets of Kapton were then bonded on the inner ring, followed by inner ring grid insulation strapped in place, solid ground G-10CR panels bonded to the sidewall opposite the pancake, and pancake channel insulation bonded in place. Since the grid insulation was allowed to creep during winding, it was held in place with tension straps to prevent the Kapton from tearing. After installation of all the insulation, an insulation voltage breakdown test was performed. This completed the preparation for winding. The coil was then moved from the Building 37 true-up station onto the coil winding machine in Building 52.

5.2 Coil Winding

Winding of the four axicell coils was done in accordance with procedure 71E0047. All four axicell coils were wound identically. Figure 5-3 illustrates the major operations performed during winding. The major equipment involved in winding these coils were: the conductor reel and reel support, tensioner and button applicator, tether post assembly, and

coil winder. As the coil winder rotated, the conductor from the conductor reel and reel support passed over the tether post assembly, through the tensioner and button insulation applicator, and finally onto the coil bobbin which was mounted on the coil winder.

The conductor was received on spools, in multiple lengths, prewound side-by-side, and in several layers. The support stand was mounted on a track to facilitate loading and unloading. As the conductor came off the spool, it passed over the tether post assembly, through the length counter and straightening rollers, and then into the tensioner capstan. The capstan provided the tension to the conductor which was reacted by the tether post assembly. As the conductor passed through the tensioner, button-on-a-string (turn-to-turn insulation) was applied by the button dispenser. Prior to reaching the coil, the conductor was passed through a pretwist station to relieve residual strains in the conductor. Until a producibility improvement in the form of an automatic pretwist station was designed, built, and installed, the operator was required to manually twist the conductor prior to reaching the coil. This pretwist angle facilitated winding compaction. The tensioner was mounted on a scissor-type lift which provided the correct altitude for winding each turn. Controls for the scissor lift were incorporated at the master control panel. The tether post assembly consisted of a 500-lb dead weight and a 100-lb spring load for a design tension of 600 pounds. The tether post carriage was adjustable to raise or lower the weight system for a straight-line pull on the tensioner and system's load cell. Controls for the carriage were also incorporated in the master control panel. The coil winder turntable rotated to pull the conductor through the tensioner. As the conductor was wound onto the coil bobbin, tension on the conductor was monitored by the system's load cell and was visually displayed on the control console. The control circuitry for operating the winding turntable was integrated with those for the tensioner. The winding operation took place inside a polyethylene protective tent and both white smocks and gloves were worn by all personnel. The tent provided protection from dust and overhead contamination from bird nests and droppings. Four portable air conditioners provided positive air pressure inside the tent at all times.

Coil winding began with a single pancake wind. The pancake was wound against the lower sidewall, starting at the inner ring and winding outward. Winding clamps (HDTO SK-114) were used for winding the single pancake. The clamps were removed as each turn was installed and were then reinstalled. After completion of the pancake wind, holddown clamps (HDTO SK-115) were installed in place of the winding clamps to keep the pancake flat against the sidewall. Six clamps of each configuration were required. Both types of clamps were supported from the holding fixture legs. The tension ring clamp (HDTO SK-124) was used to hold the free end of the pancake conductor against the inner ring. The pancake was flat to within $\pm .005$ inches when the top surface was checked with a straight edge. The conductor was also flat against the sidewall with a gap of no greater than .005 inches. The maximum gap between the turns was also .005 inches. Maximum tightness was maintained by maintaining a tensioner load on the conductor of 600 ± 25 pounds. Conductor reels were positioned onto the reel support stand so that the conductor unwound from the top of the reel and with the seam facing down. Generally, each length of conductor had a solid copper leader at each end. The end of the leader was marked with a painted band on the conductor jacket. The leader material had to be cut off and the end filed down to verify that the core contained niobium titanium superconductor. An additional five-foot length superconductor was then cut off, identified, and delivered to the Quality Assurance Manager.

Before winding the conductor onto the coil bobbin, a pancake-to-layer joggle was placed against the sidewall at the 90 degree position, with the flat side of the joggle resting against the channel insulation on the sidewall. Approximately eighteen inches from the lower sidewall, the conductor was clamped to the inner ring using a tension clamp. The coil bobbin was then rotated in a counterclockwise direction, winding four turns. It was not necessary to pack these turns tightly as they would later be unwound following winding of the pancake. After four turns, the conductor was clamped to the inner ring using another tension ring clamp. The bobbin was then rotated in a counterclockwise direction against the

pancake-to-layer joggle as firmly as possible. The first pancake turn was then completed, winding against the sidewall with the aid of six winding clamps equally spaced around the coil. A voltage tap was installed on the first pancake turn at 29 degrees, and a conductor ramp was placed at the end of the first pancake turn. The ramp directs the conductor over the joggle to begin the second pancake turn. Turn insulation was then placed on the outside surface of the conductor and bonded in place using Loctite 414 adhesive. The remaining turns (2 through 29) were then wound with turn-to-turn insulation between the conductor turns.

Before completing pancake turn 29, a tension clamp was installed outside of turn 28. The remainder of turn 29 was then wound against the tension clamp ramp. The end of turn 29 at 0 degrees was then temporarily fixed to the anchor block to maintain the winding tension. The conductor was then cut at a point 60 inches from the anchor block clamp and the end filed to verify the presence of superconducting core. Another five-foot sample was cut from the reel for Quality Assurance. The pancake turn insulation was then installed around the outer surface of pancake turn 29, except for that part of conductor that was ramping over the tension clamp ramp. Pancake shims and filler insulation was then installed.

The pancake was then isolated from the layer-wound pack by insulation. This insulation electrically isolated the pancake while still allowing helium circulation. G-10CR channel insulation was laid against the pancake, followed by six layers of Kapton. Solid .063-inch thick G-10CR was then laid against the Kapton to provide a solid wall for winding the layer portion of the conductor pack. The upper left photo in Figure 5-3 shows a wound pancake prior to its insulation.

The layer-wound pack began at the inner ring with the loose end of conductor that joggled over from the pancake wind. The layer pack was wound tightly between the pancake isolation insulation and the opposite side wall. Nine winding clamps, equally spaced around the pack, were used during layer winding. To assure maximum winding speed, a ratchet drive was installed on the clamps to permit installation and removal using a ratchet wrench. The lower left photo in Figure 5-3 shows the

clamps holding turn compaction during winding. Flatness and gaps between winding turns were maintained within the .005-inch allowed tolerance.

To begin layer winding, the upper tension ring clamp was removed and the conductor end fed through the tensioner. As soon as 600 +/- 25 pounds of tension was applied, the remaining tension ring clamp was removed. The conductor was then unwound to the point where it left the pancake-to-layer joggle. Prior to the start of winding of turn 1, the sidewall turn insulation was installed against the lower sidewall using Loc-tite 414 adhesive. A G-10CR joggle was installed over the conductor as it joggled from the pancake wind to the beginning of the first layer turn.

The winder was then rotated clockwise to lay the first turn of conductor against the sidewall turn insulation. The application of button-on-a-string insulation started at the point where it was no longer covered by the G-10CR joggle. The subsequent turns were wound parallel against the previously wound turns. To assist in locating the conductor splices, a waterproof felt-tip marker was used to indicate where the joggle arc began and ended.

The first splice on each coil occurred on the sixth turn of the first layer. The location and number of subsequent splices depended on the conductor lengths used on each coil. The varying conductor lengths were the result of using conductor fabricated per 71E0005 that was procured for the A-cell configuration. The splice joint was located immediately before the joggle area. Installation of a splice, which involves preparation of the conductor ends, cold-welding, and soldering of the joined conductor into the splice is described in detail in procedure 71E0054. Ramps and spacers were then installed around the splice. The upper right photo in Figure 5-3 shows a splice installation in progress. Winding was then continued.

At the end of turn 62, a ramp-up of G-10CR was installed beginning the second layer. The ventilated filler insulation and shims installed between turn 62 and the sidewall ground insulation formed a tight pack for completing layer one. The layer was then inspected and electrical checks performed per 71E0042, and the number of turns was recorded. The inspection after each layer included inspection for layer flatness of no greater than .005 inch and bottom flatness against the layer-to-layer insulation of no greater than .002 inch. Maximum allowable gap between winding turns was also .002 inch. Layer-to-layer insulation was then installed in preparation for winding of layer two.

The second layer was wound the same as the first, except for the ramp-up at the end of the layer. While winding the final turn (turn 62), turn insulation with shims was installed against the sidewall. Near the end of the final turn, a joggle was installed before ramping up to the next layer. The first and second layers had only 62 turns per layer due to the step in the coil form at the inner ring. The third layer was the first layer wound from sidewall to sidewall and over the inner ring step. The lower right photo in Figure 5-3 shows shims, filler, and layer insulation being installed.

Layers three through twenty-eight were wound in much the same manner except there were 68 turns per layer. A helium hy-pot test was conducted following winding of layer three. Voltage taps were installed on layers 3, 6, 9, 12, 15, 18, 21, 24, and 27. The final layer, layer 29, differed only in its completion and tie-down to the sidewall.

5.3 GDC Coil Closeout

Following winding, the coils were moved to the closeout station in Building 37. Closeout of the coils was accomplished as illustrated in Figure 5-4. The coils were moved by a rented mobile heavy-duty crane and lift cables attached to lifting lugs provided on the holding fixture. Alignment pins were used for location. The four T-slot bolts holding the spider fixture to the turntable were then installed and torqued.

Prior to the start of GDC closeout, CBI made some initial preparations for the case closure. This involved CBI welding on the stack adapter and helium fill tubes.

GDC closeout consisted of fitting and bonding closeout insulation on the inside of the outer rings, installation of entering and exiting leads, installation of voltage taps, installation of plenum and plenum wire-run insulation, wrapping of Kapton, and, finally, the solid plenum installation (see upper left photo in Figure 5-4). GDC closeout was accomplished by a two-man crew with a third man helping during plenum lay-up, trimming, and installation of the plenum.

Plenum panels were laid up prior to the initiation of coil closeout using a lay-up forming tool (HDT0 SK-108). Four sheets were bonded together on the lay-up tool using 3M-3549 adhesive. The slots were aligned on all sheets to allow for helium flow.

The entering lead assembly and installation was the first step of GDC closeout. A mark was made on the conductor 4.66 inches back from the 0 degree mark. This mark served as a "tit" mark. The jacket was then removed completely from the conductor from the "tit" mark forward. The conductor tension clamp was temporarily bolted to the anchor block to retain the 600 pounds of tension. A scribe mark was made across the conductor jacket and tension clamp tangs to fix the proper location for soldering. After making the mark, the C-clamp was again secured and the conductor tension clamp removed. Both the entering and exiting leads were joined into a single assembly using the conductor tension clamp. The joining procedure was the same for both entering and exiting leads. All holes were drilled in the tension clamps and exiting leads using DRPE 718320, followed by installation of interference-fit Hi-Lok pins, washers, and nuts; soldering of joints; and torquing of fasteners. The superconductor was soldered into the current lead assembly per MIL-S-6872, Type II (flame heat) using 50/50 lead/tin solder and flux. The joint was then thoroughly cleaned per the conductor joining procedure 71E0054. Before bolting the entering lead assembly to the anchor block, threaded inserts were installed in the prepared holes in the anchor

block. Mounting holes were then drilled in the G-10CR brackets using template DRPE 718320. Tension was applied to the entering lead assembly using the entering/exiting lead splice tether post weight stand (HDTO SK-126) and the C-clamp was removed. The lead assembly was then positioned and eight mounting bolts installed. The G-10CR brackets were positioned before installation of mounting bolts in the lead assembly. After installation of the lead assembly, the tether post weight stand was removed and mounting bolts installed in both G-10CR brackets. The exiting lead was installed in the same manner as the entering lead (see upper left photo in Figure 5-4).

Two voltage taps were installed on each of the entering and exiting leads and electrical checks made per procedure 71E0042.

The first two layers of plenum insulation were then installed. The trim-to-fit operation was done away from the coil. A 0.5-inch radius was made on the edge adjacent to the pancake to accommodate the Kapton wrapping and prevent damage to the Kapton. All edges of the G-10CR were sanded to a radius. Loc-tite 414 adhesive was used to bond the first plenum ply to the conductor pack. The plenum plies were installed without gaps between adjacent plies and the conductor winding. This was checked with a .002-inch thick feeler gage.

The Kapton insulation strips separating the pancake from the layer wind were folded over the two plenum plies. Before folding over the Kapton, a 3-inch wide polyurethane material was installed around the plenum corners. The polyurethane was bonded in place with 3M-74 spray adhesive. The Kapton strips were then folded over the two plenum plies and bonded in place also using the 3M-74 spray adhesive.

The current lead supports were installed after the first two plenum plies. Before installing the supports, two layers of Kapton were laid under the current leads and bonded with the 3M-74 spray adhesive. Clearance between the lower surface of the current leads and the Kapton surface over the second plenum ply was measured. The lower current lead support details were then ground to the measured dimension. These

support details were then snugly fitted in between the current lead and plenum and installed using 3M-3549 adhesive to bond the support to the lead. The bracket upper details were installed after seven plenum plies had been placed on the coil.

The remaining plenum plies (3 through 9) were then installed. Plies 3 through 7 were tightly fitted against the current lead supports. Before installation of the 8th ply, the clearance between the surface of the current leads and the bottom surface of the 8th ply was measured. The upper current lead support was ground to this dimension so it would fit snugly between the current lead and the plenum. The upper support details were installed on all four brackets using 3/16-inch screws. 3M-3549 adhesive was used to bond the bracket to the lead. The 9th layer did not completely surround the coil, an area over the top 120 degrees of the coil was left open for installation of the plenum channel insulation which was bonded in place using a light coating of the 3M-3549 adhesive.

The plenum wire run insulation was made from G-10CR sheets and strips bonded together using a lay-up forming tool. The completed assembly was then installed on the coil pack using a light coating of 3M-3549 adhesive. Voltage tap wires were then routed from the sidewall into the plenum wire-run insulation, with sufficient slack left to accommodate any movement in the coil. The wires were bonded in place with small dabs of 3M-3549 adhesive.

The solid plenum insulation was then installed around the perforated plenum, channel, and wire-run insulation. A 10.5-inch diameter hole was cut in the solid plenum at the top of the coil (0°) and an oblong hole at the bottom of the coil (180°). The solid plenum insulation established a constant radius surface over which the Kapton was wrapped. The solid plenum was bonded in place with a light coating of 3M-3549 adhesive.

Prior to wrapping the Kapton, a 3-inch wide strip of polyurethane material was installed around the plenum corners using 3M-74 spray adhesive. For coils WA1 and WA20, the Kapton strips were folded over one layer at a time. The ends were trimmed to achieve a staggered butt joint. The gap

between the the strip edges of the butt joints was held to 0.12 ± 0.03 inches. For coils EA1 and EA20, the Kapton was folded over the plenum one layer at a time, but the ends were not trimmed or staggered. The strips were cut to meet the 10.5-inch diameter hole at the top of the coil (0 degrees) and the oblong hole at the bottom of the coil (180 degrees). The strips were bonded in place with 3M-74 spray adhesive. The change in technique for wrapping the Kapton saved considerable time on the last two coils (EA1 and EA20). An engineering change was incorporated as a result of this producibility study.

Formed fiberglass Kapton protectors were installed over the Kapton. Before installation a 13.50-inch diameter hole was cut in the Kapton protectors at the top of the coil (0 degrees) to accommodate the lead-to-vent insulator, and an oblong hole was cut in the bottom (180 degrees) to accommodate the helium inlet. The protectors were then bonded in place with 3M-74 adhesive.

To prevent the current leads from shorting to the outer ring in the vent area, the formed fiberglass lead-to-vent insulator was installed next. The insulator assembly was wrapped in Kapton and installed over the leads and on to the coil pack in the 13.50-inch diameter cut-out at the top of the coil (0 degrees). It was then bonded in place with 3M-74 spray adhesive.

Finally, the solid plenum was installed around the circumference of the coil pack. The layers of solid plenum were applied until the surface became flush with the edge of the bobbin sidewall when the plenum was compressed with the closeout compression clamp (HDT0 SK-129). The width of the sheets was trimmed to allow for clearance of the weld back-up bars. A 10.5-inch diameter hole was cut at the top of the coil (0 degrees) and an oblong hole was cut at the bottom (180 degrees). Joints were staggered between the sheets of solid plenum to prevent the joints from occurring in the same location in consecutive layers. The sheets were not bonded in place. Tension straps were applied around the coil circumference over the solid insulation. A 1.0-inch wide heavy-duty

filament tape was installed around the circumference and the tension straps were removed. To provide additional protection of the conductor pack during closeout welding, a 2.0-inch wide Hitco tape (UT96) was applied in the areas of the back-up bars on both sides of the coil.

Experience on the first GDC axicell coil closeout will be described in detail in the "Lessons Learned" section of this report. The first coil plenum pack was oversize and CBI could not pull the outer rings together.

A layer of slotted plenum had to be removed, which resulted in extensive rework and schedule impact.

5.4 CBI Case Closeout

Prior to start of outer-ring closeout welding by CBI, the outer-ring segments were prepared for installation. This involved weld installation of the stack adapters and helium fill tubes on the appropriate segments and installation of weld back-up bars by CBI. This was followed by leak test of the stack adapters and fill tubes using fixture HOTO SK-105, and GDC installation of closeout insulation inside the outer rings. Both the A1 and A20 coils use the same 10-inch stack adapter at the top of the coil (0 degrees). The A1 coils use a 4-inch fill tube while the A20 coils use a 4-inch to 3-inch reducing fill tube. The solid plenum insulation that had been bonded to the inner surface of the rings using 3M-3549 adhesive was reduced from two layers to one layer, following the oversize pack experience on the first coil.

Before start of closeout welding, the outer rings were fit-checked on the coil by CBI. When a gap greater than 0.06 inches occurred in the fit of the backup bar to the bobbin, the backup bar was buttered with weld metal or ground to fit. The three butt splices were also checked for fit. The outer-ring-to-bobbin width was also checked and any variations noted.

Following fit-check, CBI completed closeout welding of all joints. (See the lower left photo in Figure 5-4).

Following grinding of the welds and die-penetrant inspection by CBI, the coil was removed from the turntable and placed upside-down on the floor. With the aid of a forklift, the holding fixture was removed from the coil. This was followed by GDC leak test using leak test fixture HDT0 SK-104, and final electrical checks. The coil was then moved to the CBI clevis installation station on the concrete slab adjacent to Building 52.

5.5 Clevis Installation

The clevis fitting installation was accomplished by CBI. CBI built their own clevis-locating fixtures. Two fixtures were fabricated on-site. The first fixture was a jig with locating pins and was secured to the concrete pad adjacent to Building 52. This clevis station was used on both A1 coils, as shown in Figures 2-6 and the upper right photo in figure 5-4. The other fixture was a portable jig which mated to the stationary fixture on the pad. This portable jig was used on both A20 coils.

The clevis fittings were received from C&I Birmingham with pilot holes located and drilled. These pilot holes were used with the locating pins on the fixtures. After the coils were moved to the clevis station and clocked for correct angular position, the clevis fittings were pinned to the fixture and welded. Once tacked, the pins were removed. It was necessary to turn the coil over once for completion of welds.

As a producibility item, a rotation power drive was installed for CBI so the vertical welding could be accomplished down-hand. Further details can be found in Producibility, Section 7.0. After completion of welds, the clevis pin holes were in-line bored to the correct larger-size holes.

Following the clevis-fitting installation, alignment targets were shot in by transit and installed. The coil was then loaded on a truck (see upper right photo Figure 5-4) and shipped to LLNL.

5.6 Schedule and Performance

The original schedule dated 14 February was revised on 30 June 1985 to increase the span time for GDC closeout from 15 to 18 days for the axicell coils and from 20 to 40 days for the transition coils. The second revision took place on 10 August to adjust for the 10-day strike and to incorporate two 10-hour shifts, 6 days per week. The third revision on 21 September 1984 adjusted the schedule back to two 8-hour shifts, 6 days per week. On 1 November, the schedule was again adjusted to assure meeting the super incentive bonus fee dates for axicell coils A2E, A1W, and A2E, and to meet the last ditch incentive fee dates on A2W and all four of the transition coils. Table 5-1 reflects the schedule completion dates for each manufacturing step in keeping with these revisions. The schedule dates are shown in parentheses, along with the actual completion dates.

Table 5-2 shows a summary of span times by manufacturing step for each of the four axicell coils, along with the average span time per step.

Table 5-3 shows the average time for each coil and the composite average time for each step of winding for the axicell coils. The steps include winding the pancake, winding the odd layers up, splice and shim, wind the even layers down, and installation of filler and shims following the even layers. The documentation for these averages can be found in Appendix E.

In order to assign winding crews priorities and tasks each day, schedule performance thermometer charts were developed and maintained to show the Winding crews the exact progress and status on each coil versus the schedule requirements.

TABLE 5-1

MFTF-B AXICELL MAGNETS - MANUFACTURING WORK PLAN

COIL NO.	GDC RECEIVE COIL FORM	GDC TRUE-UP COMPLETE	GDC KAPTON GR. LAYER COMPLETE	GDC WINDING COMPLETE	GDC PLENUM CLOSEOUT COMPLETE	WELD COMPLETE	GDC FINAL ELEC/LEAK COMPLETE	CBI CLEVISSES COMPLETE	GDC SHIP
A2W	⁰ (2/6/84) 2/6/84	⁰ (2/27/84) 2/28/84	⁰ (3/19/84) 3/21/84	⁰ (7/3/84) 7/17/84	³ (8/31/84) 8/28/84	³ (10/1/84) 9/28/84	³ (10/15/84) 10/4/84	⁴ (11/3/84) 11/7/84	⁴ (11/7/84) 11/7/84
A1W	⁰ (2/13/84) 2/13/84	⁰ (3/19/84) 3/21/84	⁰ (4/9/84) 4/20/84	³ (9/20/84) 8/11/84	³ (10/11/84) 9/10/84	³ (11/8/84) 10/9/84	³ (11/26/84) 10/13/84	³ (12/17/84) 10/29/84	³ (12/19/84) 10/19/84
A1E	¹ (5/25/84) 5/25/84	¹ (6/29/84) 6/29/84	³ (7/31/84) 7/31/84	³ (10/29/84) 10/23/84	⁴ (11/5/84) 11/5/84	⁴ (11/29/84) 11/26/84	⁴ (12/5/84) 11/28/84	⁴ (12/26/84) 12/17/84	⁴ (12/27/84) 12/17/84
A2E	¹ (7/3/84) 7/9/84	² (8/11/84) 8/11/84	² (8/21/84) 8/31/84	⁴ (11/19/84) 11/20/84	⁴ (12/4/84) 11/29/84	⁴ (12/21/84) 12/12/84	⁴ (12/28/84) 12/15/84	⁴ (1/12/84) 1/9/85	⁴ (1/14/85) 1/10/85

() - Schedule date.

TABLE 5-2. AXICELL SPAN TIMES (M-DAYS)

COIL NO.	ALIGN ON SPIDER	TRUE-UP	KAPTON/GRD. INSTL.	WINDING*	CLOSEOUT	WELD (CBI)	CLEVIS INSTL.	TOTAL
1 (A2W)	3	11	17	80	22	25	18	176
2 (A1W)	3	19	23	83	12	21	12	173
3 (A1E)	3	17	15	68	12	11	15	141
4 (A2E)	3	15	14	66	8	9	14	129
Average Span M-Days	3	16	17	74	14	16	15	155

* Includes Pancake

TABLE 5-3. AXICELL COIL WINDING TIMES

	<u>A2W</u> (1)	<u>A1W</u> (2)	<u>A1E</u> (3)	<u>A2E</u> (4)
Pancake	14:05	12:30	18:50	21:55
Odd Layer (Up)	10:55	12:02	9:36	9:44
Splice and Shim	12:17	12:12	11:17	10:35
Even Layer (Down)	11:36	11:33	10:57	8:56
Filler and Shim	7:57	8:54	8:52	7:04
Totals	66:40	57:11	59:32	58:14

AXICELL AVERAGES

Pancake	16:50
Odd Layer (Up)	10:34
Splice and Shim	11:35
Even Layer (Down)	10:43
Filler and Shim	<u>8:09</u>
Total	41:01

LEAK TEST COIL FORM

TRUE-UP COIL FORM

INSTALL GROUND, KAPTON
& CHANNEL INSULATION

Figure 5-2. Axicell Coil Prep for Winding

269,333-23

**WIND PANCAKE & CLAMP-OFF
SPLICE TO START LAYER WIND**

COIL WINDING STATIONS

LENGTH-TO-LENGTH SPLICE

TURN-TO-TURN COMPACTION

AXICELL COIL CONDUCTOR PACK

**INSTALL SHIMS, FILLER &
LAYER INSULATION**

269.333-24

Figure 5-3. Axicell Coil Winding

The diagram illustrates the 'CLOSE OUT AND WELD STATION' process, which involves several steps to prepare a coil for shipment:

- RECEIVE & INSPECT STACK ADAPTER & HELIUM FILL TUBE FROM VENDORS**: The process begins with receiving and inspecting the stack adapter and helium fill tube.
- WELD STACK ADAPTER & HELIUM FILL TUBES FIT & BOND CLOSEOUT INSULATION TO INSIDE OF OUTER RINGS**: The stack adapter and helium fill tubes are welded and bonded to the inside of the outer rings.
- RECEIVE & INSPECT CLEVIS FITTINGS & PINS FROM VENDORS**: Clevis fittings and pins are received and inspected.
- FIT & COMPRESS OUTER RINGS INTO POSITION WELD OUTER RING SEGMENTS**: The outer rings are fitted and compressed into position, and the segments are welded.
- RECEIVE & INSPECT CLEVIS FITTINGS & PINS FROM VENDOR FIT & WELD**: The clevis fittings and pins are received, inspected, and welded.
- ALIGNMENT TARGET**: An alignment target is used to ensure proper alignment.
- REMOVE FROM HOLDING FIXTURE PERFORM FINAL ELECTRICAL & LEAK TESTS, LOCATE ALIGNMENT TARGETS**: The assembly is removed from the holding fixture, and final electrical and leak tests are performed. Alignment targets are located.
- INSULATION**: Insulation is applied to the assembly.
- CASE**: The assembly is placed in a case.
- FIT, BOND & INSTALL PLENUM & WIREBUN INSULATION AROUND COIL PACK**: The plenum and wirebun insulation are fitted, bonded, and installed around the coil pack.
- SHIP TO LINE**: The final assembly is shipped to the line.

269.333.25

Figure 5-4. Axicell Coil Closeout, Weld, and Clevis Installation

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6.0

TRANSITION MANUFACTURING

6.1 Manufacturing Sequence and Flow

The manufacturing sequence for the four transition coils is illustrated in Figure 6-1. The four major manufacturing steps were: preparing the coil form for winding, winding the coil, GDC closeout, CBI closeout welding, and clevis fittings and tie-bar installation.

Figure 6-2a highlights the steps involved in preparing the coil form for winding. Actual photos of the tasks being accomplished are provided in Figure 6-2b. The steps shown in these photos were typical for all four transition coils (two T2's and two T1's). The first step was the receipt of the coil form from the CBI, Salt Lake City facility. The second photo shows two operators preparing the coil form for true-up, which took place in Building 37. This involved leveling the coil in the trunion fixture, installation of counterbalance weights, establishing and marking the dimensional variations from a true continuous "L" shape around the coil form, and installation of clamping tools on the adapter. On both T2 coil forms and the first T1 coil form, a "come-along" was used to rotate the coil form. A major productivity improvement was made for the last T1 coil. One end of the adapter spindle was mounted in a turntable to power the rotation of the coil form. The third photo shows the true-up of a minor radius. A metal plate true-up tool was used on the flat surface of the minor radius. True-up tools for the curved surfaces were manufactured from wood, as shown in the fourth photo. The fifth photo shows the true-up of a vertical surface where the tools were also made out of metal plate material. In each case, the location of the true-up tool was shot in using a transit, providing the continuous "L"-shaped cavity required for winding the superconductor. Jack screws provided the means for leveling the tools. The tools were progressively located, and an epoxy versamid mixture with fiberglass fill was injected through holes in the tool until the space between the coil form surface and the tool was filled. The true-up epoxy consisted of 50 parts by weight of Shell Epon

815 Resin and 50 parts General Mills Versamid 125 curing agent with 120 parts by weight of 1/32-inch long milled glass fiber. After the proper cure time had elapsed, the tools were removed and the holes left by the jack screws were filled. A three-man crew worked effectively on the true-up operation. The true-up was then inspected and voids were repaired. This was followed by drilling and tapping the fifteen holes in the lower end minor radius and sixteen holes in the upper end of the minor radius using drill plates for locating the holes. Threaded clamp rods were screwed into these holes during GDC closeout. Finally, six layers of .005-inch thick Kapton strips were glued onto the epoxy surfaces. These strips provide a minimum shorting path of three inches. Single sheets of .063-inch thick solid G-10CR insulation was then installed over the Kapton, followed by a layer of perforated .063-inch thick G-10CR on the vertical wall and four layers on the winding surface. This completed the preparation for winding.

6.2 Coil Winding

Following preparation for winding, the coil form was transported from Building 37 to the winding machine in Building 52. Winding of the coil, GDC closeout of the coil, and the initial part of the CBI closeout took place while the coil was on the winding machine, as shown in Figure 6-3a. Winding and closeout of the transition coil was done in accordance with Winding Procedure 71E0045. Coil winding consisted of placing 24 layers, with 25 turns per layer, on the T2 coils, except for layers one and two which required 23 and 24 turns respectively. The T2 coils required 24 splices which occurred at the centerline of the lower minor radius. The inner splices occurred on the even layers and the outer splices on the odd layers, except for the first and last layers which were later installed in the inlet and outlet leads respectively. Two of the 24 splices were required on layers one and two due to using Grade I conductor with insufficient lengths for completing the total layer. The varying conductor lengths were the result of using conductor fabricated per 71E0006 that was procured for the A-cell configuration. Winding of the T1 coils was similar to T1, with 30 layers and 15 turns per layer, except for layers one and two which had 13 and 14 turns respectively.

The T1 coils required 28 splices. On all four transition coils, winding of the odd-numbered layers was done in a clockwise direction and even-numbered layers in a counterclockwise direction.

All regular splices occurred at the lower end of the minor radius of the coil, with the inner splices on even-numbered layers and the outer splices on odd-numbered layers. Ramping of the conductor from one layer to the next was accomplished in the upper minor radius end of the coil. Ramping from an odd layer to the next even layer above was done on the inside of the conductor pack. Ramping from an even layer to the next odd layer above was done on the outside of the conductor pack. In this way the ramps were alternated between the inside and outside of the conductor pack as the coil was wound.

Each completed layer of conductor was closed out by side glue blocks which served to locate and hold the geometry of the finished layers. The glue blocks were bonded to the lower adjacent layer-to-layer insulation. The radial glue blocks located at the minor radius ends served to maintain the geometry resulting from reversed spiral winding and differing geometries of inner and outer splices and ramps. The glue blocks also provide a means of truing the coil pack to a specific size and surface finish by a final machining operation which was accomplished during the GDC closeout.

As the coils were wound, turn-to-turn insulation in the form of octagonally shaped buttons-on-a-string was applied to the outside surface of the conductor. This was done by an automatic feeding of the conductor through a button applicator machine to the coil. The button machine applied a tiny drop of Loctite adhesive to each button as it came off the button-on-a-string spool. The button-on-a-string insulation then passed through a set of rollers which pressed the glued button onto the conductor. The inspection after each layer included inspection for layer flatness no greater than .005 inch and bottom flatness against the layer-to-layer insulation no greater than .002 inch. Maximum allowable gap between winding turns was also .002 inch. Layer-to-layer insulation was

applied following winding of each layer. The layer-to-layer insulation was made from a G-10CR fiberglass laminate.

Figure 6-3b shows actual photographs of the coil winding process. The upper left hand photo shows the winding starting on top of the ground insulation. In preparation for the inside splice to layer two following the winding of layer one, the end of the conductor has been clamped off on the other side of the coil form, at location 625°45'. The center photo shows the tensioner, button machine, and winder, with winding of a minor radius in progress. The winder has both tilt and rotating capability. This capability, plus the power scissor table on the tensioner, provided a means of winding the conductor tangent to the coil at all times. The winding rotation speed, tilt of the winder, and scissor table height was controlled by the operator who was located at a control panel to the rear of the tensioner. Maximum efficiency was achieved with a four-man crew: one control panel operator, one button-machine operator, and two operators tapping the conductor tightly against the previous turn, removing clamps that have rotated around on the previous turn, and reinstalling the clamps on the turn in progress. The control panel operator maintained a tension of between 500 and 700 pounds which achieved the winding tightness and minimum gap. The upper right hand photograph shows the compaction clamps used on the minor radius. Each clamp was applied with a minimum vertical force of 2,000 pounds.

This photo also shows an inside and an outside splice. The inside splice joined the beginning end of the even-numbered layer to the end of the odd-numbered layer at location 596°15' per superconductor joining procedure, 71E0016. The outside splice joins the odd-numbered layer and the end of the underlying even-numbered layer at location 596°15'. The outside joint was made so the splice did not fit tightly on its inside radius, as shown in the photo. To obtain a tight fit, shims were placed between the splice and the next-to-the-last turn. Each splice fitting had an overall length of 22 inches and was symmetrical about the centerline. The first 3 inches from each end of the splice fitting accommodated the full conductor, the next three inches provided for the conductor with the lower jacket surface removed, and the remaining 5 inches accommodated

superconductor only with its jacket completely removed. The to-be-spliced conductor ends were trimmed to leave excess superconductor. The two ends of superconductor were then cold-welded together, shortening the bared superconductor until a good fit was made with the splice. A maximum of six strokes were applied. Each stroke shortened the conductor by approximately 1/2 inch, leaving the "tits" 8-1/2 inches apart. The "tits" had to be left between 8-1/2 and 8-5/8 inches apart for a completed inside splice, so the number of strokes had to be six or less. The outside splice also required six strokes or less. Each 1/2-inch stroke of the cold-weld press closed the radial gap by .16 inches. After a maximum of five strokes, the joint was lowered into position to check the clearance between the joint and the outside turn of winding. The specification required that the radial clearance be from 1/8 to 1/4 inch to allow for packing. The conductor was then soldered into the splice fitting. The splice fitting was made from 1/8-hard copper with annealed tangs. The lower left hand photo shows the side clamps used on the major radius. These clamps applied horizontal force to hold each coil turn against the previous turn. The lower right hand photo shows the glue block clamping towers and the installation of a voltage tap.

6.3 GDC Coil Closeout

Following completion of winding, the first step of the GDC closeout consisted of filling all gaps between the butt joints of the glue blocks with G-10 fiberglass shims bonded in place using 3549 adhesive. In areas where the radius needed to be built out, we used a filled epoxy consisting of:

- 200 parts by weight Shell 815 resin
- 100 parts by weight Genamid 2000 hardener
- 550 parts by weight 1/32-inch chopped glass fiber

It was necessary to insure that the mixture had a putty-like consistency so it would not slump or run into the conductor pack.

Following cure of the epoxy fill, the outside surface was routed and sanded to provide a smooth, flat surface. To establish a guide for maintaining the depth and contour of the finished surface, grooves were cut at intervals using a router tool. A body sander was used to grind the surface smooth and flat using the grooves as a guide. The joint end minor radius was completed first, followed by the ramp end (which contains the leads) and then the major radii. A vacuum cleaner backup was used during the routing and sanding operations to remove as much residue as possible. Figure 6-3d, upper left photo, shows the joint end of a minor radius on which machining of the glue blocks was completed. Following finishing of the outside surface of the glue blocks, the voltage tap glue blocks on the minor radius end were removed, cut to proper curvature, and then bonded in place with 3549 adhesive. A groove was then cut in the radial glue blocks so that the wire guide and its cover both fit flush. The minor radius ends were then covered with HITCO tape (UT96) to prevent damage to the pack, and the clamping bars were welded in place by CBI. At this point, the first T2 coil (T2W) was removed from the winder and located in a special transition coil closeout station (see Figure 6-3c). This closeout station was installed to permit earlier modification of the winder platform and an earlier start on the winding of coil T1W. Following GDC closeout of T2W in this station, it was moved to the concrete pad outside of Building 52 for CBI closeout welding. Coil T2E was then moved from the LLNL winder to the closeout station for completion of the GDC closeout, thus expediting the start of the winding of coil T1E. Start of winding of each of the T1 coils was thus accelerated by approximately four weeks.

The next step involved fitting and trimming of the plenum insulation. After trimming, all sharp edges were removed to avoid damaging the Kapton. All trimming and grinding was done on a bench away from the conductor pack. To assure final installation in the same location, each piece of plenum was tagged following the fitting and trimming operation. The cutouts for the voltage tap wires were made during fitting and trimming, but the cutouts for the current leads were done during installation of the leads.

Installation of plenum and completion of GDC closeout, including Kapton wrapping, was accomplished first on the splice end minor radius of the coil. This involved installation of the first one inch of plenum material by bonding of four 1/4 plies together using 3549 adhesive. This was followed by installation of a slip plane, consisting of two layers of Mylar sheets Kapton-taped at the edges, which fit in between the glue blocks and the Kapton strips. Polyurethane material was then installed over the inside and outside edges of the plenum and ground layer using 3M-74 adhesive to protect the Kapton strips from sharp corners. The Kapton strips were then trimmed so they would butt up to one another, but not overlap. They were then bonded using 3M-74 adhesive.

The clamp plates, clamp blocks, clamp rods, and clamp plate shims were then installed. The clamp blocks were ground to fit the conductor pack and then drilled for installation of clamp rods. A hole finder was used to locate one hole at each end of the first layer of clamp blocks, by transferring from the tapped holes in the coil form. The hole locations were then transferred sequentially from layer to layer. The holes were then brought out to full size (.625) using a drill plate. Prior to installation of the clamp plates, a .005-inch thick Mylar sheet was applied to the bottom using 3M-74 adhesive. Prior to installation, the thread end of the clamp rods was coated with cetyl alcohol. In the process of installing each of the three clamp plates on the splice end minor radius, all but the top clamp block was located; and then the clamp rods were installed through the clamp plate and clamp blocks into the threaded holes in the coil form. The nuts were then tightened by hand. As many shims as possible were also installed by hand. The nuts were then tightened until the clamp plate was flat to within .07. Pressure was applied using screw jacks and support plates in conjunction with the nut-tightening process. After a short time, the screw jacks were removed in order to see if the plate was still flat within .07 inch. If the plate remained flat, the process was repeated until the plate bowed more than .07 inches or the nut torque reached 570 inch-pounds when the clamp was removed. After this process was complete, the thickness of the gap between the stack of clamp blocks and the bottom of the clamp

plates was measured and the top clamp block was machined to that thickness. Figure 6-3d, middle photo on the left, shows the clamp blocks, plates, and rods in the process of installation on the splice end minor radius. This process was very tedious and time-consuming and required almost continual support from liaison Engineering.

Closeout of the ramp end of the coil pack was similar to the splice end except that the current leads and voltage tap wires had to be installed. The last turn of the first layer was pulled out from $108^{\circ}45'$ to $228^{\circ}45'$ and unwrapped in preparation for splicing to the inlet lead. Drilling of the holes and installation of the threaded inserts necessary to assembly the inlet lead was accomplished on the bench. The lead sections were bolted together, but not soldered until after fit-up. After thoroughly vacuuming the conductor pack, the plenum layers and clamp plates were then replaced in the area from 45° to $288^{\circ}45'$. Due to an accumulation of engineering tolerances and manufacturing as-built conditions, the actual inlet and outlet leads were used to make a template for locating the cutouts in the plenum layers. With the plenum and clamp plates installed, a sheet of Mylar between the plenum layers and lead assemblies was used to mark around the perimeter of the details to manufacture the tooling templates. The templates were then used to mark and route around the plenum layers so as to provide cutouts for installation of the leads. This operation was done in conjunction with routing of the clamp plate and clamp blocks. Extreme care was used in routing the clamp blocks so as not to cut through the bottom block. The clamp blocks were then disassembled and the bottom clamp block cutout was routed. After obtaining satisfactory fit of both current leads, the leads were removed, along with the clamp blocks, clamp plates, and all of the plenum layers except for one inch on the bottom. The four 1/4-inch plies were then bonded together using 3549 adhesive. The inlet lead was then taken to the bench and a length of Grade 1 superconducting core was fitted and soldered into the inlet lead groove. Special care was taken at all times to assure that the superconductor was never bent to a radius smaller than 6.0 inches.

The inlet lead was then spliced to the last turn of the first layer using the cold-weld splice procedure. The splice was then placed against the 22nd turn, making certain that they were separated by a row of buttons-on-a-string. The spacer blocks in the area of the splice had to be trimmed before reinstallation in order to fit correctly. The ends of the radial glue blocks were then trimmed to fit around the inlet lead and were bonded in place using 3549 adhesive. The upper right photo in Figure 6-3d shows the inlet lead installation. The voltage tap wires were then routed up the instrumentation wire guide and along the cutouts in the plenum. The cover was then bonded to the wire guide using 3549 adhesive. The cover was bonded to the wire guide using 3549 adhesive. Care was taken to eliminate all sharp edges that could damage the wires.

The slip plane and polyurethane material was then installed on the ramp end and the Kapton strips were removed from the protective covering and wrapped around the completed pack, as described earlier for the splice end. A hole was required at $168^{\circ}45'$ on the outside of the first layer of conductor where the inlet lead exits the pack. The clamp plates, clamp blocks, and clamp rods were installed following the same procedure described for the splice end of the coil. The inlet lead cover was then installed over the outside vertical part of the inlet lead. An inlet lead wedge was used to hold tension on the last turn of the first layer. The wedge was trimmed to fit correctly and then driven into place. To retain the wedge, a G-10 shim was cut to fit between the end of the wedge and the clamp blocks. The wedge and shim were then bonded in place using 3549 adhesive. The sublayers of Kapton were wrapped along the outside of the clamp blocks and bonded in place using 3M-74 adhesive. The plenum material in which the cutouts were made was replaced. The outlet lead was then spliced to the last turn of the last layer using the same procedure as used on the inlet lead. The middle photo on the right-hand side in Figure 6-3d shows the exit lead installation.

The first step in the installation of the tension block assembly involved lay out, match drill, insert installation, and assembly of the anchor plate to the tension block. Then, with the outlet lead and conductor under tension, the tension block was located against the outlet lead and the anchor plate was welded to the coil form. HITCO tape (UT96) and

stainless steel spacers were placed between the Kapton and anchor plate so to avoid heat damage to the Kapton. The lower two halves of the divider assembly were then match drilled and bolted together. Threaded inserts were installed in each half to match the holes that had been predrilled in the corresponding lead. Three sheets of Kapton were placed between the two halves of the divider assembly. The inlet and outlet leads were installed, tested, coiled, and bagged.

The next step in the GDC coil closeout involved completion of plenum installation on the top inch of the minor radius ends and the entire plenum installation of the major radius. This was followed by installation of the slip plane and polyurethane material and final wrapping of the Kapton as shown in Figure 6-3d, lower left photo. Finally, .063-inch thick G-20 filler laminate was installed over all exposed surfaces. This filler material serves to prevent the later-to-be-applied epoxy fill compound from entering the slotted plenum insulation or contaminating the Kapton wrap. The filler also serves to reduce shim requirements and to protect the conductor pack during welding procedures. All seams and edges were covered with heavy-duty filament tape to assure no access to the conductor pack. CBI then installed the case closure weld backup bars in preparation for the epoxy shim and case closure installation. The backup bars were installed around the full periphery, located 4.19 inches from the top of the vertical wall and the edge of the flange. During the welding operation, a welding shield was used to protect the Kapton from physical or thermal damage. Fiber tape was applied to the underside of the backup bars after they were welded on. The coil was then moved to the CBI closeout weld station, as shown in the lower right photo, Figure 6-3d, for the coil closeout epoxy shim installation and closure plate welding.

6.4 CBI Case Closeout

The steps involved in the transition coil case closeout and assembly by CBI are illustrated in Figure 6-4a. Two stations with rotation power drive were provided on the concrete slab adjacent to Building 52 for closeout welding of the two T2 coils. The power drive enabled CBI to

install the case closure sections in the most efficient sequence following stack closure, which had to be located first. The power drive trunion fixture, coupled with CBI's utilization of their own 18-ton cherry picker, provided the means for rapid location and installation of the closure sections. The closure mating weld backup bars and the vent fittings and stack were welded in place by CBI prior to the start of case closure installation. The first step performed by CBI was application of epoxy shim compound for the stack closure section. A series of very heavy strips of filled epoxy compound were applied over the top and sides of the coil bundle in preparation for fitting the closure to the coil. A uniform coating of mold release (carnuba wax) was then applied to the inside surface of the closure section. The closure section was then located on the coil form per the drawing, and clamped in place. After epoxy cure, the closure section was removed and the epoxy was inspected for consistent cure. The space between the cured epoxy strips on the surface of the coil bundle were then filled with more of the same epoxy mixture. Before relocating the stack closure section, the upper two halves of the divider assembly were match drilled, inserts installed in each half (three sheets of Kapton were used between the halves), and then were bolted together. The mold release was then removed from the closure section and the closure again located on the coil form, followed by tack welding of the closure section to the coil form. This process was repeated for each of the coil closure sections, until all twelve closure sections were tack welded in place. Closeout welding of all closure sections was then accomplished. Figure 6-4b, upper left photo, shows the application of epoxy shim and fitting of case closures in progress. The upper right photo shows CBI closeout welding in progress.

Following closeout welding, the coil was moved to the shipping fixture and the adapter was removed, as illustrated in Figure 6-4a. This provided better access for completing the dye penetrant inspection and leak test. Figure 6-4b, lower left photo, also shows the coil located on the shipping fixture just prior to removal of the adapter. CBI then welded the tension tie bars in place and completed the leak test of all welds.

Final electrical checks and location of the alignment targets was accomplished by GDC just prior to shipment of the coil to LLNL. The lower right photo in Figure 6-4b shows the coil loaded on the truck ready to depart for LLNL. CBI closeout of the T1 coils was accomplished in the same manner except for the location. CBI closeout welding of T1W was accomplished in the closeout station inside Building 52. GDC closeout of T1E was completed on the winder and it was finished and ready to move to the Building 52 closeout station the same day that CBI completed the closeout welding of T1W.

6.5 Clevis Installation

CBI made an attempt to locate the T1 clevis fitting using the tool they had manufactured to locate the A20 clevis fittings. The tool was not sturdy enough to hold its shape, however, and would not locate the fittings accurately. Therefore the T1 coil's clevis fittings were also shipped with the coils for installation by CBI at LLNL. The T1 clevis fittings were properly located by CBI at LLNL by mating to the A20 coils. The T2 clevis fittings were also installed at LLNL by mating to the yin-yang coils. CBI was unable to locate the T2 clevis fittings at GDC because the yin-yang locating tool sent from LLNL did not establish the relative position of the two sets of clevis fittings.

Without the clevis fittings, the T2 coils could not be pinned to the shipping fixture for transporting to LLNL. This problem was solved by welding the shipping fixture to the case.

The T1 coils did not require a shipping fixture. They rested on the flat surfaces of the coil.

6.6 Schedule and Performance

The transition coils were in trouble schedule-wise throughout the length of the program due to a late start, winder down-time, and a more complex and time-consuming GDC closeout operation than originally anticipated.

The original schedule dated 14 February 1984 was revised on 30 June 1984 to increase the GDC closeout schedule on the transition coils from twenty (20) to forty (40) days, and for the axicells from fifteen (15) to eighteen (18) days. The next revision took place on 10 August 1984 to adjust for the ten-day strike by the machinist's union and for the winder breakdown during July, 1984. A ten-hour shift, six days per week was incorporated in this schedule revision. The third revision on 21 September, 1984, adjusted the schedule back to eight hours per day, six days per week. On 1 November, the schedule was adjusted to match the last-ditch delivery dates necessary to earn the basic schedule incentive fee. On 26 November the schedule was revised to establish earlier delivery dates which allowed for CBI installation of the clevises at LLNL. Table 6-1 reflects the schedule dates in keeping with these revisions along with the actual completion dates for each manufacturing step.

Winding of coil T2W started on 16 March 1984 and was completed on 18 July 1984. During that period of time, eight equivalent days were lost due to winder down-time and ten (10) days were lost due to the IAM strike. Winding of coil T2E started on 14 May 1984 and was completed on 27 August 1984. During this time, ten (10) days were lost due to the IAM strike and nineteen (19) equivalent days were lost due to winder down-time.

In order to stimulate the winding crew's performance, schedule performance thermometer charts were developed and maintained to show actual progress versus the schedule priorities and task requirements each day.

The manufacturing span days for each major manufacturing step required on each coil are provided in Table 6-2.

TABLE 6-1
MFTF-9 TRANSITION MAGNETS - MANUFACTURING WORK PLAN

COIL NO.	GDC RECEIVE COIL FORM	GDC TRUE-UP COMPLETE	GDC KAPTON GR. LAYER COMPLETE	GDC WINDING COMPLETE	GDC PLENUM CLOSEOUT COMPLETE	CBI WELD COMPLETE	GDC FINAL ELEC/LEAK COMPLETE	CBI CLEAVISES COMPLETE	GDC SHIP
T2W	(1/6/84) 1/6/84	(3/1/84) 2/24/84	(3/15/84) 3/15/84	(7/20/84) 7/20/84	(10/20/84) 10/20/84	(11/30/84) 11/30/84	(12/5/84) 12/9/84	-- --	(12/10/84) 12/10/84
T2E	(1/31/84) 1/31/84	(4/13/84) 3/1/84	(5/14/84) 5/13/84	(8/27/84) 8/27/84	(10/22/84) 10/22/84	(12/15/84) 12/12/84	(12/28/84) 12/20/84	-- --	(1/3/85) 12/26/84
T1W	(5/31/84) 5/31/84	(8/17/84) 8/24/84	(8/27/84) 9/7/84	(11/21/84) 11/20/84	(12/21/84) 1/4/85	(2/6/85) 1/30/85	(2/18/85) 2/2/85	-- --	(3/7/85) 2/13/85
T1E	(6/29/84) 7/5/84	(9/28/84) 9/10/84	(10/12/84) 10/4/84	(1/11/85) 12/22/84	(2/8/85) 1/31/85	(3/18/85) 2/20/85	(3/18/85) 2/26/85	-- --	(4/16/85) 2/27/85

() - Schedule date.

TABLE 6-2. NFTF-B TRANSITION COIL SPAN TIMES - MANUFACTURING DAYS

COIL NO.	TRUE-UP AND KAPTON/GROUND INST.	WINDING	(GDC) CLOSEOUT	(CBI) CLOSEOUT WELD	GDC FINAL TESTS
T2W	49	87	70	28	8
T2E	70	84	50	36	7
T1W	62	55	30	18	3
T1E	44	51	25	14	5

269.333-26

Figure 6-1. Transition Coil Manufacturing Sequence and Flow

269.333-27

Figure 6-2a. Transition Coil Prep for Winding Sequence

RECEIVE COIL
FORM FROM CBI

PREPARE COIL FORM
FOR TRUE-UP

TRUE-UP OF
MINOR RADIUS

TRUE-UP OF
WINDING SURFACE

TRUE-UP OF
VERTICAL SURFACE

INSTALL KAPTON &
GROUND INSULATION

269.353-28

Figure 6-2b. Transition Coil Prep for Winding Photos

WIND COIL

- DOWN RAMP TO START WIND (TAIL END-ENTERING LEAD)
- WIND LAYER 1, CUT & CLAMP OFF CONDUCTOR
- WIND LAYER 2 OPPOSITE DIRECTION
- SPLICE LAYER 2 TO LAYER 1 (OUTSIDE).
SPLICE LAYER 2 TO NEW LENGTH (INSIDE).
- WIND LAYER 3 OPPOSITE DIRECTION
- REPEAT STEPS FOR SUBSEQUENT LAYERS
(TAIL END-EXITING LEAD)

CLOSEOUT COIL (GDC)

- INSTALL GLUE BLOCKS, EPOXY AND MACHINE
- INSTALL ENTERING AND EXITING LEADS
- INSTALL CLAMP DOWN BLOCKS, RODS & PLATE
- INSTALL PLENUM INSULATION
- COMPLETE KAPTON WRAP & FINAL CLOSEOUT INSULATION
- PREPARE FOR CLOSEOUT WELDING

WINDING & CLOSEOUT STATION

269.333-29

Figure 6-3a. Transition Coil Winding & Closeout Sequence (GDC)

START OF WINDING

MINOR RADIUS - COMPACTION CLAMPS
INSIDE/OUTSIDE SPLICES

COIL WINDING

MAJOR RADIUS
COMPACTION TOOLS

CLAMPING TOWERS -
GLUE BLOCK & VOLTAGE
TAP INSTALLATION

Figure 6-3b. Transition Coil Winding

269.333-30

269.333-31

Figure 6-3c. Transition Coil Closeout Station (GDC)

EPOXY & MACHINE
GLUE BLOCKS

INSTALL & SPLICE INLET
LEAD - RAMP END

INSTALL CLAMP BLOCKS, RODS
& PLATE - SPLICE END

INSTALL EXIT LEAD &
PLENUM INSULATION

COMPLETE KAPTON WRAP &
FINAL CLOSEOUT INSULATION

MOVE TO CBI CLOSEOUT
WELD STATION

Figure 6-3d. Transition Coil Closeout Photos (GDC)

269.333.32

269.333-33

Figure 6-4a. Transition Coil Case Closeout & Assembly Sequence (CBI)

APPLY CLOSEDOUT EPOXY SHIM
FIT CASE CLOSURES

CBI WELD
CASE CLOSURES

PLACE ON SHIPPING FIXTURE -
REMOVE ADAPTER

LOAD & SHIP
TO LLNL

Figure 6-4b. Transition Coil Case Closeout Photos (CBI)

269.333-34

7.0

PRODUCIBILITY

7.1 Introduction

A major responsibility of Manufacturing Engineering, from the start of the design phase until the last coil was delivered, was producibility. It was the responsibility of Manufacturing Engineering to monitor the designs as they evolved to insure that the magnet designs were economically producible with current technology and that the drawings produced were accurate and comprehensive for shop use. Concurrent with those activities, tooling concepts were developed, along with the Manufacturing Sequence and Flow, factory layout, and equipment and facility requirements.

The winding procedures provided the manufacturing instructions in conjunction with the engineering drawings to assure that each task step was accomplished in proper sequence and in accordance to engineering design. The winding procedures provided detailed data sheets, logs, and checklists. Shift logs were maintained to provide status and highlight problem areas throughout the entire manufacturing process.

One of the early producibility achievements was the unique design, modification, and installation of the large coil winding machines for winding of the two T2 and the two T1 transition coils. Two machines (designated "GDC" and "LLNL") were required to meet the production schedule since one winding machine, even with a seven-day, three-shift operation could not meet the aggressive schedule. All four transition coils were delivered in time to earn the basic schedule-incentive fee.

7.2 Solenoid Coils

The method of accomplishing true-up on the first four solenoid coils involved a machining operation. Short pieces of plastic rod (buttons) were bonded to the outer perimeter of the upper and lower inner surfaces of the coil form. A milling machine was mounted on a stand with adjustable heights. The required position of the milling head was shot in with a transit. The winding machine rotated the coil and the milling machine milled the buttons, establishing a true plane around the coil form. The true-up plates were then clamped on top of the buttons and with the epon versamid mixture. To eliminate the milling operation and the requirement for leveling buttons, a jack-screw concept was installed for leveling the true-up plates. (See upper-left-hand photo in Figure 7-1). This producibility item saved three man-days per coil on coils five through twelve.

The solenoid conductor required extensive cleaning and one full-time man on each of the two winding lines was initially required for the cleaning operation. Even then, there were short delays due to cleaning difficulties. An automatic conductor clean station was designed, fabricated, and installed on each line, thus eliminating the manual cleaning effort entirely. (See middle photo on left in Figure 7-1). This producibility item saved the equivalent of two men from August of 1982 through August of 1983.

Three men were required to move the Koldweld Press into position on the line each time a conductor splice operation took place. An air-bearing base was developed for the Koldweld Press which made it possible for one man to move the heavy machine quickly into position. (See the lower-left-hand photo in Figure 7-1). One hundred and twenty Koldweld Press moves were made on the solenoid lines after the concept was installed, saving an estimated two hundred and forty manhours. (Savings were also realized during the winding of the four axicell coils.)

The number of solenoid conductor spool changes was cut in half by incorporating a reel-support stand for double spools (see upper-right photo in Figure 7-1). This saved an estimated two men approximately 288 manhours (four hours times three changes for each of the twelve coils).

It was a program QA requirement that Kapton be installed on the coil form while under a protective tent. This required seven days use of the winding machine inside the winding-line tent before winding could start. A reusable/movable Kapton tent attached to the spider fixture was designed and built which permitted installation of Kapton on the true-up turntable outside the winding lines' tent. This concept was used on ten coils, permitting winding full time and saving thirty-five span days on each of the winding lines.

The protective tent over the solenoid lines, and later over the axicell lines (see middle photo on the right in Figure 7-1), was designed to retract above the winding equipment and to traverse either direction providing cover for either winder while loading or unloading the other winder. It was also necessary to move the tent for bringing in and removing the helium hy-pot leak-test fixture, and it provided quick access for forklifts and other large equipment that was required at times. The powered lift and traverse of the tent saved many manhours that would have been required to disassemble and reassemble a stationary tent.

Two weeks were expended on the final helium leak test of the first solenoid coil when it was determined that pumpdown would require three weeks or longer due to outgassing. This amount of time was totally unacceptable. To solve the problem, shroud-type leak-test fixtures were designed and built which pulled a vacuum on the outside, rather than the inside, of the coil. (See the lower righthand photo in Figure 7-1.) The leak test was accomplished in three days on each of the remaining coils.

The universal spider fixtures were originally intended to serve only as machine accessories for mating the solenoid coil forms to the winding machines. Due to the solenoid coil form's out-of-tolerance condition,

caused by weld distortion, the legs of the spider fixture were used to correct the deformation and to hold the coil form in its proper shape until closeout welding was completed. The need for four additional spider fixtures was determined on a timely basis which avoided a potential six-month schedule delay. All schedule incentive fees were achieved for the solenoid coils.

7.3 Axicell Coils

The solenoid spider fixtures were modified for use on the axicell coils (see upper left photo in Figure 7-2) resulting in a reduction of manhours and material.

The axicell coil-winding time was substantially reduced through design and incorporation of ratchet-drive compaction clamps. Using a ratchet wrench one man could quickly install or remove the clamps along with tapping the conductor tight. (See middle photo on left in Figure 7-2).

An adjustable conductor pre-twist station was designed and installed on each of the axicell winding lines (see upper right photo in Figure 7-2). This installation greatly reduced delays due to manually pre-twisting the conductor to achieve the compaction flatness requirements.

Elimination of the staggered overlap of the Kapton wrap (middle right photo in Figure 7-2) resulted in a substantial reduction of manhours and span time while still meeting the specification for applying Kapton.

A major improvement was incorporated on the axicell coil-winding equipment. Due to the larger pack width of the axicell coils, it would have required a tremendous number of manual adjustments to the tether post weight stand. The tether post stand consists of a dead weight and a spring load for measuring winding tension. During solenoid winding, the tether post weight stand was adjusted manually several times, utilizing a forklift to achieve the proper straight-line pull on the systems' load

cell. A new system was designed, fabricated, and installed for both axicell winding lines. The new tether post carriage was powered to raise or lower the weight system. Controls were easily accessible at the master control panel. A substantial savings in manhours was realized during the winding of the four axicell coils.

The power drive installed on the axicell clevis installation trunion fixture enabled the CBI welders to weld in a downward direction at all times. The crew size for this operation was thus reduced from five to two.

By adjusting the crew size and utilizing overtime as required to complete various phases of coil assembly concurrently, on more than one coil, the number of outside contract heavy-duty crane moves (four-hour minimum charge) was reduced from thirty planned to twenty actual moves. The crane moves were consolidated as follows:

7/19/84 -- Moved coil A2W from the winder in Building 52 to the closeout station inside the south door of Building 37. Moved coil form A2E from Building 37 to the winding line in Building 52.

8/13/84 -- Moved coil A1W from the winder in Building 52 to the closeout station inside the north door of Building 37. Moved coil form A2E from Building 37 to the winding line in Building 52.

Moved coil form T1W from the true-up station in Building 37 to the closeout station in Building 52 for drilling of the clamp plate holes and installation of Kapton.

9/12/84 -- Turned coil A2W over in Building 37 for closeout welding of the opposite side. Removed coil T2W from the winder and loaded in into the closeout station in Building 52 after setting coil T1W on a stand outside Building 52 temporarily. Coil T1W was then loaded on the winder machine.

- 9/25/84 -- Loaded coil A2W onto a lowboy trailer, moved it outside of Building 37, turned the coil over, moved it back into Building 37, and loaded in back on the turntable for closeout welding of the other side.
- 10/4/84 -- Moved coil A2W from the turntable in Building 37 to the clevis installation station on the concrete slab. Turned coil A1W over in Building 37 for welding of the other side.
- 10/11/84 -- Moved coil T2W from the closeout station in Building 52 to the CBI closeout weld station on the concrete slab. Removed coil T2E from the winder and located it in the GDC closeout station inside Building 52. Moved coil T1E from the true-up station in the north end of Building 37 to the winding machine in Building 52.
- 10/15/84 -- Moved coil A2W from clevis installation station #1 to clevis installation station #2. Turned coil A1W over and moved it from the closeout weld station in Building 37 to the #1 clevis installation station on the pad.
- 10/29/84 -- Loaded coil A2W on a shipping trailer for transportation to LLNL. Moved coil A2E from the winder in Building 52 to the closeout station in the north end of Building 37. Moved coil T2E from the GDC closeout station in Building 52 to the CBI closeout weld station on the pad concrete slab.
- 11/8/84 -- Moved coil A2E from the winder in Building 52 to the closeout station in the north end of Building 37. Loaded coil A2W for shipment to LLNL.

- 11/29/84 -- Moved coil A1E (was A2E) from the Building 37 closeout station to the clevis installation station on the concrete slab.
- Moved coil A2E (was A1E) from the winder in Building 52 to the closeout station in the north end of Building 37.
- 12/5/84 -- Loaded coil T2W with shipping tool onto a low-boy trailer and moved it into Building 37.
- 12/7/84 -- Turned coil A1E over for CBI on the slab. Turned coil A2E over for CBI in Building 37 for welding of the bottom perimeter. Transferred coil T2W from the low-boy trailer to the shipping trailer for shipment to LLNL on 12/10/84.
- 12/17/84 -- Loaded coil T2E onto a low-boy trailer and moved it into Building 37 for completion of leak test and installation of tie bars. Loaded coil A1E onto shipping trailer for departure to LLNL.
- 12/21/84 -- Transferred T2E from the low-boy trailer onto the shipping trailer for shipping to LLNL on 12/26/84. Moved coil A2E from the GDC closeout station in the north end of Building 37 onto blocks in the south end of Building 37 for clevis installation.
- 1/10/85 -- Loaded coil A2E on shipping truck inside Building 37 and Moved the coil outside and turned it over on blocks with the long clevis fittings down. Targets were then located and welded in place prior to departure of the truck at 11:06 a.m. A section of the winder platform was then removed and coil T1W was moved from the winder to the closeout station inside Building 52.
- 1/23/85 -- Rotated coil T1W 90°, which permitted completing the balance of the closeout welding in a downward direction which saved approximately one week of welding time.

- 1/31/85 -- Moved the base of the high-bay winder to the storage area in the yard. It was in the way for the unloading of coil T1E from the winder.
- 2/1/85 -- Moved the high-bay winder spindle to storage. Removed coil T1W from the closeout station and set it on the floor. Removed coil T1E from the low-bay winder and located it in the closeout station inside Building 52.
- 2/13/85 -- Loaded coil T1W for shipment to LLNL. Rotated coil T1E 90° to permit downward welding on the balance of closeout. Removed chain drive and A-frames from low-bay winder and placed on 2x6 planks inside Building 52.
- 2/27/85 -- Loaded coil T1E for shipment to LLNL. Moved winder assemblies to storage areas.

7.4 Transition Coils

The first major item affecting the producibility of transition coils was the addition of the LLNL coil winder and the modification of both winders to accommodate the transition (Axicell configuration) coils.

In conjunction with the modification of the winders, a draw bridge was installed connecting the two winder platforms. (See upper left photo in Figure 7-3). This walkway saved personnel a great deal of time and energy (going up and down 36 steps) in moving from one winder platform to the other.

Retractable safety work platforms on rails were also designed, built, and installed. (See the middle photo on left in Figure 7-3). The platforms could be locked in position on either end of the coil enabling the crew to work on the minor radii in safety. This design eliminated the use of a hoist for moving the platforms in and out.

Manually operated clamps were designed and manufactured, eliminating the costly hydraulic clamps (see upper right photo, Figure 7-3) used at LLNL. The clamps were of a simple mechanical concept, were easier to operate than the hydraulic clamps, and were equally as effective.

The installation of a power drive turntable for the T1 true-up station in Building 37 (see middle photo on right in Figure 7-3) produced a substantial reduction in span time and manhours for true-up of the second T1 coil, as compared with the manually operated come-along method used on the first three transition coils. The reduction of sixteen manufacturing days in preparing the coil form for winding from the first T1 to the second T1 coil was largely due to the added power drive.

A major producibility item which enabled GDC to earn the basic schedule incentive fee on each of the four transition coils was the installation in Building 52 of a special GDC closeout station with power drive. (See lower left photo in Figure 7-3). The plan to install the special closeout station was developed in the month of June, 1984, when it was recognized that winding of the T1 transition coils could not begin on schedule if GDC closeout of the T2 transition coils was accomplished on the winding machine. The need for the station became even more critical due to excessive winder down time, the IAM strike, and a more time-consuming GDC closeout of T2 coils than originally planned. By moving the T2 coils progressively from the winding machine to the special closeout station, start of winding was accelerated twenty-three manufacturing days on coil T1W and ten manufacturing days on coil T1E.

Incorporation of the power drive turntables for the two CBI closeout weld stations on the concrete slab (see lower right photo in Figure 7-3) saved CBI (and the program) a minimum of one week of span time on each of the two T2 transition coils. This was the major contributing factor toward earning the schedule incentive fees on each of the T2 coils.

Elimination of the staggered overlap of the Kapton wrap on the T1 transition coils resulted in a substantial reduction of manhours and span time while still meeting the specification for applying Kapton.

**ELIMINATED REQUIREMENT
FOR TRUE-UP LEVELING
BUTTONS**

**REDUCED THE NUMBER
OF CONDUCTOR SPOOL
CHANGES**

**ELIMINATED THE MANUAL
CONDUCTOR CLEANING
OPERATION**

**INSTALLED REUSABLE/
MOVABLE TENTS**

**INSTALLED AIR BEARING BASE ON
KOLWELDER FOR EASY MOBILITY**

**REDUCED SPAN TIME
FOR FINAL LEAK TEST**

Figure 7-1. Producibility Photos - Solenoid Coils

269.333-36

MODIFIED EXISTING
HOLDING FIXTURES

INCORPORATED CONDUCTOR
PRE-TWIST STATION

INCORPORATED RACHET
DRIVE COMPACTION CLAMPS

ELIMINATED OVERLAP
OF KAPTON WRAP

INSTALLED ROTATION
POWER DRIVE FOR CBI
CLEVIS WELD STATION

REDUCED THE NUMBER
OF HEAVY DUTY CRANE
MOVES REQUIRED

269,333-38

Figure 7-2. Producibility Photos - Axicell Coils

PROVIDED WALK-WAY
BETWEEN WINDER PLATFORMS

ELIMINATED REQUIREMENTS
FOR HYDRAULIC CLAMPS

INSTALLED MOVABLE SAFETY
WORK PLATFORMS & RAILS

INSTALLED ROTATION POWER
DRIVE FOR T1 TRUE-UP STATION

INSTALLED SPECIAL GDC
C/O STATION WITH
POWER DRIVE

INCORPORATED ROTATION
POWER DRIVE FOR THE
T2(2) CBI WELD C/O STATIONS

269.333-37

Figure 7-3. Producibility Photos - Transition Coils

LESSONS LEARNED

Up-front producibility studies during the product design phase is a very important activity. Although all drawings were reviewed and signed off by Manufacturing Engineering, some installations could have been further simplified. The design of the inlet leads for the transition coils is one example. The subcontractor was unable to manufacture the parts to print and reworking the leads on installation was very difficult and time consuming.

True-up of all coil forms for the twenty MFTF-B magnets manufactured at GDC was a time-consuming and costly process, even after installation of jack screws for leveling of the true-up plates and installation of powered rotating capability on the fixture. Before planning to true-up coil forms on future programs, a trade-off study should be made to determine if machining of the inner walls and ring can be done and would it be less costly than using a versamid epoxy mix with fiberglass fill.

Coil winder maintenance turned out to be a major problem during winding the four transition coils. Eight equivalent manufacturing days were lost due to down time on the high-bay winder, and nineteen equivalent manufacturing days were lost on the low-bay winder. In the future, a complete maintenance manual should be developed before the start of winding and appropriate spare parts should be ordered and on hand. Also, there should be no delay in seeking outside factory representative assistance if in-house maintenance personnel cannot solve the problem quickly.

Layer-to-layer electrical shorts occurred frequently on the T2 transition coils, especially following installation of the inside splices and winding of the next layer. The major cause of the shorts was the coupling jell used in ultrasonic inspection that turned out to be conductive. A splice-cleaning procedure was developed which required cleaning the splices with a baking soda solution followed by several clear hot-water rinses.

Layer-to-layer shorts continued to occur occasionally following correction of the coupling-jell shorting problem. Moisture in the splices was thought to be causing the problem. The use of a pyrometer-monitored heat gun to cook the moisture out of the splice solved this problem.

We found that our original method of pumping down the internal solenoid coils for final helium-leak check was time and cost prohibitive using the available GDC equipment. Two weeks were consumed on the first coil and it still was not pumped down. Now, shroud-type leak test fixtures were designed and fabricated which pulled a vacuum on the outside of the coil and accomplished leak testing in three days. This method was also used on the axicell coils. The use of smaller segment leak-test tools rather than the large total shroud type on the transition coils permitted progressive and rapid completion of leak testing following ultrasonic inspection. We also found that the coupling jell used for ultrasonic testing was contaminating the VEECO leak detectors. Cleaning the coil surface was a major job. The procedures were changed to follow leak testing with the ultrasonic inspection.

The VEECO leak detector and pump-down equipment, as well as the technician for operating the equipment, were provided by the GDC Test Lab on request. This was a very difficult scheduling problem and occasionally a conflict developed with other program priorities. On future programs, where multiple coils are to be manufactured and leak tested, the capital investment for program-dedicated equipment should be planned and the coil crew should be trained to operate the equipment. Improved equipment with greater pump-down capacity for repetitive use should be procured.

We found that subcontracting the manufacture of major tools such as the tensioner for the transition coil winder, the spider fixtures for the solenoid coils, and the transition coil form adapters was less costly than if made in-house at GDC. In addition, these procurements were fixed-price.

An enclosed stockroom with a stock crib attendant was justified as the MFTF-B program progressed. This provided a much-improved means of controlling parts and shortages. A system of kitting parts and delivering them to the winding and closeout stations also reduced down time and lost manhours by the crew.

Excessive rework of axicell conductor splices occurred due to solder disbands found during U.T. inspection. The splice tool was failing to hold the conductor properly in the splice fitting. The splice tool was modified by incorporating additional clamps and jack screws which corrected the problem.

Even though a substantial amount of effort was involved in the development of soldering conductor splices, the axicell and transition conductor splice soldering times were greatly reduced considerably by using a simple pyrometer monitoring torch. Earlier methods using the welder (resistance heater) and heating element tools proved inefficient.

During installation of the plenum on the first axicell coil, the sections had a tendency to buckle up when butted against another section. Laying of the curved (4-ply) plenum sections was resulting in a few inches of flat surface on the ends of each section. These few inches did not pull in to the curvature of the coil. This problem was solved by trimming off the few inches of flat surface so the entire section had curvature, and then by cutting the last section to fit.

Following GDC closeout of the first axicell coil, A2W, the coil pack was approximately .40 inches oversize. The case closure sections could not compress the plenum insulation so the case covers had the proper gap for welding. This was due to the accumulation of tolerances, plus excessive adhesive application in bonding the plenum plies. It was necessary to disassemble the solid plenum, Kapton, wire-run panel, and two layers of slotted plenum. Layer nine of slotted plenum was removed, and, in addition, the 1/4-inch backup bars on the case closure sections were replaced with 1/8-inch backup bars and the 4-ply, 1/4 inch insulation inside the closure sections was reduced to 2-ply, 1/8-inch insulation. After reassembly of the pack the closure sections fit, but approximately eight days and a substantial number of manhours were lost in order to accomplish this rework. Starting with axicell number two, A2E, circumferential measurements were taken following the installation of each

layer of plenum. For the last three axicell coils it was also necessary to eliminate layer nine of the slotted plenum and use 1/8-inch backup bars and 1/8-inch insulation on the closure sections. This was done as the pack was assembled and did not result in any plenum rework.

The application of 3549 adhesive using a regular paint roller to bond plenum plies resulted in a film approximately .005 inch thick. A polyethylene material was then used to cover the roller in order to reduce the excessive soaking-up of the adhesive. This resulted in a film approximately 0.002 inch thick which eliminated the problem.

The 200 parts Shell 815 resin and 100 parts Genamid 2000 hardener with 550 parts 1/32-inch chopped glass fiber (all parts by weight) that was applied to both minor radii of coil T2E, in order to allow for grinding of the glue blocks and epoxy to a smooth surface, would not cure, even with applied heat. The epoxy mix had to be removed. Apparently, some of the ingredients in the Genamid had settled to the bottom of the 50-gallon barrel. The following action was taken to correct this problem. Several hours prior to application, the Genamid barrel was rotated and a sample mix made to ascertain if the cure process was working before application of the mixture to the coil.

When establishing the manufacturing station and fixture requirements prior to a start of a program, consideration should be given to providing a planned station/fixture at a point in the line where schedule delaying problems are most likely to occur. This should also include the facility floor requirements so that additional equipment, if required, can be installed. The two large transition coil winders were offset from each other, not only to allow access for cranes, but for the necessity to reserve floor space. The addition of the GDC closeout station for the T2 transition coils, which enabled GDC to earn the schedule incentive fees on all four transition coils, is an example. Another example is the addition of the second true-up/closeout station for the solenoid coils.

On any large magnet program, the installation of power-drive trunion fixtures should be considered in the original tool design. For example, the true-up and preparation for winding of coil T1E required sixteen fewer manufacturing days than coil T1W. This was largely due to the installation of the power drive.

Proper indoctrination of all personnel relative to quality and schedule requirements can stimulate team involvement and reduce rework and production delays. Proper training of the entire winding crew relative to equipment operating procedures and maintenance requirements can reduce equipment downtime and production delays. Any member of the crew may be required to operate the controls for short periods of time and an operator error can cause serious equipment damage.

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DEACTIVATION PLAN

The MFTF-B deactivation plan provides a complete listing of hand tooling, support tooling, spare winder parts, closing inventory of parts and materials including superconductor and insulation, and other miscellaneous items including conductor reels and storage stands, major coil winder components, hoists, button machines, etc.

A disposition code with six categories was established, and recommended disposition has been provided for each item listed.

The recommended disposition code is as follows:

- 1) - Scrap at GDC.
- 2) - Purchase by GDC.
- 3) - Store and protect at GDC.
- 4) - Transfer to other DOE programs.
- 5) - Ship to LLNL.
- 6) - Transfer to CRI.

The completed deactivation plan is provided in Appendix F. All items are shown as "complete," based on the assumption that those items that are incomplete at the date of this publication will be disposed of as recommended by LLNL.

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CONCLUSIONS

- The General Dynamics commitment to provide highly experienced management and technically trained personnel for the life of the MF1F-B program was met.
- All capital facilities, including space, machines, and equipment, were provided on a timely basis to support the program.
- The design and manufacture of all program-peculiar tools and equipment was accomplished on a timely basis.
- All manufacturing cost and schedule objectives were achieved through the combined efforts of engineering liaison, manufacturing engineering, and operations personnel.
- General Dynamics has established its credibility as a producer of large, superconducting magnets to specification, on schedule, and within cost.

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REFERENCES

- 11-1 "MFTF-B A-Cell Transition Coil Winder Procurement," General Dynamics Specification No. 71E0001, Revision A, dated 19 January 1981.
- 11-2 "MFTF-B Solenoid Magnet Conductor," General Dynamics Specification No. 71E0005, Revision D, dated 17 March 1983.
- 11-3 "MFTF-B A-Cell and Transition Coil Stabilized Conductor," General Dynamics Specification No. 71E0006, Revision A, dated 9 April 1981.
- 11-4 "MFTF-B A-Cell and Transition Coil Winding Tensioner," General Dynamics Specification No. 71E0009, Revision A, dated 25 May 1982.
- 11-5 "MFTF-B Solenoid In-Process and Final Verification Test Procedure, General Dynamics Specification No. 71E0011, Revision B, dated 20 May 1983.
- 11-6 "MFTF-B Transition Coils Stabilized Conductor Joining Procedure," General Dynamics Specification No. 71E0016, Revision B, dated 2 May 1984.
- 11-7 "MFTF-B Transition Coil Button-on-a-String Installation Procedure," General Dynamics Specification No. 71E0017, Revision B, dated 1 January 1985.
- 11-8 "MFTF-B Coil Winder/Tensioner Operating Procedure," General Dynamics Specification No. 71E0018, Revision A, dated 15 February 1984.
- 11-9 "MFTF-B Solenoid Button-on-a-String Installation Procedure," General Dynamics Specification No. 71E0019, Revision A, dated 15 November 1985.

- 11-10 "MFTF-B Solenoid Coil Winding Procedure," General Dynamics Specification no. 71E0021, Revision B, dated 28 July 1982.
- 11-11 "GDC Solenoid Coil Winder/Tensioner Operation & Maintenance Manual," General Dynamics Specification No. 71E0022, Revision C, dated 17 November 1984.
- 11-12 "GDC Solenoid Coil Prep/Weld Positioner Operation and Maintenance Manual," General Dynamics Specification No. 71E0023, Revision A, dated 20 November 1984.
- 11-13 "GDC Stabilizer Conductor Coldweld Press Operation and Maintenance Manual," General Dynamics Specification No. 71E0025, Revision A, dated 2 January 1985.
- 11-14 "MFTF-B Ultrasonic Inspection of Solenoid Coil Entering Current Lead, Conductor Splices, and Exiting Lead," General Dynamics Specification No. 71E0028, Revision A, dated 23 September 1982.
- 11-15 "MFTF-B Procedure for Instrumentation Sensor Installations," General Dynamics Specification No. 71E0029, Revision A, dated 30 July 1982.
- 11-16 "GDC Electrical Manual for Solenoid Tensioners," General Dynamics Specification No. 71E0033, dated 19 March 1984.
- 11-17 "MFTF-B T2 Coil Winding Procedure," General Dynamics Specification No. 71E0045, Revision B, dated 13 August 1984.
- 11-18 "MFTF-B T1 Coil Winding Procedure," General Dynamics Specification No. 71E0046, dated 18 September 1984.
- 11-19 "MFTF-B Axicell Coil Winding Procedure," General Dynamics Specification No. 71E0047, Revision C, dated 1 December 1984.
- 11-20 "MFTF-B Magnet System Transition Coil T1 Procedure for Voltage Tap Installations," General Dynamics Specification No. 71E0048, Revision B, dated 24 September 1983.

- 11-21 "MFTF-B Magnet System Axicells, A1/A20 Procedure for Voltage Tap Installations," General Dynamics Specification No. 71E0050, Revision B, dated 20 September 1983.
- 11-22 "MFTF-B Ultrasonic Inspection of Transition and Axicell Coil Entering Current Leads, Conductor Clamps, Splices, and Exiting Leads," General Dynamics Specification No. 71E0053, dated 29 March 1984.
- 11-23 "MFTF-B Axicell Coils Stabilized Conductor Joining Procedure," General Dynamics Specification No. 71E0054, Revision A, dated 3 July 1984.
- 11-24 "MFTF-B Ultrasonic Inspection of Transition and Axicell Superconductor," General Dynamics Specification No. 71E0055, dated 29 March 1984.
- 11-25 "MFTF-B Electrical Manual for A-Cell/Transition Coil Winder/Tensioner," General Dynamics Specification No. 71E0056, dated 26 April 1984.
- 11-26 "MFTF-B Coil Winder/Tensioner Installation and Maintenance Manual, General Dynamics Specification No. 71E0057, dated 24 July 1984.
- 11-27 "GDC Liquid Dispenser Operation and Maintenance Manual," General Dynamics Specification No. 71E0059, dated 21 January 1985.

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APPENDIX A

MFTF-B CAPITAL EQUIPMENT,
HAND TOOLS, AND SUPPORT TOOLING LISTS

MTTF-B CAPITAL EQUIPMENT,
HAND TOOLS, AND SUPPORT TOOLING LISTS

GENERAL

Following is a list of all major equipment, special support tooling, and hand tools required for coil winding of the MTTF-B magnets. Capital equipment was purchased at GDC expense in support of this program. Support tooling is program peculiar equipment and property of Lawrence Livermore National Laboratory (LLNL). Hand tools (HDTO) are MAIDS (or manufacturing aids) developed by operations to ease in assembly. All hand tools are serialized and identified.

NOTES:

- 1) All tooling listed is the property of Lawrence Livermore National Laboratory (contract number 9590309) unless noted.
- 2) All capital equipment belongs to General Dynamics - Convair.
- 3) Numbers in the nomenclature, i.e. (-4), (A-2), and (1), refer to Detail No. -4, A-Cell No. 2, and Solenoid Winding Line No. 1, or Item No. 1, etc.
- 4) Letters in the nomenclature, i.e. (I), (O) refer to Axicell No. 2, Inner and Outer.

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MFIF-B CAPITAL EQUIPMENT LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET					
							TRANS T1	T2	SOLN	BARR	INS	SHL
True-Up Mixer Gear Motor	E318508	--	--	2/28/82	Style 318309 Model HR 64649		X	X	X	X		
Vacuum Pumping Station	E321536	--	--	5/9/82	Kinney Model KC-15		X	X	X	X		
DC Power Supply	E322230	--	--	6/10/83	Hewlett-Packard				X			
DC HyPot Tester	E322332	--	--	11/8/82	Model 5220		X	X	X	X		
Digital Multimeter	E322513	--	--	11/8/82	Fluke 8810A		X	X	X	X		
Datalogger	E323448	--	--	7/28/83	Fluke M/N 2240B				X			
Hvy Duty (Vertical Lift) Turntable (Blue Max)	E323624	--	--	8/26/83	Jetline Engr. Model 578 S/N 79230					X		
Five (5) Ton Hoist w/Load Bar Sling	E323710	--	--	1/15/82	PAR812850	X	X	X				
	R002997	--	--	9/26/83	3-PE29031 PAR832160							
DC Power Supply	E324701	--	--	11/8/82	Hewlett Packard 6264B		X	X	X	X		
Take-Off Machine (1) (Tensioner and Electronic Controls	E325163	--	--	9/10/81	PAR802190 Model BS-600-VT-4				X	X		
Deadweight Ten- sioner w/Torque Motor System	E325544	--	--	5/25/81	PAR812850 71E0009	X	X	X				

MFTF-B CAPITAL EQUIPMENT LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET					
							TRANS		SOLN	BARR	INS	SHL
							T1	T2				
Koldweld Press and Die (w/ Inserts) (1,2)	E325607	--	--	3/31/81	PAR812850 Model HPB-043				X	X		
Heavy Duty Turntable Posi- tioner - Free Standing (1)	E325710	--	--	10/12/81	PAR812850 Model 80,000				X	X		
Heavy Duty Turntable Posi- tioner - Free Standing (1)	E325711	--	--	10/12/81	PAR812850 Model 80,000				X	X		
Heavy Duty Turntable Positioner - Tilt Type (1) Support Stand	E325712	--	--	10/10/81	PAR812850 Model 40,000				X	X		
	E325712-1 (711915)	MCAC	WA1550	4/15/82					X			
Heavy Duty Turn- table Positioner Tilt Type (2)	E325713	--	--	10/12/81	PAR812850				X	X		
Hall Probe (Gaussmeter)	E325714	--	--	8/31/81	PAR812850 Model 620 Probe HAGA-2508 Cable XOQ4-0100		X	X		X		
Universal Spider Fixture (1)	E325715	--	--	8/27/81	PAR812850				X			

MFTF-B CAPITAL EQUIPMENT LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET					
							TRANS T1	T2	SOLN	BARR	INS	SHL
Universal Spider Fixture (2)	E325716	--	--	8/27/81	PAR812850				X			
Universal Spider Fixture (3)	E325717	--	--	8/27/81	PAR812850				X			
Universal Spider Fixture (4)	E325718	--	--	8/27/81	PAR812850				X			
Universal Spider Fixture Handling Tool	E325719	--	--	9/30/81	PAR812850				X			
Take-Off Mach. (2) Electronic Controls, Button Dispenser, Tether Post Assy, Load Cell, Scissor Lift.	E325720 (762248-1 thru -4)	-- SPMC	-- TTA2574	9/10/81 3/19/82	PAR812850				X X		X	
ALTER - Tether Post Assy., Button Mach. for Axicell	E325720-5 E325720-6 E325720-8		TWD3596	9/23/83	SN50774 M/N SL1-63254-E PAR832160		X	X	X X X		X	
Reel ALTER-Axicell Coil	E325720-7 (711912)	TOAC	TWA1552 TWD3593	4/15/82 9/23/83	MFTF-B-SK-007 PAR832160				X		X	
Take-off Machine (2) (Tensioner and Electronic Controls)	E325721	--	--	9/10/81	PAR812850 model BS-600- VT-4				X		X	
Koldweld Press and Die (w/Inserts)	E325722	--	--	10/10/81	PAR812850 Model HPB-043	X	X	X				

MFTF-8 CAPITAL EQUIPMENT LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET					SHL
							TRANS T1	T2	SOLN	BARR	INS	
Weld Positioner Closeout Sta.	E325919	--	--	5/2/83	Aronson Model GE250				X	X		
Weld Positioner Closeout Sta.	E325921	--	--	5/2/83	Aronson Model GE120				X			
Weld Positioner Closeout Sta.	E325962	--	--	2/28/83	Aronson Model GE120				X			
Weld Positioner Prep Station	E325963	--	--	1/6/83	Aronson Model GE120				X			
46 Take-Off Mach. (1) Electronic Controls, Button Dispenser, Tether Post Assy., Load Cell, Scissor Lift, ALTER - Tether Post Assy. Button Mach. for Axicell	E326017-1 thru -4 (762249)	-- SPMC	-- TTA2573	2/25/82 3/19/82	PARB02190				X X			
	E326017-5 E326017-6 E326017-8		TWD3598	9/23/83	S/N 57441 M/N SL1-63254-E PARB32160	X	X		X		X	
	E326017-9 (711075)	HDFX	TWA1549 TWD3594	4/15/82 9/23/83	MFTF-B-SK-006				X		X	
	E326017-7 (711914)	TOAC	TWA1551 TWD3544	4/15/82 9/23/83	MFTF-B-SK-007 PARB32160				X		X	
	E326097	--	--	4/19/82	PARB12850				X		X	
23,000 BTU Air Conditioner	E326098	--	--	4/19/82	PARB12850				X		X	

MFTF-B CAPITAL EQUIPMENT LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET		SOLN	BARR	INS	SHL
							TRANS	TRANS				
							T1	T2				
23,000 BTU Air Conditioner	E326099	--	--	4/19/82	PAR812850				X	X		
23,000 BTU Air Conditioner	E326100	--	--	4/19/82	PAR812850				X	X		
Zenith Data System - Apple II Plus (-2) Printer (Epson)(-1) Disk Drive (-3)	E326510	--	--	1/17/83	2VM-121		X	X	X	X		
					MX-80111F/T AZM0003							
Load Cell - Spare (500 lbs)	E326552	--	--	3/19/82	PAR812850 S/N 57913				X			
Two (2) Ton Hoist and Trolley	E327078 R002998	-- --	-- --	4/2/82 9/26/83	PAR812850 PAR832160	X	X	X				
Load Cell (2000 lb)	E328786	--	--	9/26/83	PAR 832160 Toroid Model 36L-223A S/N 59177					X		
Load Cell (2000 lb)	E328787	--	--	9/26/83	PAR Toroid Model 36L-223A S/N 59178					X		
Load Cell (2000 lb)	E328788	--	--	9/26/83	PAR 832160 Toroid Model 36L-223A S/N 59179					X		
Panel Saw & Accessories	E328789	--	--	9/26/83	PAR 832160 Model 52		X			X		

MFTF-B CAPITAL EQUIPMENT LIST - MFTF-B OP-001

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET		SOLN	BARR	INS	SHL
							TRANS	TRANS				
							T1	T2				
Dust Collector	E328790	--	--	9/26/83	PAR 832160 Model Nb MRM-10		X	X		X		
23000 BTU Air Conditioner	E328792	--	--	9/26/83	PAR 832160		X	X				
23000 BTU Air Conditioner	E328793	--	--	9/26/83	PAR 832160		X	X				
23000 BTU Air Conditioner	E328794	--	--	9/26/83	PAR 832160		X	X				
23000 BTU Air Conditioner	E328794	--	--	9/26/83	PAR 832160		X	X				
23000 BTU Air Conditioner	E328795	--	--	9/26/83	PAR 832160		X	X				
23000 BTU Air Conditioner	E328796	--	--	9/26/83	PAR 832160		X	X				
Scissor Lift Table (1)	E328798	--	--	9/26/83	PAR 832160 Model SLI-23678-E						X	
Scissor Lift Table (2)	E328799	--	--	9/26/83	PAR 832160 Model SLI-23678-E						X	
Mill Machine	E328800	--	--	9/26/83	PAR 832160 Model No. 194-1152		X	X		X		

MFTF-B CAPITAL EQUIPMENT LIST

MAGNET												
NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	TRANS T1	T2	SOLN	BARR	INS	SHL
South Bend Lathe	E328801	--	--	9/26/83	PAR 832160 Model No. CL145C		X	X		X		
Portable Power Hacksaw	E328802	--	--	9/26/83	PAR 832160 Model No. 20-900		X	X		X		
Disc Grinder/Sander	E328803	--	--	9/26/83	PAR 832160		X	X		X		
DoAll Bandsaw	E328804	--	--	9/26/83	PAR831260		X	X		X		
Duo-Seal Vacuum Pump	E368617	--	--	6/10/83	Welch Mfg.Co. S/N /2514-2				X	X		
Leak Detector	E393913	--	--	5/9/82	Veeco Model		X	X	X	X		

MFTF-B HAND TOOL LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET					
							TRANS T1	T2	SOLN	BARR	INS	SHLD
Conductor Straightening Tool	SK-001	HDT0	--	5/9/82	--	X	X	X				
Transition Forming Tool	SK-002	HDT0	--	5/9/82	--	X	X	X				
Overbending Shoe Tool	SK-003	HDT0	--	5/9/82	--	X	X	X				
Hold-Down Fixture	SK-004	HDT0	--	4/16/82	--	X	X	X				
Router Fixture	SK-005	HDT0	--	8/12/82	--	X	X	X				
Tensioner Travel Extension	SK-009	HDT0	--	3/15/82	--	X	X	X				
Conductor Jacket Cutting Tool	SK-010	HDT0		4/22/82		X	X	X	X			
Rotary Jacket Cutter	SK-011	HDT0	--	5/9/82	--	X	X	X				
ALTER - Fab Cutter and Modify Bearings				11/6/82					X			
Koldweld Head Load Bar	SK-013	HDT0	--	4/28/82	--	X	X	X				
Kapton Locator	SK-014	HDT0	--	5/14/82	--					X		
Downward Turn Support Wedges	SK-016	HDT0	--	10/29/82	--					X		
A-Cell Tension Clamp	SK-018	HDT0	--	5/14/82	--	X	X	X			X	

410

MFTF-B HAND TOOL LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	MAGNET						
						A- CELL	TRANS T1	T2	SOLN	BARR	INS	SHLD
Solder Wash Tank	SK-019	HDT0	--	4/12/82	--	X	X	X			X	
Coil Form Rework Strongback	SK-021	HDT0	--	6/14/82	--				X			
A-Cell Offset Locator	SK-022	HDT0	--	10/22/82	--	X						
Coil Form Inspec- tion Gage, True-up	SK-023	HDT0	--	8/16/82	--				X			
A-Cell True-Up Fixture	SK-024	HDT0	--	10/26/82	--	X						
Side Wall True-Up Fixture	SK-026	HDT0	--	8/12/82	--				X			
Stabilizer Koldweld Tensile Tester	SK-028	HDT0	--	8/5/82	--		X	X	X		X	
Solenoid Lever Compaction Tool	SK-030	HDT0	--	10/28/82	--				X			
Shipping Reel Conductor Support	SK-032	HDT0	--	8/17/82	--				X			
Coil Form MIC Holder	SK-033	HDT0	--	9/8/82	--				X			
Compaction Clamp	SK-034	HDT0	--	9/9/82	--				X			
Entering Lead Sol- derring Fixture	SK-038	HDT0	--	8/17/82	--				X			
Prep Station Pro- tective Cover	SK-039	HDT0	--	9/8/82	--				X			

NETHER HAND TOOL LIST

NAME/LOCATION	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET			SOLN	BARR	INS	SHLD
							TRANS	T1	T2				
Kellogg Press Air Bearing Support Stand	SK-041	HDT0	--	9/9/82	--					X	X		
Conductor Storage Reel	SK-042	HDT0	--	1/9/83	--					X			
Conductor Bend Test Fixture	SK-043	HDT0	--	10/20/82	--					X			
Solder Stripper Acid Dip Tank	SK-045	HDT0	--	11/11/82	--					X			
Tornado Model Shop Vacuum Cleaner	SK-046	HDT0	--	10/23/82	PAR812850	X	X	X		X		X	
Tornado Model Shop Vacuum Cleaner	SK-047	HDT0	--	10/23/82	PAR812850	X	X	X		X		X	
Tornado Model Shop Vacuum Cleaner	SK-048	HDT0	--	10/23/82	PAR812850	X	X	X		X		X	
Tornado Model Shop Vacuum Cleaner	SK-049	HDT0	--	10/23/82	PAR812850	X	X	X		X		X	
Conductor Splice Support Stanchion	SK-050	HDT0	--	11/5/82	--					X			
Conductor Reel Handling Fixture	SK-051	HDT0	--	10/29/82	--					X			
Leak Detector/- Pumping Station Shroud	SK-052	HDT0	--	11/12/82	--					X			

MTTF-B HAND TOOL LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	MAGNET						
						A- CELL	TRANS T1	T2	SOLN	BARR	INS	SHLD
Helium Hi-Pot Pump- ing Test Adapter	SK-053	HDT0	--	11/15/82	--				X	X		
Stabilizer Slot (Hacksaw) File Tool	SK-054	HDT0	--	1/11/82	--				X			
Solenoid Filler & Shim Insulation Tool	SK-055	HDT0	--	1/11/83	--				X			
Voltage Tap Installation Tool	SK-056	HDT0	--	1/11/83	--				X	X		
Voltage Tap Soldering Tool	SK-057	HDT0	--	1/11/83	--				X	X		
Solenoid Layer- to-Layer Insulation Trim Fixture	SK-058	HDT0	--	1/11/83	--				X			
Solenoid Conductor Straightening Tool	SK-059	HDT0	--	1/11/83	--				X			
Solenoid Conductor Spool Extension	SK-060	HDT0	--	1/12/83	--				X			
Pienum Insulation Layer Forming Tool	SK-061	HDT0	--	1/10/83	--				X			
Axicell (Barrier Coil) Splice Test Fixture	SK-062	HDT0	--	1/7/83	--						X	

MFTF-B HAND TOOL LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	TRANS		MAGNET			
							T1	T2	SOLN	BARR	INS	SHLD
Solenoid Closeout Weld Ring Clamp	SK-064	HDT0	--	1/17/83	--				X			
Exiting Lead Tension Clamp	SK-065	HDT0	--	1/20/83	--				X			
Plenum Wire Run Insulation Layup Forming Tool	SK-066	HDT0	--	1/20/83	--				X			
Stack Adapter/ Helium Fill Leak Test Fixtures	SK-067	HDT0	--	1/28/83	--				X			
True-Up Glass Fill Balance Scale	SK-068	HDT0	--	2/28/83	--	X	X	X	X	X		
Closeout Weld Leak Test (Shipping) Fixture	SK-069	HDT0	--	2/3/83	--				X			
Stack Hat Kapton Applicator	SK-070	HDT0	--	3/21/83	--				X			
Tension Block Kapton Trim Template	SK-071	HDT0	--	3/30/83	--				X			
Closeout Weld Leak Test Fixture	SK-073	HDT0	--	5/17/83	--				X			
Alignment Target Locator	SK-075	HDT0	--	6/24/83	--				X			

MFTF-B HAND TOOL LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET					
							TRANS T1	T2	SOLN	BARR	INS	SHLD
Leak Test Fixture Support Swivel Hoist	SK-076	HDT0	--	6/15/83	--						X	
Trans. Coil (T2) True-Up Fixture	SK-078	HDT0	--	6/21/83	--			X				
Barrier Coil True-Up Fixture	SK-079	HDT0	--	6/15/83	--						X	
Barrier Coil Layer Winding Clamps	SK-085	HDT0	--	9/12/83	--						X	
Shoulder Bushing Kapton Trim Template	SK-086	HDT0	--	7/25/83	--				X			
True-Up Station Work Stands (Blue Max)	SK-087	HDT0	--	9/14/83	--						X	
Shield Bracket Test Fixture	SK-088	HDT0	--	10/21/83	--							X
Trans. Coil Winder Adapter (Drive Side) Drill Plate	SK-101	HDT0	--	6/13/83	--			X	X			
Trans. Coil Winder Adapter (Support Side) Drill Plate	SK-102	HDT0	--	6/13/83	--			X	X			

MFTF-B HAND TOOL LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	TRANS		MAGNET			
							T1	T2	SOLN	BARR	INS	SHLD
Closeout Case Welding Support Dogs	SK-103	HDT0	--	10/21/83	--		X	X				
Closeout Weld Leak Test Fixture	SK-104	HDT0	--	11/3/83	--						X	
Stack & Helium Fill Tube Leak Test Fixture	SK-105	HDT0	--	11/7/83	--						X	
Closeout Weld/ Shipping Protective Can	SK-106	HDT0	--	11/7/83	--		X				X	
True-Up Check Gage	SK-107	HDT0	--	11/7/83	--						X	
Plenum Insul. Layup Forming Tool	SK-108	HDT0	--	11/10/83	--						X	
Wire Run Insul Layup Forming Tool	SK-109	HDT0	--	11/10/83	--						X	
T2 Coil Splice Soldering Fixture	SK-110	HDT0	--	11/30/83	--					X		
T2 Clamp Plate Drill Plate	SK-111	HDT0	--	2/13/83	--					X		
Pancake Winding Clamp	SK-114	HDT0	--	12/5/83	--						X	
Pancake Holddown Clamp	SK-115	HDT0	--	12/9/83							X	

MTF-B HAND TOOL LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	MAGNET							
						A- CELL	TRANS T1	T2	SOLN	BARR	INS	SHLD	
Axicell Coil Splice Fixture	SK-117	HDT0	--	2/1/84	--							X	
T2 Coil Closeout Weld Leak Test Fixture	SK-118	HDT0	--	12/20/83	--				X				
Conductor Spool Handling Fixture	SK-119	HDT0	--	12/21/83	--			X	X			X	
Pancake Anchor Block Clamp	SK-120	HDT0	--	1/13/84	--							X	
Closeout Weld Work Stands (Wilson) -- Deleted	SK-121	HDT0	--	1/26/84 5/22/84	--							X	
T1 Coil Closeout Weld Leak Test Fixture	SK-122	HDT0		6/6/84				X					
Pancake Pigtail Clamp	SK-124	HDT0	--	2/21/84								X	
Kapton Locator	SK-125	HDT0	--	2/15/84								X	
Entering/Exiting Lead Splice Tether Post Weight Stand	SK-126	HDT0	--	3/13/84	--							X	
T1 Coil True-Up Fixture	SK-127	HDT0	--	3/8/84	--			X					
T1 Clamp Plate Drill Fixture	SK-128	HDT0	--	3/10/84	--			X					

MFTF-B HAND TOOL LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	MAGNET						
						A- CELL	TRANS T1	T2	SOLN	BARR	INS	SHLD
Double Button Machine	SK-129	HDT0	--	4/13/84	--		X	X				
Splice Forming Tools	SK-130	HDT0	--	3/23/84	--			X				
Splice Support Stand	SK-131	HDT0	--	4/2/84	--						X	
T2 Plenum Layup Forming Tool	SK-132	HDT0	--	4/13/84	--			X				
Glue Block Machine Tool (T2)	SK-133	HDT0	--	5/15/84	--			X				
Closeout Station Handling Tool	SK-134	HDT0	--	5/17/84	--		X	X				
Splice Wire Brush Clean Enclosure	SK-135	HDT0	--	5/17/84	--		X	X			X	
T1 Prep Station Stands	SK-136	HDT0	--	5/22/84	--		X					
T2 Closeout Holddown Clamp	SK-137	HDT0	--	6/14/84	--		X	X				
T2 Coil Vent and Stack Leak Test Fixture	SK-138	HDT0	--	6/21/84	--			X				
T1 Coil Splice Fixture	SK-139	HDT0	--	6/11/84	--		X					

A-18

MFTF-B HAND TOOL LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET					
							TRANS T1	T2	SOLN	BARR	INS	SHLD
Inlet Lead Cover Router Tool	SK-140	HDT0	--	6/10/84	--			X				
T2 Stack (Closeout) Weld/Shipping Protective Can	SK-141	HDT0	--	7/31/84	--			X				
Entering/Exiting Lead Splice Tether Post Weight Stand	SK-142	HDT0	--	8/2/84	--		X	X				
Glue Block Machine Tool (T1)	SK-143	HDT0	--	8/8/84	--		X					
Clamp Block Drill Fixture (T2)	SK-144	HDT0	--	8/14/84	--			X				
Closeout Station Protective Tent (T2)	SK-145	HDT0	--	9/26/84	--			X				
Handling & Shipping Fixture (T2)	SK-146	HDT0	--	10/24/84	--			X				
Plenum Layout Forming Tool (T1)	SK-147	HDT0	--	9/4/84	--		X					
Inlet Lead Forming Tool	SK-148	HDT0	--	9/19/84	--		X	X				
Inlet Lead Cover Router Tool (T1)	SK-149	HDT0	--	10/31/84	--		X					
Handling & Shipping Fixture (T1)	SK-150	HDT0	--	11/7/84	--		X					
Coil Plate Leak Test Tools	SK-151	HDT0	--	11/21/84	--		X	X				

MFTF-B SUPPORT TOOLING LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET				
							TRANS T1	T2	SOLN	BARR	INS
A-Cell Coil Winder Adapter	710777	MCAC	TTA0551	8/28/81	72E0200	X					
A-Cell Button Dispenser	710778	MCAC	TTA0552	12/18/81	72E0201	X	X	X			
ALTER - Scissor Lift Airmotor Drive			TTA3949	3/19/82		X					
ALTER - Incorporate Electric Lift Table			TWD3607	7/18/83			X	X			
Tether Post Weight Stand	711196	ASTO	TWS3097	12/8/81	11-38006-1				X		
A-20 Solenoid Winding Line Protective Cover (Tent)	711913	PRCR	TTA9607	4/15/82	MFTF-B-SK-008				X	X	
Master Mill Accessory Stand	711958	MCAC	TTA9609	4/23/82	MFTF-B-SK-012				X		
Solenoid Coil Form True-Up Mold - 90° (1)	711959	PDMO	TTA9610	4/29/82	71E0612				X		
Solenoid Coil Form Leak Test Fixture (1)	712019	TSAC	TTA9613	5/10/82	MFTF-B-SK-012				X		
INACTIVATE - Used for TSAC 716540			TWD3666	7/19/83							
Solenoid Coil Wind- ing and Mock-up	712020	TSTO	TTA9612	5/10/82	MFTF-B-2016				X		

MFTF-B SUPPORT TOOLING LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	TRANS		MAGNET		
							T1	T2	SOLN	BARR	INS
Master Mill Acces- sory Stand (2)	712024	MCAC	TTA9614	5/10/82	MFTF-B-SK-012				X		
Side-Wall Insula- tion Cut-Outs	712048	MFTP	TTA9615	5/20/82	71E0678				X		
Solenoid Splice Doubler Solder Fixture	712049	WLFX	TTA9616	5/20/82	MFTF-B-SK-020				X		
Lincoln Welder (K 1170)	712067	MA1B	TTA9608	6/11/82	AC2255	X					
Clamping Details Test Set-Up	712097	TSTO	TWA3273	6/11/82	MFTF-B-SK-025	X					
Solenoid Coil Winding Compac- tion Tool	712385	HNTD	TTA9612	7/22/82	MFTF-B-SK-015				X		
Universal Spider Fixture (5)	712422	MCAC	TWA3275	8/3/82	PAR812850				X		
INACTIVATE - Used for MCAC 716538			TWD3662	7/19/83							
Universal Spider Fixture (6)	712423	MCAC	TWA3276	8/3/82	PAR812850				X		
INACTIVATE - Used for MCAC 716538			TWD3665	7/19/83							
Universal Spider Fixture (7)	712424	MCAC	TWA3277	8/3/82	PAR812850				X		

MFTF-B SUPPORT TOOLING LIST

			TOOL ORDER			MAGNET					
NOMENCLATURE	TOOL NUMBER	SYMBOL	NUMBER	ISSUE DATE	PART NUMBER	A-CELL	TRANS T1	T2	SOLN	BARR	INS
INACTIVATE - Used for MCAC 716539			TWD3664	7/19/83							
Universal Spider Fixture (8)	712425	MCAC	TWA3278	8/3/82	PAR812850				X		
INACTIVATE - Used for MCAC 716539			TWD3663	7/19/83							
Compaction Check Gage (1)	712512	CKGA	TWA3279	8/3/82	MFTF-B-SK-029				X		
ALTER - Axicell Coil			TWD3602	7/29/83						X	
Compaction Check Gage (2)	712513	CKGA	WA3280	8/3/82	MFTF-B-SK-044				X		
ALTER - Axicell Coil			TWD3603	7/29/83						X	
Conductor File Fixture (1)	714498	TOAC	TWA3293	10/25/82	MFTF-B-SK-044				X		
Conductor File Fixture (2)	714567	TOAC	TWB0876	10/28/82	MFTF-B-SK-044				X		
Solenoid Tension Clamp (2)	714899	HNTD	TWB0877	11/18/82	MFTF-B-SK-027				X		
Solenoid Conductor Slot Router Fixture (Handle)	714900	TOAC	TWB0881	11/19/82	MFTF-B-SK-011				X		
Solenoid Prep Station Work Stand	715376	MCAC	TWB0878	1/12/83	MFTF-B-SK-063				X		

MFTF-B SUPPORT TOOLING LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	TRANS		MAGNET		
							T1	T2	SOLN	BARR	INS
Trans. Coil Winding Mach/Tensioner w/work platform, stairwell, base plates, gantry crane, and Koldweld Press (LLNL)	715472	SPMC	TWB0879	1/17/83	71E0001		X	X			
ALTER - Platforms (T2)			TWC7138	10/3/83					X		
ALTER - Platforms (T1)			TWC7140	10/3/83					X		
ALTER-Platforms (T2)			TWC7138						X		
ALTER-Platforms (T1)			TWC7140						X		
Transition (T2) Coil Form Support (1)	716291	MCAC	TWB0883	3/29/83	71E03305			X			
ALTER - Clamps			TWD3608						X		
Transition (T2) Coil Form Support (2)	716292	MCAC	TWB0884	3/29/83	71E03305			X			
ALTER - Clamps			TWD3659						X		
Transition (T1) Coil Form Support (1)	716294	MCAC	TWB0886	3/29/83	71E03205		X				
ALTER - Clamps			TWD3660					X			
Transition (T1) Coil Form Support (1)	716293	MCAC	TWB0886	3/29/83	71E03205		X				
ALTER - Clamps			TWD3661					X			
Axicell Holding Fixture (1)	716539	MCAC	TWD3557	7/12/83	MFTF-B-SK-077						X

MFTF-B SUPPORT TOOLING LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	TRANS		MAGNET		
							T1	T2	SOLN	BARR	INS
Axicell Holding Fixture (2)	716539	MCAC	TWD3558	7/12/83	MFTF-B-SK-077						X
Axicell Coil Form Leak Test Fixture (1)	716540	MCAC	TWD3559	7/12/83	MFTF-B-SK-077						X
Axicell Holding Fixture (3)	716542	MCAC	TWD3599	10/19/83	MFTF-B-SK-077						X
Axicell Winder Work Stands	716547	MAID	TWD3600	9/27/83	MFTF-B-SK-081						X
Axicell Holding Fixture (4)	716548	MCAC	TWD3601	10/19/83	MFTF-B-SK-077						X
Transition Coil Tent (1)	716549	PRCR	TWD3604	8/26/83	MFTF-B-SK-083			X	X		
Transition Coil Tent (2)	716550	PRCR	TWD3605	8/26/83	MFTF-B-SK-083			X	X		
Transition Coil Button Dispenser (2)	717387	MCAC	TWD3606	7/12/83	71E03305		X	X			
Axicell Anchor Block Drill Plate	718320	DRPE	TWD3595	2/1/84	MFTF-B-SK-123						X
Shim Bladder Test Article Hydro- Press Form - End Cap Major Radius	761153	HPFM	TWT7244	8/18/81	71E0218	X					

MFTF-B SUPPORT TOOLING LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	TRANS			MAGNET		
							T1	T2		SOLN	BARR	INS
Shim Bladder Test Article Hydro- Press Form - Minor Radius	761154	HPFM	TWT7243	8/18/81	71E0219	X						
Trans. Coil Prep Station Tent	761169	MAID	TWT7251	1/28/82	011-38001-1		X	X				
A-Cell Handling Tool (A-2)	762096	HATO	TTA3946	7/30/81	73E0200	X						
A-Cell Dimple Bladder - Major Radius (-1) - Sush for PDTA TA3941	762099	SUSH	TTA3939	2/15/82	71E0214	X						
A-Cell Dimple Bladder - Major Radius	762100	PDTA	TTA3941	2/15/82	71E0214	X						
NC Production Tape Proof for PDTA			TTA3942	2/15/82		X						
A-Cell Dimple Bladder - Hydro- Press Form - Minor Radius (-1) CANCEL	762101	HPFM	TTA3936	2/15/82 4/16/82	71E0211-1	X						
A-Cell Dimple Bladder - Hydro- Press Form - Minor Radius (-4) CANCEL	762102	HPFM	TTA3937	2/15/82 4/16/82	71E0211-4	X						

MFTF-B SUPPORT TOOLING LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET			INS
							TRANS	SOLN	BARR	
							T1	T2		
A-Cell Dimple Bladder - Hydro- Press Form - Major Radius (-1)	762103	HPFM	TTA3938	2/15/82	71E0214	X				
A-Cell Bead Bladder - Hydro- Press Form - Major Radius (-3)	762104	HPFM	TTA3944	2/15/82	71E0224	X				
A-Cell Handling Tool (A-1)	762105	HATO	TTA3945	7/30/81	73E0200	X				
A-Cell Bead Bladder - Minor Radius (-1)	762106	HPFM	TTA3940	2/15/81	71E0216-1	X				
<u>CANCEL</u>				4/16/82						
A-Cell Clamp - Plate and Plenum Installation Drill Plate	762119	ORPE	TTA3947	2/18/82	71E0319	X				
Shim Bladder Pres- sure Test Fixture - Minor Radius	762120	TSAC	TTA3948	2/18/82	71E0219	X				
A-Cell/Transition Coil Winding Mach. w/Work Platform, Stairwell, Base Plates, and Gantry Crane (GDC)	762126	SPMC	TTA3950	1/31/82	71E0001A	X	X	X		

A-26

MFTF-B SUPPORT TOOLING LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	A- CELL	MAGNET			
							TRANS T1	T2	SOLN	BARR INS
ALTER - To Wind T1 and T2 Trans. Coils			TWB0882	1/21/83			X	X		
ALTER - Platforms (T2)			TWC7139	10/3/83				X		
ALTER - Platforms (T1)			TWC7141	10/3/83			X			
Mock-Up A-Cell Minor Radius Coil Packs	762250	MAID	TTA3951	3/19/82	MA762250	X				
Mock-Up A-Cell Minor Radius Coil Form	762251	TSTO	TTA9606	3/19/82	71E02028	X				
Mock-Up A-Cell Major Radius Coil Pack	762252	MAID	TTA9605	3/19/82	MA762252	X				
A-27 Solenoid Coil Form True-Up Mold 90° (2)	762554	PDMO	TTA9832	6/25/82	71E0612				X	
Solenoid Coil Form True Up Mold 180° (Opposite)	762257	PDMO	TTA9834	6/28/82	71E0612				X	
Solenoid Tension Clamp(1)	762675	HNT0	TWA3274	8/16/82	MFTF-B-SK-027				X	
Entering Lead 90° Bend Fixture	762687	FMMD	TWA6797	8/16/82	MFTF-B-SK-032				X	

MFTF-B SUPPORT TOOLING LIST

NOMENCLATURE	TOOL NUMBER	SYMBOL	TOOL ORDER NUMBER	ISSUE DATE	PART NUMBER	MAGNET					
						A- CELL	TRANS T1	T2	SOLN	BARR	INS
Master Mill Extension Support Stand	762714	MCAC	TWA3282	8/24/82	MFTF-B-SK-036				X		
Solenoid Conductor Cutoff File Fixture	762715	TOAC	TWA3283	8/24/82	MFTF-B-SK-035				X		
Solenoid Coil Form Leak Test Fixture (2)	762716	TSAC	TWA3281	8/24/82	MFTF-B-SK-017				X		
Plenum Insulation Cut-Out Template	762772	MKTP	TWA3286	9/15/82	71E0684				X		
Solenoid Spice Solder Fixture	762782	WLFX	TWA3285	9/8/82	MFTF-B-SK-040				X		

APPENDIX B

SOLENOID COIL WINDING TIMES PERFORMANCE LOG

**SOLENOID COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. ESI

TASK		TASK	
1. Layer 1	<u>18:50</u>	1. Layer 13	<u>7:10</u>
2. Filler & Shim	<u>13:55</u>	2. Filler & Shim	<u>10:20</u>
3. Layer 2	<u>11:40</u>	3. Layer ⑭	<u>6:15</u>
4. Splice & Shim	<u>32:50</u>	4. Splice & Shim	<u>18:25</u>
TOTAL: <u>77:15</u>		TOTAL: <u>42:10</u>	
1. Layer 3	<u>10:30</u>	1. Layer 15	<u>8:55</u>
2. Filler & Shim	<u>5:50</u>	2. Filler & Shim	<u>1:44</u>
3. Layer ④	<u>7:40</u>	3. Layer ⑯	<u>6:05</u>
4. Splice & Shim	<u>28:20</u>	4. Splice & Shim	<u>20:55</u>
TOTAL: <u>52:20</u>		TOTAL: <u>37:39</u>	
1. Layer 5	<u>17:35</u>	1. Layer 17	<u>7:25</u>
2. Filler & Shim	<u>3:50</u>	2. Filler & Shim	<u>6:45</u>
3. Layer ⑥	<u>5:00</u>	3. Layer ⑰	<u>9:25</u>
4. Splice & Shim	<u>19:30</u>	4. Splice & Shim	<u>38:15</u>
TOTAL: <u>45:55</u>		TOTAL: <u>60:50</u>	
1. Layer 7	<u>5:45</u>	1. Layer 19	<u>7:50</u>
2. Filler & Shim	<u>5:05</u>	2. Filler & Shim	<u>5:10</u>
3. Layer ⑧	<u>6:15</u>	3. Layer ⑲	<u>9:25</u>
4. Splice & Shim	<u>24:05</u>	4. Splice & Shim	<u>18:50</u>
TOTAL: <u>41:10</u>		TOTAL: <u>41:15</u>	
1. Layer 9	<u>4:30</u>	1. Layer 21	<u>7:35</u>
2. Filler & Shim	<u>7:55</u>	2. Filler & Shim	<u>6:10</u>
3. Layer ⑩	<u>8:10</u>	3. Layer ⑳	<u>6:10</u>
4. Splice & Shim	<u>24:00</u>	4. Splice & Shim	<u>17:20</u>
TOTAL: <u>44:35</u>		TOTAL: <u>37:15</u>	
1. Layer 11	<u>20:10</u>	1. Layer 23	<u>3:07</u>
2. Filler & Shim	<u>9:20</u>	2. Filler & Shim	<u>7:23</u>
3. Layer 12	<u>7:00</u>	3. Layer ⑳	<u>6:55</u>
4. Splice & Shim	<u>21:10</u>	4. Splice & Shim	<u>15:30</u>
TOTAL: <u>56:40</u>		TOTAL: <u>22:55</u>	
AVERAGES			
1. Odd Layer (Up)	<u>9:57</u>		
2. Filler & Shim	<u>6:52</u>		
3. Even Layer (Down)	<u>7:25</u>		
4. Splice & Shim	<u>23:58</u>		
Totals:		<u>48:12</u>	

SOLENOID COIL WINDING TIMES PERFORMANCE LOG

COIL NO. WS1

TASK		TASK	
1. Layer 1	<u>12:20</u>	1. Layer 13	<u>5:45</u>
2. Filler & Shim	<u>8:50</u>	2. Filler & Shim	<u>5:45</u>
3. Layer 2	<u>5:30</u>	3. Layer <u>14</u>	<u>8:12</u>
4. Splice & Shim	<u>48:25</u>	4. Splice & Shim	<u>27:53</u>
TOTAL:	<u>75:05</u>	TOTAL:	<u>47:35</u>
1. Layer 3	<u>4:35</u>	1. Layer 15	<u>11:35</u>
2. Filler & Shim	<u>5:00</u>	2. Filler & Shim	<u>3:35</u>
3. Layer <u>4</u>	<u>4:50</u>	3. Layer <u>16</u>	<u>5:40</u>
4. Splice & Shim	<u>24:10</u>	4. Splice & Shim	<u>25:40</u>
TOTAL:	<u>38:35</u>	TOTAL:	<u>56:30</u>
1. Layer 5	<u>15:20</u>	1. Layer 17	<u>9:55</u>
2. Filler & Shim	<u>6:20</u>	2. Filler & Shim	<u>2:50</u>
3. Layer <u>6</u>	<u>7:00</u>	3. Layer <u>18</u>	<u>5:20</u>
4. Splice & Shim	<u>18:40</u>	4. Splice & Shim	<u>18:40</u>
TOTAL:	<u>47:20</u>	TOTAL:	<u>36:45</u>
1. Layer 7	<u>9:40</u>	1. Layer 19	<u>6:20</u>
2. Filler & Shim	<u>4:50</u>	2. Filler & Shim	<u>5:20</u>
3. Layer <u>8</u>	<u>5:10</u>	3. Layer <u>20</u>	<u>7:00</u>
4. Splice & Shim	<u>19:15</u>	4. Splice & Shim	<u>22:40</u>
TOTAL:	<u>38:55</u>	TOTAL:	<u>41:20</u>
1. Layer 9	<u>10:05</u>	1. Layer 21	<u>9:10</u>
2. Filler & Shim	<u>8:37</u>	2. Filler & Shim	<u>4:45</u>
3. Layer <u>10</u>	<u>12:08</u>	3. Layer <u>22</u>	<u>7:15</u>
4. Splice & Shim	<u>30:50</u>	4. Splice & Shim	<u>26:25</u>
TOTAL:	<u>61:40</u>	TOTAL:	<u>41:35</u>
1. Layer 11	<u>8:15</u>	1. Layer 23	<u>5:35</u>
2. Filler & Shim	<u>6:40</u>	2. Filler & Shim	<u>5:10</u>
3. Layer 12	<u>9:10</u>	3. Layer <u>24</u>	<u>5:00</u>
4. Splice & Shim	<u>22:35</u>	4. Splice & Shim	<u>(4:50)</u>
TOTAL:	<u>46:30</u>	TOTAL:	<u>20:35</u>
AVERAGES			
1. Odd Layer (Up)	<u>9:08</u>		
2. Filler & Shim	<u>5:39</u>		
3. Even Layer (Down)	<u>6:51</u>		
4. Splice & Shim	<u>25:23</u>		
Totals:	<u>47:01</u>		

**SOLENOID COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. ES2

TASK		TASK	
1. Layer 1	<u>6:18</u>	1. Layer 13	<u>5:45 (5:34) ①</u>
2. Filler & Shim	<u>4:37</u>	2. Filler & Shim	<u>4:30</u>
3. Layer 2	<u>5:55</u>	3. Layer ⑭	<u>5:55</u>
4. Splice & Shim	<u>22:17</u>	4. Splice & Shim	<u>12:56 ②</u>
TOTAL:	37:07	TOTAL:	29:06
1. Layer 3	<u>8:18</u>	1. Layer 15	<u>4:59</u>
2. Filler & Shim	<u>3:45</u>	2. Filler & Shim	<u>3:50</u>
3. Layer ④	<u>7:20</u>	3. Layer ⑮	<u>4:55</u>
4. Splice & Shim	<u>14:40</u>	4. Splice & Shim	<u>17:25</u>
TOTAL:	34:03	TOTAL:	31:09
1. Layer 5	<u>5:54</u>	1. Layer 17	<u>5:15</u>
2. Filler & Shim	<u>2:31</u>	2. Filler & Shim	<u>3:05</u>
3. Layer ⑥	<u>3:55</u>	3. Layer ⑯	<u>5:05</u>
4. Splice & Shim	<u>15:25</u>	4. Splice & Shim	<u>13:47</u>
TOTAL:	27:45	TOTAL:	27:12
1. Layer 7	<u>6:50</u>	1. Layer 19	<u>7:03</u>
2. Filler & Shim	<u>5:18</u>	2. Filler & Shim	<u>5:20</u>
3. Layer ⑧	<u>6:17</u>	3. Layer ⑰	<u>5:05</u>
4. Splice & Shim	<u>17:10</u>	4. Splice & Shim	<u>12:50 ③</u>
TOTAL:	35:35	TOTAL:	30:18
1. Layer 9	<u>6:40</u>	1. Layer 21	<u>3:20</u>
2. Filler & Shim	<u>5:30</u>	2. Filler & Shim	<u>5:55</u>
3. Layer ⑩	<u>6:50</u>	3. Layer ⑱	<u>5:00</u>
4. Splice & Shim	<u>17:05</u>	4. Splice & Shim	<u>11:25</u>
TOTAL:	36:05	TOTAL:	25:40
1. Layer 11	<u>7:15</u>	1. Layer 23	<u>5:25</u>
2. Filler & Shim	<u>5:30</u>	2. Filler & Shim	<u>4:43</u>
3. Layer 12	<u>5:20</u>	3. Layer ⑳	<u>6:47</u>
4. Splice & Shim	<u>17:10 ①</u>	4. Splice & Shim	<u>(6:45) ④</u>
TOTAL:	35:15	TOTAL:	23:40

AVERAGES

1. Odd Layer (Up)	<u>6:03</u>
2. Filler & Shim	<u>4:33</u>
3. Even Layer (Down)	<u>5:42</u>
4. Splice & Shim	<u>15:37</u>
Totals:	<u>31:57</u>

NOTES: ① Electrical short in Layer 12 splice - unwound Layer 13 and removed shims Layer 12 - Rewound Layer 13. CAR No. CC 22058. (19:31 N/I).

② Apparent electrical short in turn 25 - Engineering evaluation. OK. (3:00 N/I).

③ Replaced air bearing foot on Koldwel Air (1:30 N/I).

④ Electrical short between layers 14 & 20 - Engineering evaluation - burned out with 10 amps CAR No. CC 22040. (25:00 N/I).

**SOLENOID COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. WS2

TASK		TASK	
1. Layer 1	<u>7:00</u>	1. Layer 13	<u>5:22</u>
2. Filler & Shim	<u>5:00</u>	2. Filler & Shim	<u>4:53</u>
3. Layer 2	<u>7:00</u>	3. Layer <u>(14)</u>	<u>4:45</u>
4. Splice & Shim	<u>18:43</u>	4. Splice & Shim	<u>13:50</u> ②
TOTAL: 37:48		TOTAL: 28:55	
1. Layer 3	<u>5:00</u>	1. Layer 15	<u>5:30</u>
2. Filler & Shim	<u>11:52</u> ①	2. Filler & Shim	<u>4:55</u>
3. Layer <u>(4)</u>	<u>4:18</u>	3. Layer <u>(16)</u>	<u>4:35</u>
4. Splice & Shim	<u>15:35</u>	4. Splice & Shim	<u>17:40</u> ③
TOTAL: 37:15		TOTAL: 32:40	
1. Layer 5	<u>5:25</u>	1. Layer 17	<u>5:30</u>
2. Filler & Shim	<u>5:30</u>	2. Filler & Shim	<u>3:10</u>
3. Layer <u>(6)</u>	<u>3:50</u>	3. Layer <u>(18)</u>	<u>5:10</u>
4. Splice & Shim	<u>11:10</u>	4. Splice & Shim	<u>19:00</u> ④
TOTAL: 25:55		TOTAL: 32:50	
1. Layer 7	<u>4:30</u>	1. Layer 19	<u>5:25</u>
2. Filler & Shim	<u>3:35</u>	2. Filler & Shim	<u>5:30</u>
3. Layer <u>(8)</u>	<u>5:05</u>	3. Layer <u>(20)</u>	<u>6:30</u>
4. Splice & Shim	<u>16:30</u>	4. Splice & Shim	<u>18:10</u>
TOTAL: 29:40		TOTAL: 35:35	
1. Layer 9	<u>4:30</u>	1. Layer 21	<u>4:05</u>
2. Filler & Shim	<u>3:56</u>	2. Filler & Shim	<u>7:10</u>
3. Layer <u>(10)</u>	<u>6:04</u>	3. Layer <u>(22)</u>	<u>5:55</u>
4. Splice & Shim	<u>17:30</u>	4. Splice & Shim	<u>17:25</u> ⑤
TOTAL: 32:00		TOTAL: 34:35	
1. Layer 11	<u>4:15</u>	1. Layer 23	<u>5:05</u>
2. Filler & Shim	<u>4:08</u>	2. Filler & Shim	<u>5:40</u>
3. Layer 12	<u>5:13</u>	3. Layer <u>(24)</u>	<u>6:35</u>
4. Splice & Shim	<u>14:15</u>	4. Splice & Shim	<u>(6:35)</u>
TOTAL: 27:51		TOTAL: 23:55	

AVERAGES

1. Odd Layer (Up)	<u>5:08</u>
2. Filler & Shim	<u>5:27</u>
3. Even Layer (Down)	<u>5:25</u>
4. Splice & Shim	<u>16:21</u>
Totals:	<u>32:21</u>

NOTES: ① Conductor ferrule pushed in by shims, removed for engineering evaluation. Reinstall. QAR No. CC22051c (I)
 ② Installation of Koldwelder plates - (7:30 N/I).
 ③ Splice got bent had to straighten - QAR No. CC22059 (I)
 ④ Power Supply problem end of layer tests - (1:15 N/I).
 ⑤ Voltage tap damaged - waited for new cable to be fabricated (3:00 N/I).

**SOLENOID COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. ES3

TASK		TASK	
1. Layer 1	<u>6:02</u>	1. Layer 13	<u>4:05</u>
2. Filler & Shim	<u>7:13</u>	2. Filler & Shim	<u>4:35</u>
3. Layer 2	<u>3:50</u>	3. Layer ⑭	<u>6:15</u>
4. Splice & Shim	<u>18:50 ①</u>	4. Splice & Shim	<u>15:30 ⑤</u>
TOTAL:	35:55	TOTAL:	30:25
1. Layer 3	<u>21:10 ②③</u>	1. Layer 15	<u>5:00</u>
2. Filler & Shim	<u>11:00 ④</u>	2. Filler & Shim	<u>4:35</u>
3. Layer ④	<u>5:20</u>	3. Layer ⑯	<u>5:35</u>
4. Splice & Shim	<u>18:15 ⑤</u>	4. Splice & Shim	<u>16:30 ①⑤</u>
TOTAL:	55:45	TOTAL:	31:40
1. Layer 5	<u>6:55</u>	1. Layer 17	<u>5:50</u>
2. Filler & Shim	<u>4:40</u>	2. Filler & Shim	<u>6:20</u>
3. Layer ⑥	<u>6:10</u>	3. Layer ⑱	<u>8:00</u>
4. Splice & Shim	<u>21:00 ⑤</u>	4. Splice & Shim	<u>16:05</u>
TOTAL:	38:45	TOTAL:	37:05
1. Layer 7	<u>6:30</u>	1. Layer 19	<u>7:55</u>
2. Filler & Shim	<u>5:10</u>	2. Filler & Shim	<u>4:50</u>
3. Layer ⑧	<u>6:45</u>	3. Layer ⑳	<u>9:50</u>
4. Splice & Shim	<u>24:15 ⑥⑦</u>	4. Splice & Shim	<u>20:05</u>
TOTAL:	42:40	TOTAL:	
1. Layer 9	<u>5:55</u>	1. Layer 21	<u>6:25</u>
2. Filler & Shim	<u>4:40</u>	2. Filler & Shim	<u>5:40</u>
3. Layer ⑩	<u>4:50</u>	3. Layer ㉑	<u>7:25</u>
4. Splice & Shim	<u>16:20</u>	4. Splice & Shim	<u>18:15</u>
TOTAL:	31:45	TOTAL:	37:45
1. Layer 11	<u>7:10</u>	1. Layer 23	<u>6:10</u>
2. Filler & Shim	<u>5:20</u>	2. Filler & Shim	<u>6:25</u>
3. Layer 12	<u>3:20</u>	3. Layer ㉒	<u>7:55</u>
4. Splice & Shim	<u>11:30</u>	4. Splice & Shim	<u>14:05</u>
TOTAL:	27:20	TOTAL:	24:35

AVERAGES

1. Odd Layer (Up)	<u>7:26</u>
2. Filler & Shim	<u>5:52</u>
3. Even Layer (Down)	<u>6:11</u>
4. Splice & Shim	<u>17:57</u>
Totals:	<u>37:26</u>

NOTES: ① Only one (1) man available for shimming. ② Gaps present between side wall insulation (Post) and conductor - had to clean off excessive adhesive and shim (2:30 F.). ③ Conductor flipping - un-wound 9 turns and rewound (12:20 I.). ④ Conductor flipping - forced down with clamps (3:00 I.). ⑤ Only one (1) man available for splice. ⑥ Damaged superconductor in splice - lower R line did (5:00 I.). ⑦ Conductor required additional support under post insulation (3:00 I.).

**SOLENOID COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. W53

TASK		TASK	
1. Layer 1	<u>8:04</u>	1. Layer 13	<u>7:45</u>
2. Filler & Shim	<u>8:40</u>	2. Filler & Shim	<u>4:35</u>
3. Layer 2	<u>6:10</u>	3. Layer (14)	<u>5:50</u>
4. Splice & Shim	<u>11:45</u>	4. Splice & Shim	<u>16:05</u> (2)(3)
TOTAL:	<u>34:39</u>	TOTAL:	<u>34:15</u>
1. Layer 3	<u>6:20</u>	1. Layer 15	<u>5:40</u>
2. Filler & Shim	<u>5:20</u>	2. Filler & Shim	<u>4:05</u>
3. Layer (4)	<u>5:10</u>	3. Layer (16)	<u>3:20</u>
4. Splice & Shim	<u>17:10</u>	4. Splice & Shim	<u>21:15</u> (4)(5)
TOTAL:	<u>34:00</u>	TOTAL:	<u>34:20</u>
1. Layer 5	<u>7:10</u>	1. Layer 17	<u>6:25</u>
2. Filler & Shim	<u>5:20</u>	2. Filler & Shim	<u>4:25</u>
3. Layer (6)	<u>8:25</u>	3. Layer (18)	<u>4:50</u>
4. Splice & Shim	<u>16:25</u> (1)	4. Splice & Shim	<u>16:05</u>
TOTAL:	<u>37:20</u>	TOTAL:	<u>31:45</u>
1. Layer 7	<u>7:10</u>	1. Layer 19	<u>6:10</u>
2. Filler & Shim	<u>3:50</u>	2. Filler & Shim	<u>4:10</u>
3. Layer (8)	<u>6:40</u>	3. Layer (20)	<u>5:40</u>
4. Splice & Shim	<u>14:35</u>	4. Splice & Shim	<u>16:50</u> (3)
TOTAL:	<u>32:15</u>	TOTAL:	
1. Layer 9	<u>6:40</u>	1. Layer 21	<u>5:30</u>
2. Filler & Shim	<u>6:15</u>	2. Filler & Shim	<u>4:40</u>
3. Layer (10)	<u>6:00</u>	3. Layer (22)	<u>5:20</u>
4. Splice & Shim	<u>14:20</u>	4. Splice & Shim	<u>17:10</u>
TOTAL:	<u>33:15</u>	TOTAL:	<u>32:40</u>
1. Layer 11	<u>4:35</u>	1. Layer 23	<u>6:10</u>
2. Filler & Shim	<u>5:05</u>	2. Filler & Shim	<u>5:35</u>
3. Layer 12	<u>6:10</u>	3. Layer (24)	<u>8:00</u>
4. Splice & Shim	<u>13:05</u>	4. Splice & Shim	<u>(5:25)</u>
TOTAL:	<u>28:55</u>	TOTAL:	

AVERAGES

1. Odd Layer (Up)	<u>6:28</u>
2. Filler & Shim	<u>5:10</u>
3. Even Layer (Down)	<u>5:58</u>
4. Splice & Shim	<u>15:53</u>
Totals:	<u>33:29</u>

NOTES: (1) Over-heated in annealing process - failed tension pull test - replaced splice (2:50 N/E). (2) Only one (1) man available for splice. (3) Splice failed pull test - both sides - replaced splice (2:00 N/E). (4) Pyrometer not functioning correctly. (5) Only one (1) man available for splicing. (6) Splice change delayed due to weather conditions (2:00 N/E).

**SOLENOID COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. ES4

TASK		TASK	
1. Layer 1	<u>10:05 (1)</u>	1. Layer 13	<u>4:20</u>
2. Filler & Shim	<u>7:05</u>	2. Filler & Shim	<u>7:30</u>
3. Layer 2	<u>7:20</u>	3. Layer (14)	<u>6:35</u>
4. Splice & Shim	<u>10:25</u>	4. Splice & Shim	<u>18:45</u>
TOTAL:	<u>40:55</u>	TOTAL:	<u>37:10</u>
1. Layer 3	<u>6:25</u>	1. Layer 15	<u>5:55</u>
2. Filler & Shim	<u>6:10 (2)</u>	2. Filler & Shim	<u>5:35</u>
3. Layer (4)	<u>6:20</u>	3. Layer (16)	<u>5:40</u>
4. Splice & Shim	<u>18:40</u>	4. Splice & Shim	<u>20:30 (5)</u>
TOTAL:	<u>37:35</u>	TOTAL:	<u>37:40</u>
1. Layer 5	<u>11:15 (3)</u>	1. Layer 17	<u>6:00 (6)</u>
2. Filler & Shim	<u>4:05</u>	2. Filler & Shim	<u>4:00 (7)</u>
3. Layer (6)	<u>6:50</u>	3. Layer (18)	<u>6:35</u>
4. Splice & Shim	<u>17:35</u>	4. Splice & Shim	<u>18:30</u>
TOTAL:	<u>39:45</u>	TOTAL:	<u>34:55</u>
1. Layer 7	<u>8:30</u>	1. Layer 19	<u>6:00</u>
2. Filler & Shim	<u>5:20</u>	2. Filler & Shim	<u>6:35</u>
3. Layer (8)	<u>5:25</u>	3. Layer (20)	<u>5:20</u>
4. Splice & Shim	<u>20:25</u>	4. Splice & Shim	<u>11:00</u>
TOTAL:	<u>40:10</u>	TOTAL:	<u>28:55</u>
1. Layer 9	<u>4:25</u>	1. Layer 21	<u>4:50</u>
2. Filler & Shim	<u>4:45</u>	2. Filler & Shim	<u>4:00</u>
3. Layer (10)	<u>5:20</u>	3. Layer (22)	<u>3:35</u>
4. Splice & Shim	<u>17:38 (4)</u>	4. Splice & Shim	<u>11:30</u>
TOTAL:	<u>32:08</u>	TOTAL:	<u>23:45</u>
1. Layer 11	<u>6:57</u>	1. Layer 23	<u>4:50</u>
2. Filler & Shim	<u>5:35</u>	2. Filler & Shim	<u>4:00</u>
3. Layer 12	<u>5:25</u>	3. Layer (24)	<u>4:45</u>
4. Splice & Shim	<u>4:20</u>	4. Splice & Shim	<u>13:15</u>
TOTAL:	<u>32:17</u>	TOTAL:	
AVERAGES			
1. Odd Layer (Up)	<u>6:38</u>		
2. Filler & Shim	<u>5:23</u>		
3. Even Layer (Down)	<u>5:44</u>		
4. Splice & Shim	<u>16:57</u>		
Totals:	<u>34:36</u>		

NOTES: (1) Conductor twisting first 6 turns - delay for re-clamping (2:00 T). (2) Only one (1) man available for shimming. (3) Conductor twisting - stopped winding for correct problem. (4) only one (1) man available for splice. (5) stopped line to remove spider left hand coil No. 2 (1:00 N/T). (6) Winder control system inoperative (10:30 N/T). (7) Electrical short - 20 amps applied (4:05 N/T).

* Group meeting

**SOLENOID COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. WS4

TASK		TASK	
1. Layer 1	<u>7:20</u>	1. Layer 13	<u>4:35</u>
2. Filler & Shim	<u>4:05</u>	2. Filler & Shim	<u>5:45</u>
3. Layer 2	<u>8:20</u>	3. Layer 14	<u>5:45</u>
4. Splice & Shim	<u>19:00</u>	4. Splice & Shim	<u>19:25 (9)</u>
TOTAL: <u>38:45</u>		TOTAL: <u>35:30</u>	
1. Layer 3	<u>7:55 (1)</u>	1. Layer 15	<u>7:10</u>
2. Filler & Shim	<u>9:55</u>	2. Filler & Shim	<u>5:15</u>
3. Layer 4	<u>4:40</u>	3. Layer 16	<u>5:55 (10)</u>
4. Splice & Shim	<u>19:10 (2)</u>	4. Splice & Shim	<u>15:35</u>
TOTAL: <u>41:40</u>		TOTAL: <u>33:55</u>	
1. Layer 5	<u>7:55</u>	1. Layer 17	<u>4:40</u>
2. Filler & Shim	<u>6:15 (3)</u>	2. Filler & Shim	<u>3:50 (11)</u>
3. Layer 6	<u>10:00 (4)</u>	3. Layer 18	<u>5:35</u>
4. Splice & Shim	<u>13:35 (5)</u>	4. Splice & Shim	<u>15:20</u>
TOTAL: <u>37:45</u>		TOTAL: <u>29:25</u>	
1. Layer 7	<u>6:30</u>	1. Layer 19	<u>7:40</u>
2. Filler & Shim	<u>4:20</u>	2. Filler & Shim	<u>10:55 (3)</u>
3. Layer 8	<u>4:14</u>	3. Layer 20	<u>5:45</u>
4. Splice & Shim	<u>15:00 (6)</u>	4. Splice & Shim	<u>23:20 (3)</u>
TOTAL: <u>30:10</u>		TOTAL: <u>49:40</u>	
1. Layer 9	<u>6:40</u>	1. Layer 21	<u>4:35</u>
2. Filler & Shim	<u>3:50</u>	2. Filler & Shim	<u>7:35</u>
3. Layer 10	<u>4:40</u>	3. Layer 22	<u>7:20</u>
4. Splice & Shim	<u>12:40</u>	4. Splice & Shim	<u>11:50</u>
TOTAL: <u>27:50</u>		TOTAL: <u>31:20</u>	
1. Layer 11	<u>6:05</u>	1. Layer 23	<u>4:10</u>
2. Filler & Shim	<u>4:25</u>	2. Filler & Shim	<u>6:35</u>
3. Layer 12	<u>5:35 (7)</u>	3. Layer 24	<u>6:10</u>
4. Splice & Shim	<u>16:45 (8)</u>	4. Splice & Shim	<u>13:05</u>
TOTAL: <u>32:50</u>		TOTAL: <u>20:00</u>	

AVERAGES

1. Odd Layer (Up)	<u>6:16</u>
2. Filler & Shim	<u>6:04</u>
3. Even Layer (Down)	<u>6:10</u>
4. Splice & Shim	<u>16:31</u>
Totals:	<u>35:01</u>

* Group Meeting

NOTES: (1) Belt replacement on Winder (4:50 N/E). (2) Extra spool change conductor shortage. (3) Only one man available for splice and/or shimming. (4) New man trained. (5) Removal of solder between conductors & layer insulation (2:00 N/E). (6) Shim problem over entering lead - new work (2:30 N/E). (7) Short due to temperature (3:05 N/E). (8) No Conductor (74:50 N/E). (9) Short on wire (5:40 N/E). (10) all operators helped in #7 mat (2:00 N/E). (11) Held for electrical lock and alert (3:25 N/E).

SOLENOID COIL WINDING TIMES PERFORMANCE LOG

COIL NO. E55

TASK		TASK	
1. Layer 1	<u>5:20</u>	1. Layer 13	<u>8:05</u>
2. Filler & Shim	<u>6:15</u>	2. Filler & Shim	<u>5:50 (4)</u>
3. Layer 2	<u>7:15</u>	3. Layer (14)	<u>6:05</u>
4. Splice & Shim	<u>13:25</u>	4. Splice & Shim	<u>15:05 (5)</u>
TOTAL: <u>32:15</u>		TOTAL: <u>35:05</u>	
1. Layer 3	<u>5:25</u>	1. Layer 15	<u>11:15 (6)</u>
2. Filler & Shim	<u>4:50</u>	2. Filler & Shim	<u>4:20</u>
3. Layer (4)	<u>5:25</u>	3. Layer (16)	<u>4:40</u>
4. Splice & Shim	<u>13:20</u>	4. Splice & Shim	<u>11:40</u>
TOTAL: <u>29:00</u>		TOTAL: <u>39:55</u>	
1. Layer 5	<u>5:05</u>	1. Layer 17	<u>5:40</u>
2. Filler & Shim	<u>3:25</u>	2. Filler & Shim	<u>3:10</u>
3. Layer (6)	<u>5:50</u>	3. Layer (18)	<u>6:40</u>
4. Splice & Shim	<u>17:10</u>	4. Splice & Shim	<u>12:55</u>
TOTAL: <u>31:30</u>		TOTAL: <u>28:25</u>	
1. Layer 7	<u>6:35</u>	1. Layer 19	<u>6:45</u>
2. Filler & Shim	<u>5:50</u>	2. Filler & Shim	<u>3:50</u>
3. Layer (8)	<u>6:10</u>	3. Layer (20)	<u>6:10 (7)</u>
4. Splice & Shim	<u>18:55</u>	4. Splice & Shim	<u>13:05</u>
TOTAL: <u>37:30</u>		TOTAL: <u>29:50</u>	
1. Layer 9	<u>7:30 (1)</u>	1. Layer 21	<u>3:55</u>
2. Filler & Shim	<u>4:25 (2)</u>	2. Filler & Shim	<u>3:15</u>
3. Layer (10)	<u>6:20</u>	3. Layer (22)	<u>4:55</u>
4. Splice & Shim	<u>17:10</u>	4. Splice & Shim	<u>9:25</u>
TOTAL: <u>35:25</u>		TOTAL: <u>21:30</u>	
1. Layer 11	<u>5:10</u>	1. Layer 23	<u>4:00</u>
2. Filler & Shim	<u>3:55</u>	2. Filler & Shim	<u>2:54</u>
3. Layer 12	<u>5:00 (3)</u>	3. Layer (24)	<u>4:00</u>
4. Splice & Shim	<u>15:40</u>	4. Splice & Shim	<u>(6:25)</u>
TOTAL: <u>29:45</u>		TOTAL: <u>17:19</u>	
AVERAGES			
1. Odd Layer (Up)	<u>6:14</u>		
2. Filler & Shim	<u>4:20</u>		
3. Even Layer (Down)	<u>5:43</u>		
4. Splice & Shim	<u>15:05</u>		
Totals:	<u>31:22</u>		

NOTES: (1) Belt for weld positioner tech broke - made repairs (1:00 N/I)
 (2) maintenance repaired tech & replaced belt and a sheet
 was found in layer - 12 - layer (1:35 N/I) (3) Repair
 of Bendover electronics (3:05 N/I) (4) Tensioner down
 (5:05 N/I) (5) Tensioner down (13:05 N/I) (6) Conductor
 slipped, played down for repairs and completion of layer.
 (7) Held for electrical test (no tech) (1:00 N/I).

SOLENOID COIL WINDING TIMES PERFORMANCE LOG

COIL NO. 455

TASK		TASK	
1. Layer 1	<u>4:10</u>	1. Layer 13	<u>5:50</u> (4)
2. Filler & Shim	<u>4:40</u>	2. Filler & Shim	<u>5:55</u>
3. Layer 2	<u>3:50</u>	3. Layer (14)	<u>4:35</u>
4. Splice & Shim	<u>14:50</u> (1)	4. Splice & Shim	<u>17:50</u>
TOTAL:	<u>27:30</u>	TOTAL:	<u>34:10</u>
1. Layer 3	<u>5:10</u>	1. Layer 15	<u>6:10</u>
2. Filler & Shim	<u>4:40</u>	2. Filler & Shim	<u>5:10</u>
3. Layer (4)	<u>4:30</u>	3. Layer (16)	<u>6:35</u>
4. Splice & Shim	<u>13:35</u>	4. Splice & Shim	<u>24:40</u> (3)
TOTAL:	<u>27:55</u>	TOTAL:	<u>42:35</u>
1. Layer 5	<u>4:45</u>	1. Layer 17	<u>6:15</u>
2. Filler & Shim	<u>2:15</u>	2. Filler & Shim	<u>9:45</u> (5)
3. Layer (6)	<u>4:20</u>	3. Layer (18)	<u>5:50</u>
4. Splice & Shim	<u>13:40</u> (2)	4. Splice & Shim	<u>19:50</u> (6)
TOTAL:	<u>25:00</u>	TOTAL:	<u>40:40</u>
1. Layer 7	<u>4:35</u>	1. Layer 19	<u>6:30</u>
2. Filler & Shim	<u>4:50</u>	2. Filler & Shim	<u>5:50</u>
3. Layer (8)	<u>4:25</u>	3. Layer (20)	<u>5:30</u>
4. Splice & Shim	<u>17:35</u>	4. Splice & Shim	<u>16:50</u>
TOTAL:	<u>31:25</u>	TOTAL:	<u>34:40</u>
1. Layer 9	<u>4:20</u>	1. Layer 21	<u>6:05</u>
2. Filler & Shim	<u>4:00</u>	2. Filler & Shim	<u>2:30</u>
3. Layer (10)	<u>4:15</u>	3. Layer (22)	<u>4:20</u>
4. Splice & Shim	<u>15:35</u>	4. Splice & Shim	<u>13:45</u>
TOTAL:	<u>28:10</u>	TOTAL:	<u>26:30</u>
1. Layer 11	<u>7:10</u>	1. Layer 23	<u>5:45</u>
2. Filler & Shim	<u>5:40</u>	2. Filler & Shim	<u>4:40</u>
3. Layer 12	<u>4:05</u>	3. Layer (24)	<u>6:25</u>
4. Splice & Shim	<u>22:00</u> (3)	4. Splice & Shim	<u>N/A</u>
TOTAL:	<u>38:55</u>	TOTAL:	<u>N/A</u>

AVERAGES

1. Odd Layer (Up)	<u>5:34</u>
2. Filler & Shim	<u>4:54</u>
3. Even Layer (Down)	<u>4:53</u>
4. Splice & Shim	<u>17:17</u>
Totals:	<u>32:38</u>

NOTES: (1) Two men absent (6:10 N/I). (2) Held for voltage step (no tech) (1:10 N/I). (3) Only one man available for splice & shim. (4) Short time for splice - didn't wind (15:30 N/I). (5) Only one man available for shimming. (6) Splice failed pull test - had to replace (4:40 N/I).

**SOLENOID COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. ES6

TASK		TASK	
1. Layer 1	<u>7:10 ①</u>	1. Layer 13	<u>4:40</u>
2. Filler & Shim	<u>7:25 ②</u>	2. Filler & Shim	<u>3:35</u>
3. Layer 2	<u>4:00</u>	3. Layer ⑭	<u>3:25 ⑦</u>
4. Splice & Shim	<u>13:35 ③</u>	4. Splice & Shim	<u>10:15</u>
TOTAL:	<u>32:10</u>	TOTAL:	<u>21:55</u>
1. Layer 3	<u>3:50</u>	1. Layer 15	<u>5:35</u>
2. Filler & Shim	<u>3:35</u>	2. Filler & Shim	<u>3:50</u>
3. Layer ④	<u>5:05</u>	3. Layer ⑮	<u>4:05</u>
4. Splice & Shim	<u>11:35</u>	4. Splice & Shim	<u>15:30</u>
TOTAL:	<u>24:05</u>	TOTAL:	<u>29:10</u>
1. Layer 5	<u>3:50</u>	1. Layer 17	<u>4:45 ⑧</u>
2. Filler & Shim	<u>5:05</u>	2. Filler & Shim	<u>3:50</u>
3. Layer ⑥	<u>5:30 ④</u>	3. Layer ⑯	<u>4:50</u>
4. Splice & Shim	<u>13:20</u>	4. Splice & Shim	<u>9:55</u>
TOTAL:	<u>27:45</u>	TOTAL:	<u>23:20</u>
1. Layer 7	<u>4:40</u>	1. Layer 19	<u>5:00</u>
2. Filler & Shim	<u>4:00</u>	2. Filler & Shim	<u>2:35</u>
3. Layer ⑧	<u>4:20</u>	3. Layer ⑰	<u>4:20</u>
4. Splice & Shim	<u>20:30 ⑤</u>	4. Splice & Shim	<u>11:55</u>
TOTAL:	<u>33:30</u>	TOTAL:	<u>23:50</u>
1. Layer 9	<u>6:10</u>	1. Layer 21	<u>5:25</u>
2. Filler & Shim	<u>4:05</u>	2. Filler & Shim	<u>2:50</u>
3. Layer ⑩	<u>6:10</u>	3. Layer ⑱	<u>4:35</u>
4. Splice & Shim	<u>12:40</u>	4. Splice & Shim	<u>10:10</u>
TOTAL:	<u>29:05</u>	TOTAL:	<u>23:00</u>
1. Layer 11	<u>8:15 ⑪</u>	1. Layer 23	<u>4:50</u>
2. Filler & Shim	<u>1:50</u>	2. Filler & Shim	<u>2:50</u>
3. Layer 12	<u>4:10</u>	3. Layer ⑳	<u>4:15</u>
4. Splice & Shim	<u>8:20</u>	4. Splice & Shim	<u>N/A</u>
TOTAL:	<u>22:35</u>	TOTAL:	<u>N/A</u>

AVERAGES

1. Odd Layer (Up)	<u>5:21</u>
2. Filler & Shim	<u>3:48</u>
3. Even Layer (Down)	<u>4:34</u>
4. Splice & Shim	<u>12:31</u>
Totals:	<u>26:14</u>

NOTES: ① Held for engineering disposition on bad conductor (59:40 N/I) - additional splice required (5:55 N/I). ② Held for engineering approval & repair. splice & screw also assigned. Held off - bad conductor shipment (7:40 N/I). ③ Man power shortage - vacuum helium hi-pot test (2:00 N/I). ④ missed electrical test - held until completed (3:30 N/I). ⑤ conductor reel change. ⑥ Conductor tipping problem. ⑦ Damaged conductor - held for engineering disposition (8:10 N/I). Man injured - went to nurse - and shut - down (2:15 N/I).

**SOLENOID COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. W56

TASK		TASK	
1. Layer 1	<u>4:50</u>	1. Layer 13	<u>4:15</u>
2. Filler & Shim	<u>6:50</u> ①	2. Filler & Shim	<u>5:40</u>
3. Layer 2	<u>5:40</u>	3. Layer ⑭	<u>4:45</u>
4. Splice & Shim	<u>12:35</u>	4. Splice & Shim	<u>16:35</u>
TOTAL:	<u>29:55</u>	TOTAL:	<u>31:15</u>
1. Layer 3	<u>4:23</u>	1. Layer 15	<u>5:00</u>
2. Filler & Shim	<u>5:20</u>	2. Filler & Shim	<u>3:30</u>
3. Layer ④	<u>4:55</u>	3. Layer ⑮	<u>3:20</u>
4. Splice & Shim	<u>14:05</u> ②, ③	4. Splice & Shim	<u>13:25</u>
TOTAL:	<u>28:43</u>	TOTAL:	<u>25:15</u>
1. Layer 5	<u>6:25</u>	1. Layer 17	<u>5:05</u>
2. Filler & Shim	<u>4:35</u>	2. Filler & Shim	<u>4:20</u>
3. Layer ⑥	<u>5:10</u>	3. Layer ⑯	<u>3:00</u>
4. Splice & Shim	<u>14:30</u> ②, ④	4. Splice & Shim	<u>11:45</u>
TOTAL:	<u>30:40</u>	TOTAL:	<u>24:10</u>
1. Layer 7	<u>5:00</u>	1. Layer 19	<u>4:50</u>
2. Filler & Shim	<u>4:25</u>	2. Filler & Shim	<u>4:25</u>
3. Layer ⑧	<u>5:20</u>	3. Layer ⑰	<u>6:50</u>
4. Splice & Shim	<u>13:50</u>	4. Splice & Shim	<u>17:40</u> ⑤
TOTAL:	<u>28:55</u>	TOTAL:	<u>33:45</u>
1. Layer 9	<u>6:15</u>	1. Layer 21	<u>6:25</u>
2. Filler & Shim	<u>6:20</u>	2. Filler & Shim	<u>4:05</u>
3. Layer ⑩	<u>5:20</u>	3. Layer ⑱	<u>3:55</u>
4. Splice & Shim	<u>17:10</u>	4. Splice & Shim	<u>10:10</u>
TOTAL:	<u>35:05</u>	TOTAL:	<u>24:35</u>
1. Layer 11	<u>4:05</u>	1. Layer 23	<u>4:20</u>
2. Filler & Shim	<u>4:05</u>	2. Filler & Shim	<u>2:45</u>
3. Layer 12	<u>3:35</u>	3. Layer ⑳	<u>3:20</u>
4. Splice & Shim	<u>13:25</u>	4. Splice & Shim	<u>N/A</u>
TOTAL:	<u>25:10</u>	TOTAL:	

AVERAGES

1. Odd Layer (Up)	<u>5:04</u>
2. Filler & Shim	<u>4:42</u>
3. Even Layer (Down)	<u>4:30</u>
4. Splice & Shim	<u>14:06</u>
Totals:	<u>28:22</u>

NOTES: ① Repair line 1 air bearing (0:30 N/I). ② Only one man available for splice. ③ Held for relay tape installation (11:00 N/I). ④ Short man power (1:00 N/I). ⑤ Power off (1:00 N/I).

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APPENDIX C

SOLENOID CONDUCTOR SPLICE CHECKLIST

SOLENOID CONDUCTOR SPLICE CHECKLIST

INSTRUCTIONS

This procedure provides a step-by-step checklist for completing a solenoid splice. A new checklist will be issued by inspection for each splice. A splice team shall consist of a two (2) man crew. One person shall be responsible for filling in this checklist. Once the splice has begun, enter START and FINISH times (AM or PM) for the six (6) major operations in the boxes provided. If any operation is incomplete or interrupted due to breaks, lunch, shift changes, or mechanical failures, make notation of STOP and enter STOP times. Circle the appropriate letter for the operation incomplete. Enter START and the START time when the task has been restarted. At completion of each major operation, compute SPAN times (subtract down times). Enter these values in the boxes provided and compare these values versus the target times shown. At completion of the splice, return completed checklist to inspection so the splice times can be documented. The total target SPAN time for a splice is 8:45. However, since splice operations 2 & 3 and 4 & 5 should be worked simultaneously, the "Critical Path" time is only 6:30.

Prepared by: Al Ritschel
OPERATIONS
ENERGY SYSTEMS

DATE _____
COIL NO. _____
SPLICE LAYER _____

SPLICE TEAM

1) _____ 1) _____
2) _____ 2) _____

SOLENOID CONDUCTOR SPLICE CHECKLIST

OPERATIONS		START/STOP/ FINISH	SPAN TIME	TARGET TIME
		START		
1.	<u>DETERMINE SPLICE LOCATION</u>			
a.	Wind layer 24 to voltage tap cutout. Stop button machine about five feet from tap output. Draw a line straight down from the start of all conductor joggle pieces at top of coil pack.			
b.	Position the splice so that the start of the thick section is as close to the line as possible (4 inches over the voltage tap cutout minimum). Mark the conductor 1.25 inches longer than where the end of the splice is located and identify as "cut stab" mark.			
c.	Unwind the coil about five feet and clamp off conductor at coil using tension clamp HMT0 762675.			
d.	Measure 17 inches out from "cut stab" mark (towards tensioner) and cut off the conductor. Remove any buttons in this area.			
e.	Change conductor spools on reel support stand if applicable (Layers 8 and 16 only). Install the conductor support straps (HDT0 SK-032) if applicable. Pass the new conductor through the tensioner and cut off a five-foot sample for inspection.			
		FINISH		
		SPAN		
		TARGET		<u>0.45</u>

SOLENOID CONDUCTOR SPLICE CHECKLIST

OPERATIONS		START/STOP/ FINISH	SPAN TIME	TARGET TIME
2.	<u>PREPARATION FOR SPLICE (COIL SIDE)</u>	START		
a.	Strip loose a total of 34 inches of superconductor by heating with a torch and pushing ou with a scribe and pliers.			
b.	Carefully heat the exposed superconductor and stabilizer groove with a torch to melt solder and wipe smooth with a damp cloth. Clean out excess solder with router HDT0 SK-011 using accessory fixture TOAC 714900. File smooth to remove any burrs.			
c.	Cut off the stabilizer at the "cut stab" mark. Square ends using file fixture TOAC 762715.			
d.	Support and clamp superconductor out of the way using tool HDT0 SK-038. Dip the end of the stabilizer six inches into the solder stripper (acid) tank (HDT0 SK-045). Note: This operation is normally done in conjunction with operation 3d. Remove and inspect after 15 minutes. If any solder remains, file smooth or repeat acid dip operation as required.			
		FINISH		
		SPAN		
		TARGET		<u>0:45</u>

SOLENOID CONDUCTOR SPLICE CHECKLIST

OPERATIONS		START/STOP/ FINISH	SPAN TIME	TARGET TIME
3.	<u>PREPARATION FOR SPLICE (SPOOL SIDE)</u>	START	_____	
	<u>WARNING</u>			
	When positioning the tensioner machine for a splice, caution should be taken not to ram the tensioner carriage up against the safety limit switch stops. If limit switches are inoperable, personal injury and conductor damage could result if tensioner malfunctions.			
	a. Strip loose a total of 34 inches of superconductor by heating with a torch and pushing out with a scribe and pliers.			
	b. Carefully heat the exposed superconductor and stabilizer groove with a torch to melt solder and wipe smooth with a damp cloth. Clean out excess solder with router HDT0 SK-011 using accessory fixture TOAC 714900. File smooth to remove any burrs.			
	c. Cut off the stabilizer 17 inches from the end. Square ends using file fixture TOAC 762715.			
	d. Support and clamp superconductor out of the way using tool HDT0 SK-038. Dip the end of the stabilizer six inches into the solder stripper (acid) tank (HDT0 SK-045). Note: This operation is normally done in conjunction with operation 2d. Remove and inspect after 15 minutes. If any solder remains, file smooth or repeat acid dip operation, as required.			
		FINISH	_____	
		SPAN	_____	
		TARGET		<u>0:45</u>

SOLENOID CONDUCTOR SPLICE CHECKLIST

OPERATIONS		START/STOP/ FINISH	SPAN TIME	TARGET TIME
------------	--	-----------------------	--------------	----------------

4. COLDWELD SPLICE (COIL SIDE)

START

WARNING

Prior to moving the Koldwelder into position, make sure that the air bearing floor plates are free of debris and clean. Clean with solvent if required. Foreign materials will damage the air bearing boots, rendering the machine inoperable.

- Using a new wire brush, clean the areas of the stabilizer and splice which will be inserted in the "Koldwelder jaws." Using a new file, clean the ends of the stabilizer and splice prior to coldweld. Do not use sand paper.
- Clean Koldwelder (E325607) jaws with freon. Center stabilizer and splice in jaws. Make three strokes, centering the joint between each stroke.
- Remove the flash with pliers and bag for inspection. File off the excess flashing smooth with the stabilizer. Visually inspect the weld area.
- Anneal the weld joint using an aluminum block underneath heated to 500°F to 600°F for three minutes.
- Proof load to 1350 psi gauge pressure using tensile tester HDT0-SK-028.
- Re-size stabilizer's outside dimensions using file fixture TOAC 714498. Re-size superconductor slot with router HDT0-SK-011 using accessory fixture TOAC 714900. Check fit superconductor in slot and trim to length.

FINISH

SPAN

TARGET

1:30

SOLENOID CONDUCTOR SPLICE CHECKLIST

OPERATIONS		START/STOP/ FINISH	SPAN TIME	TARGET TIME
5.	<u>COLDWELD SPLICE (SPOOL SIDE)</u>	START	_____	
	<u>WARNING</u>			
	Prior to moving the Koldwelder into position, make sure that the air bearing floor plates are free of debris and clean. Clean with solvent if required. Foreign materials will damage the air bearing boots, rendering the machine inoperable.			
	a.	Using a new wire brush, clean the areas of the stabilizer and splice that will be inserted in the Koldwelder jaws. Using a new file, clean the ends of the stabilizer and splice prior to coldweld. Do not use sandpaper.		
	b.	Clean Koldwelder jaws with freon. Center stabilizer and splice in jaws. Make three strokes, centering the joint between each stroke.		
	c.	Remove the flash with pliers and bag for inspection. File off the excess flashing smooth with the stabilizer. Visually inspect the weld area.		
	d.	Anneal the weld joint using an aluminum block underneath heated to 500°F to 600°F for three minutes.		
	e.	Proof load to 1350 psi gauge pressure using tensile tester HDT0-SK-028.		
	f.	Re-size stabilizer's outside dimensions using file fixture TOAC 714498. Re-size superconductor slot with router HDT0 SK-011 using accessory fixture TOAC 714900. Check fit superconductor in slot and trim to length.		
		FINISH	_____	
		SPAN	_____	
		TARGET		<u>1:30</u>

SOLENOID CONDUCTOR SPLICE CHECKLIST

OPERATIONS	START/STOP/ FINISH	SPAN TIME	TARGET TIME
c. <u>SOLDERING SPLICE</u>	START		
a. Clean splice and stabilizer slots and superconductor with isopropyl alcohol. b. Apply paste solder in slots. Apply solder flux to superconductor and insert into stabilizer slot. c. Clean soldering fixture WLFX 762782 prior to use with solvents. Scrape off any solder buildup from prior use. Clamp fixture into position. Heat fixture (entire length) with torch until solder melts to accomplish solder bond. d. Cool with water and remove fixture. Clean off excess solder on top of conductor with sandpaper and ultrasonically inspect the soldered area. Re-solder any voids if required. Clean remaining sides of conductor with sandpaper and file solder in slot flush to conductor. Clean with freon. e. Install voltage tap with wire facing in proper direction using installation tool HDT0 SK-056. Solder wire with iron tip HDT0 SK-057. Test voltage tap for electrical continuity and replace if required. f. Photograph completed joint in splice. Reinstall buttons over splice area. Re-tension the coil and wind in splice. Wind turn 25 up to the riser and joggle area for the next layer.	FINISH		
	SPAN		
	TARGET		<u>3:30</u>

APPENDIX D

SOLENOID CONDUCTOR SPLICE TIMES

PERFORMANCE LOG

SOLENOID CONDUCTOR SPlice TIMES	
COIL NO. <u>E52</u>	PERFORMANCE LOG
TASK	TASK
1. Determine Splice Loc. (Layer 2)	1. Determine Splice Loc. (Layer ④)
2. Prep. for Splice (Coil Side)	2. Prep. for Splice (Coil Side)
3. Prep. for Splice (Spool Side)	3. Prep. for Splice (Spool Side)
4. Coldweld Splice (Coil Side)	4. Coldweld Splice (Coil Side)
5. Coldweld Splice (Spool Side)	5. Coldweld Splice (Spool Side)
6. Soldering Splice	6. Soldering Splice
TOTAL:	TOTAL:
1. Determine Splice Loc. (Layer ④)	① Determine Splice Loc. (Layer ①⑥)
2. Prep. for Splice (Coil Side)	2. Prep. for Splice (Coil Side)
3. Prep. for Splice (Spool Side)	3. Prep. for Splice (Spool Side)
4. Coldweld Splice (Coil Side)	4. Coldweld Splice (Coil Side)
5. Coldweld Splice (Spool Side)	5. Coldweld Splice (Spool Side)
6. Soldering Splice	6. Soldering Splice
TOTAL:	TOTAL:
1. Determine Splice Loc. (Layer ⑥)	1. Determine Splice Loc. (Layer ①⑧) 0:55
2. Prep. for Splice (Coil Side)	2. Prep. for Splice (Coil Side) 1:20
3. Prep. for Splice (Spool Side)	3. Prep. for Splice (Spool Side) 1:20
4. Coldweld Splice (Coil Side)	4. Coldweld Splice (Coil Side) 2:00
5. Coldweld Splice (Spool Side)	5. Coldweld Splice (Spool Side) 2:00
6. Soldering Splice	6. Soldering Splice 6:00
TOTAL:	TOTAL: 13:35
① Determine Splice Loc. (Layer ⑧)	1. Determine Splice Loc. (Layer ②⑩) 1:40
2. Prep. for Splice (Coil Side)	2. Prep. for Splice (Coil Side) 0:50
3. Prep. for Splice (Spool Side)	3. Prep. for Splice (Spool Side) 0:45
4. Coldweld Splice (Coil Side)	4. Coldweld Splice (Coil Side) 2:00
5. Coldweld Splice (Spool Side)	5. Coldweld Splice (Spool Side) 1:55
6. Soldering Splice	6. Soldering Splice 4:10
TOTAL:	TOTAL: 11:20
1. Determine Splice Loc. (Layer ⑩)	1. Determine Splice Loc. (Layer ②②) 0:45
2. Prep. for Splice (Coil Side)	2. Prep. for Splice (Coil Side) 0:45
3. Prep. for Splice (Spool Side)	3. Prep. for Splice (Spool Side) 0:40
4. Coldweld Splice (Coil Side)	4. Coldweld Splice (Coil Side) 1:15
5. Coldweld Splice (Spool Side)	5. Coldweld Splice (Spool Side) 1:15
6. Soldering Splice	6. Soldering Splice 2:10
TOTAL:	TOTAL: 6:50
1. Determine Splice Loc. (Layer 12)	1. Determine Splice Loc. (Layer ②④)
2. Prep. for Splice (Coil Side)	2. Prep. for Splice (Coil Side)
3. Prep. for Splice (Spool Side)	3. Prep. for Splice (Spool Side)
4. Coldweld Splice (Coil Side)	4. Coldweld Splice (Coil Side)
5. Coldweld Splice (Spool Side)	5. Coldweld Splice (Spool Side)
6. Soldering Splice	6. Soldering Splice
TOTAL:	TOTAL:
AVERAGES	
1. Determine Splice Location	1:07
2. Preparation for Splice (Coil Side)	1:58
3. Preparation for Splice (Spool Side)	0:55
4. Coldweld Splice (Coil Side)	1:45
5. Coldweld Splice (Spool Side)	1:43
6. Soldering Splice	4:07
TOTALS:	10:35

SOLENOID CONDUCTOR SPlice TIMES PERFORMANCE LOG

COIL NO. WS2

TASK		TASK	
1. Determine Splice Loc. (Layer 2)		1. Determine Splice Loc. (Layer ⑭)	
2. Prep. for Splice (Coil Side)		2. Prep. for Splice (Coil Side)	
3. Prep. for Splice (Spool Side)		3. Prep. for Splice (Spool Side)	
4. Coldweld Splice (Coil Side)		4. Coldweld Splice (Coil Side)	
5. Coldweld Splice (Spool Side)		5. Coldweld Splice (Spool Side)	
6. Soldering Splice		6. Soldering Splice	
TOTAL:		TOTAL:	
1. Determine Splice Loc. (Layer ④)		① Determine Splice Loc. (Layer ①⑥)	
2. Prep. for Splice (Coil Side)		2. Prep. for Splice (Coil Side)	
3. Prep. for Splice (Spool Side)		3. Prep. for Splice (Spool Side)	
4. Coldweld Splice (Coil Side)		4. Coldweld Splice (Coil Side)	
5. Coldweld Splice (Spool Side)		5. Coldweld Splice (Spool Side)	
6. Soldering Splice		6. Soldering Splice	
TOTAL:		TOTAL:	
1. Determine Splice Loc. (Layer ⑥)		1. Determine Splice Loc. (Layer ⑱) 1:35	
2. Prep. for Splice (Coil Side)		2. Prep. for Splice (Coil Side) 0:20	
3. Prep. for Splice (Spool Side)		3. Prep. for Splice (Spool Side) 0:30	
4. Coldweld Splice (Coil Side)		4. Coldweld Splice (Coil Side) 2:50	
5. Coldweld Splice (Spool Side)		5. Coldweld Splice (Spool Side) 2:50	
6. Soldering Splice		6. Soldering Splice 4:15	
TOTAL:		TOTAL: 12:30	
① Determine Splice Loc. (Layer ⑧)		1. Determine Splice Loc. (Layer ⑳) 0:45	
2. Prep. for Splice (Coil Side)		2. Prep. for Splice (Coil Side) 0:55	
3. Prep. for Splice (Spool Side)		3. Prep. for Splice (Spool Side) 0:20	
4. Coldweld Splice (Coil Side)		4. Coldweld Splice (Coil Side) 2:00	
5. Coldweld Splice (Spool Side)		5. Coldweld Splice (Spool Side) 2:05	
6. Soldering Splice		6. Soldering Splice 4:35	
TOTAL:		TOTAL: 10:40	
1. Determine Splice Loc. (Layer ⑩)		1. Determine Splice Loc. (Layer ㉒) 0:55	
2. Prep. for Splice (Coil Side)		2. Prep. for Splice (Coil Side) 1:20	
3. Prep. for Splice (Spool Side)		3. Prep. for Splice (Spool Side) 0:35	
4. Coldweld Splice (Coil Side)		4. Coldweld Splice (Coil Side) 1:50	
5. Coldweld Splice (Spool Side)		5. Coldweld Splice (Spool Side) 1:35	
6. Soldering Splice		6. Soldering Splice 6:30	
TOTAL:		TOTAL: 12:45	
1. Determine Splice Loc. (Layer 12)		1. Determine Splice Loc. (Layer ㉔)	
2. Prep. for Splice (Coil Side)		2. Prep. for Splice (Coil Side)	
3. Prep. for Splice (Spool Side)		3. Prep. for Splice (Spool Side)	
4. Coldweld Splice (Coil Side)		4. Coldweld Splice (Coil Side)	
5. Coldweld Splice (Spool Side)		5. Coldweld Splice (Spool Side)	
6. Soldering Splice		6. Soldering Splice	
TOTAL:		TOTAL:	
AVERAGES			
1. Determine Splice Location		1:05	
2. Preparation for Splice (Coil Side)		0:55	
3. Preparation for Splice (Spool Side)		0:28	
4. Coldweld Splice (Coil Side)		2:13	
5. Coldweld Splice (Spool Side)		2:10	
6. Soldering Splice		5:07	
TOTALS:		11:58	

**SOLENOID CONDUCTOR SPLICE TIMES
PERFORMANCE LOG**

COIL NO. ES3

TASK		TASK	
1. Determine Splice Loc. (Layer 2)	<u>1:10</u>	1. Determine Splice Loc. (Layer ④)	<u>1:05</u>
2. Prep. for Splice (Coil Side)	<u>0:55</u>	2. Prep. for Splice (Coil Side)	<u>1:15</u>
3. Prep. for Splice (Spool Side)	<u>0:55</u>	3. Prep. for Splice (Spool Side)	<u>1:00</u>
4. Coldweld Splice (Coil Side)	<u>1:20</u>	4. Coldweld Splice (Coil Side)	<u>2:15</u>
5. Coldweld Splice (Spool Side)	<u>0:55</u>	5. Coldweld Splice (Spool Side)	<u>2:15</u>
6. Soldering Splice	<u>3:35</u>	6. Soldering Splice	<u>3:20</u>
TOTAL:	<u>8:50</u>	TOTAL:	<u>11:10</u>
1. Determine Splice Loc. (Layer ④)	<u>2:00</u>	① Determine Splice Loc. (Layer ⑥)	<u>4:05</u>
2. Prep. for Splice (Coil Side)	<u>N/A</u>	2. Prep. for Splice (Coil Side)	<u>1:00</u>
3. Prep. for Splice (Spool Side)	<u>N/A</u>	3. Prep. for Splice (Spool Side)	<u>1:15</u>
4. Coldweld Splice (Coil Side)	<u>N/A</u>	4. Coldweld Splice (Coil Side)	<u>1:20</u>
5. Coldweld Splice (Spool Side)	<u>N/A</u>	5. Coldweld Splice (Spool Side)	<u>1:00</u>
6. Soldering Splice	<u>N/A</u>	6. Soldering Splice	<u>2:25</u>
TOTAL:	<u>N/A</u>	TOTAL:	<u>11:05</u>
1. Determine Splice Loc. (Layer ⑥)	<u>2:30</u>	1. Determine Splice Loc. (Layer ⑧)	<u>1:05</u>
2. Prep. for Splice (Coil Side)	<u>1:35</u>	2. Prep. for Splice (Coil Side)	<u>1:00</u>
3. Prep. for Splice (Spool Side)	<u>1:35</u>	3. Prep. for Splice (Spool Side)	<u>1:15</u>
4. Coldweld Splice (Coil Side)	<u>2:35</u>	4. Coldweld Splice (Coil Side)	<u>2:50</u>
5. Coldweld Splice (Spool Side)	<u>2:35</u>	5. Coldweld Splice (Spool Side)	<u>2:20</u>
6. Soldering Splice	<u>5:55</u>	6. Soldering Splice	<u>5:30</u>
TOTAL:	<u>16:45</u>	TOTAL:	<u>14:00</u>
① Determine Splice Loc. (Layer ⑧)	<u>5:00</u>	1. Determine Splice Loc. (Layer ⑩)	<u>0:55</u>
2. Prep. for Splice (Coil Side)	<u>1:30</u>	2. Prep. for Splice (Coil Side)	<u>1:10</u>
3. Prep. for Splice (Spool Side)	<u>1:00</u>	3. Prep. for Splice (Spool Side)	<u>0:45</u>
4. Coldweld Splice (Coil Side)	<u>2:00</u>	4. Coldweld Splice (Coil Side)	<u>1:50</u>
5. Coldweld Splice (Spool Side)	<u>2:00</u>	5. Coldweld Splice (Spool Side)	<u>1:50</u>
6. Soldering Splice	<u>N/A</u>	6. Soldering Splice	<u>4:25</u>
TOTAL:	<u>N/A</u>	TOTAL:	<u>10:55</u>
1. Determine Splice Loc. (Layer ⑩)	<u>N/A</u>	1. Determine Splice Loc. (Layer ⑫)	<u>1:30</u>
2. Prep. for Splice (Coil Side)	<u>1:50</u>	2. Prep. for Splice (Coil Side)	<u>1:20</u>
3. Prep. for Splice (Spool Side)	<u>1:50</u>	3. Prep. for Splice (Spool Side)	<u>1:20</u>
4. Coldweld Splice (Coil Side)	<u>2:30</u>	4. Coldweld Splice (Coil Side)	<u>1:45</u>
5. Coldweld Splice (Spool Side)	<u>2:30</u>	5. Coldweld Splice (Spool Side)	<u>2:00</u>
6. Soldering Splice	<u>2:45</u>	6. Soldering Splice	<u>3:35</u>
TOTAL:	<u>N/A</u>	TOTAL:	<u>11:30</u>
1. Determine Splice Loc. (Layer 12)	<u>1:05</u>	1. Determine Splice Loc. (Layer ⑭)	<u>1:30</u>
2. Prep. for Splice (Coil Side)	<u>1:10</u>	2. Prep. for Splice (Coil Side)	<u>1:20</u>
3. Prep. for Splice (Spool Side)	<u>1:10</u>	3. Prep. for Splice (Spool Side)	<u>1:20</u>
4. Coldweld Splice (Coil Side)	<u>1:30</u>	4. Coldweld Splice (Coil Side)	<u>1:45</u>
5. Coldweld Splice (Spool Side)	<u>1:30</u>	5. Coldweld Splice (Spool Side)	<u>2:00</u>
6. Soldering Splice	<u>2:30</u>	6. Soldering Splice	<u>3:35</u>
TOTAL:	<u>8:55</u>	TOTAL:	<u>11:30</u>
AVERAGES			
1. Determine Splice Location		1:26	
2. Preparation for Splice (Coil Side)		1:17	
3. Preparation for Splice (Spool Side)		1:13	
4. Coldweld Splice (Coil Side)		2:00	
5. Coldweld Splice (Spool Side)		2:04	
6. Soldering Splice		3:47	
TOTALS:		11:47	

Note ①: Spool change not included in average.

SOLENOID CONDUCTOR SPLICE TIMES PERFORMANCE LOG

COIL NO. W53

TASK		TASK	
1. Determine Splice Loc. (Layer 2) <u>1:00</u>		1. Determine Splice Loc. (Layer ④) <u>1:15</u>	
2. Prep. for Splice (Coil Side) <u>1:40</u>		2. Prep. for Splice (Coil Side) <u>1:00</u>	
3. Prep. for Splice (Spool Side) <u>1:40</u>		3. Prep. for Splice (Spool Side) <u>1:10</u>	
4. Coldweld Splice (Coil Side) <u>1:35</u>		4. Coldweld Splice (Coil Side) <u>1:00</u>	
5. Coldweld Splice (Spool Side) <u>1:35</u>		5. Coldweld Splice (Spool Side) <u>1:00</u>	
6. Soldering Splice <u>2:30</u>		6. Soldering Splice <u>4:25</u>	
TOTAL: <u>10:00</u>		TOTAL: <u>10:00</u>	
1. Determine Splice Loc. (Layer ④) <u>0:45</u>		① Determine Splice Loc. (Layer ⑥) <u>5:05</u>	
2. Prep. for Splice (Coil Side) <u>1:05</u>		2. Prep. for Splice (Coil Side) <u>1:35</u>	
3. Prep. for Splice (Spool Side) <u>1:05</u>		3. Prep. for Splice (Spool Side) <u>1:30</u>	
4. Coldweld Splice (Coil Side) <u>2:20</u>		4. Coldweld Splice (Coil Side) <u>2:10</u>	
5. Coldweld Splice (Spool Side) <u>2:30</u>		5. Coldweld Splice (Spool Side) <u>2:00</u>	
6. Soldering Splice <u>2:40</u>		6. Soldering Splice <u>4:30</u>	
TOTAL: <u>10:15</u>		TOTAL: <u>16:50</u>	
1. Determine Splice Loc. (Layer ⑥) <u>1:00</u>		1. Determine Splice Loc. (Layer ⑧) <u>1:10</u>	
2. Prep. for Splice (Coil Side) <u>1:10</u>		2. Prep. for Splice (Coil Side) <u>1:05</u>	
3. Prep. for Splice (Spool Side) <u>1:10</u>		3. Prep. for Splice (Spool Side) <u>0:40</u>	
4. Coldweld Splice (Coil Side) <u>4:40</u>		4. Coldweld Splice (Coil Side) <u>2:30</u>	
5. Coldweld Splice (Spool Side) <u>4:40</u>		5. Coldweld Splice (Spool Side) <u>2:05</u>	
6. Soldering Splice <u>2:30</u>		6. Soldering Splice <u>3:30</u>	
TOTAL: <u>15:10</u>		TOTAL: <u>11:00</u>	
① Determine Splice Loc. (Layer ⑧) <u>N/A</u>		1. Determine Splice Loc. (Layer ⑩) <u>1:20</u>	
2. Prep. for Splice (Coil Side) <u>N/A</u>		2. Prep. for Splice (Coil Side) <u>1:35</u>	
3. Prep. for Splice (Spool Side) <u>N/A</u>		3. Prep. for Splice (Spool Side) <u>1:20</u>	
4. Coldweld Splice (Coil Side) <u>1:45</u>		4. Coldweld Splice (Coil Side) <u>1:05</u>	
5. Coldweld Splice (Spool Side) <u>1:00</u>		5. Coldweld Splice (Spool Side) <u>1:20</u>	
6. Soldering Splice <u>3:05</u>		6. Soldering Splice <u>3:20</u>	
TOTAL: <u>N/A</u>		TOTAL: <u>10:00</u>	
1. Determine Splice Loc. (Layer ⑩) <u>0:40</u>		1. Determine Splice Loc. (Layer ⑫) <u>1:50</u>	
2. Prep. for Splice (Coil Side) <u>1:15</u>		2. Prep. for Splice (Coil Side) <u>1:25</u>	
3. Prep. for Splice (Spool Side) <u>0:45</u>		3. Prep. for Splice (Spool Side) <u>1:25</u>	
4. Coldweld Splice (Coil Side) <u>2:15</u>		4. Coldweld Splice (Coil Side) <u>2:05</u>	
5. Coldweld Splice (Spool Side) <u>2:05</u>		5. Coldweld Splice (Spool Side) <u>2:05</u>	
6. Soldering Splice <u>3:50</u>		6. Soldering Splice <u>3:55</u>	
TOTAL: <u>10:50</u>		TOTAL: <u>12:45</u>	
1. Determine Splice Loc. (Layer 12) <u>0:50</u>		1. Determine Splice Loc. (Layer ⑭) <u></u>	
2. Prep. for Splice (Coil Side) <u>1:30</u>		2. Prep. for Splice (Coil Side) <u></u>	
3. Prep. for Splice (Spool Side) <u>0:50</u>		3. Prep. for Splice (Spool Side) <u></u>	
4. Coldweld Splice (Coil Side) <u>2:45</u>		4. Coldweld Splice (Coil Side) <u></u>	
5. Coldweld Splice (Spool Side) <u>2:35</u>		5. Coldweld Splice (Spool Side) <u></u>	
6. Soldering Splice <u>3:10</u>		6. Soldering Splice <u></u>	
TOTAL: <u>11:40</u>		TOTAL: <u></u>	
AVERAGES			
1. Determine Splice Location		<u>1:06</u>	
2. Preparation for Splice (Coil Side)		<u>1:20</u>	
3. Preparation for Splice (Spool Side)		<u>1:10</u>	
4. Coldweld Splice (Coil Side)		<u>2:12</u>	
5. Coldweld Splice (Spool Side)		<u>2:04</u>	
6. Soldering Splice		<u>3:25</u>	
TOTALS:		<u>11:17</u>	

note ①: spool change not included in average.

**SOLENOID CONDUCTOR SPlice TIMES
PERFORMANCE LOG**

COIL NO. ES4

TASK		TASK	
1. Determine Splice Loc. (Layer 2)	<u>N/A</u>	1. Determine Splice Loc. (Layer 14)	<u>0:30</u>
2. Prep. for Splice (Coil Side)	<u>0:35</u>	2. Prep. for Splice (Coil Side)	<u>0:55</u>
3. Prep. for Splice (Spool Side)	<u>0:35</u>	3. Prep. for Splice (Spool Side)	<u>0:55</u>
4. Coldweld Splice (Coil Side)	<u>1:35</u>	4. Coldweld Splice (Coil Side)	<u>2:55</u>
5. Coldweld Splice (Spool Side)	<u>1:35</u>	5. Coldweld Splice (Spool Side)	<u>N/A</u>
6. Soldering Splice	<u>2:50</u>	6. Soldering Splice	<u>3:55</u>
TOTAL:	<u>N/A</u>	TOTAL:	<u>N/A</u>
1. Determine Splice Loc. (Layer 4)	<u>1:30</u>	1. Determine Splice Loc. (Layer 16)	<u>3:45</u>
2. Prep. for Splice (Coil Side)	<u>0:50</u>	2. Prep. for Splice (Coil Side)	<u>0:45</u>
3. Prep. for Splice (Spool Side)	<u>0:50</u>	3. Prep. for Splice (Spool Side)	<u>0:35</u>
4. Coldweld Splice (Coil Side)	<u>1:45</u>	4. Coldweld Splice (Coil Side)	<u>2:20</u>
5. Coldweld Splice (Spool Side)	<u>1:25</u>	5. Coldweld Splice (Spool Side)	<u>1:30</u>
6. Soldering Splice	<u>5:05</u>	6. Soldering Splice	<u>4:30</u>
TOTAL:	<u>11:25</u>	TOTAL:	<u>13:25</u>
1. Determine Splice Loc. (Layer 6)	<u>1:15</u>	1. Determine Splice Loc. (Layer 18)	<u>2:30</u>
2. Prep. for Splice (Coil Side)	<u>1:30</u>	2. Prep. for Splice (Coil Side)	<u>0:45</u>
3. Prep. for Splice (Spool Side)	<u>0:40</u>	3. Prep. for Splice (Spool Side)	<u>0:45</u>
4. Coldweld Splice (Coil Side)	<u>1:30</u>	4. Coldweld Splice (Coil Side)	<u>1:50</u>
5. Coldweld Splice (Spool Side)	<u>1:30</u>	5. Coldweld Splice (Spool Side)	<u>1:50</u>
6. Soldering Splice	<u>3:25</u>	6. Soldering Splice	<u>4:10</u>
TOTAL:	<u>9:50</u>	TOTAL:	<u>11:50</u>
1. Determine Splice Loc. (Layer 8)	<u>7:25</u>	1. Determine Splice Loc. (Layer 20)	<u>N/A</u>
2. Prep. for Splice (Coil Side)	<u>1:05</u>	2. Prep. for Splice (Coil Side)	<u>N/A</u>
3. Prep. for Splice (Spool Side)	<u>0:50</u>	3. Prep. for Splice (Spool Side)	<u>1:45</u>
4. Coldweld Splice (Coil Side)	<u>2:15</u>	4. Coldweld Splice (Coil Side)	<u>1:35</u>
5. Coldweld Splice (Spool Side)	<u>1:40</u>	5. Coldweld Splice (Spool Side)	<u>1:35</u>
6. Soldering Splice	<u>2:05</u>	6. Soldering Splice	<u>2:30</u>
TOTAL:	<u>15:20</u>	TOTAL:	<u>N/A</u>
1. Determine Splice Loc. (Layer 10)	<u>1:15</u>	1. Determine Splice Loc. (Layer 22)	<u>0:35</u>
2. Prep. for Splice (Coil Side)	<u>2:25</u>	2. Prep. for Splice (Coil Side)	<u>0:45</u>
3. Prep. for Splice (Spool Side)	<u>1:30</u>	3. Prep. for Splice (Spool Side)	<u>0:45</u>
4. Coldweld Splice (Coil Side)	<u>2:45</u>	4. Coldweld Splice (Coil Side)	<u>1:30</u>
5. Coldweld Splice (Spool Side)	<u>2:25</u>	5. Coldweld Splice (Spool Side)	<u>30</u>
6. Soldering Splice	<u>4:20</u>	6. Soldering Splice	<u>2:25</u>
TOTAL:	<u>14:40</u>	TOTAL:	<u>7:30</u>
1. Determine Splice Loc. (Layer 12)	<u>0:40</u>	1. Determine Splice Loc. (Layer 24)	<u>N/A</u>
2. Prep. for Splice (Coil Side)	<u>0:50</u>	2. Prep. for Splice (Coil Side)	<u>N/A</u>
3. Prep. for Splice (Spool Side)	<u>0:50</u>	3. Prep. for Splice (Spool Side)	<u>N/A</u>
4. Coldweld Splice (Coil Side)	<u>2:00</u>	4. Coldweld Splice (Coil Side)	<u>N/A</u>
5. Coldweld Splice (Spool Side)	<u>2:00</u>	5. Coldweld Splice (Spool Side)	<u>N/A</u>
6. Soldering Splice	<u>3:15</u>	6. Soldering Splice	<u>N/A</u>
TOTAL:	<u>9:35</u>	TOTAL:	<u>N/A</u>
AVERAGES			
1. Determine Splice Location			<u>0:54</u>
2. Preparation for Splice (Coil Side)			<u>1:03</u>
3. Preparation for Splice (Spool Side)			<u>0:49</u>
4. Coldweld Splice (Coil Side)			<u>2:00</u>
5. Coldweld Splice (Spool Side)			<u>1:42</u>
6. Soldering Splice			<u>3:30</u>
TOTALS:			<u>10:02</u>

① spool change not included in average.

SOLENOID CONDUCTOR SPLICE TIMES PERFORMANCE LOG

COIL NO. W54

TASK		TASK	
1. Determine Splice Loc. (Layer 2)	1:50	1. Determine Splice Loc. (Layer 19)	0:45
2. Prep. for Splice (Coil Side)	0:45	2. Prep. for Splice (Coil Side)	0:50
3. Prep. for Splice (Spool Side)	0:50	3. Prep. for Splice (Spool Side)	0:45
4. Coldweld Splice (Coil Side)	2:30	4. Coldweld Splice (Coil Side)	1:30
5. Coldweld Splice (Spool Side)	2:30	5. Coldweld Splice (Spool Side)	1:30
6. Soldering Splice	2:30	6. Soldering Splice	4:10
TOTAL:	10:55	TOTAL:	9:30
① Determine Splice Loc. (Layer 4)	3:50	① Determine Splice Loc. (Layer 16)	0:40
2. Prep. for Splice (Coil Side)	1:20	2. Prep. for Splice (Coil Side)	1:45
3. Prep. for Splice (Spool Side)	0:35	3. Prep. for Splice (Spool Side)	1:00
4. Coldweld Splice (Coil Side)	2:30	4. Coldweld Splice (Coil Side)	2:55
5. Coldweld Splice (Spool Side)	2:30	5. Coldweld Splice (Spool Side)	2:10
6. Soldering Splice	3:30	6. Soldering Splice	3:15
TOTAL:	14:05	TOTAL:	12:00
1. Determine Splice Loc. (Layer 6)	1:05	1. Determine Splice Loc. (Layer 18)	0:50
2. Prep. for Splice (Coil Side)	1:15	2. Prep. for Splice (Coil Side)	1:10
3. Prep. for Splice (Spool Side)	1:00	3. Prep. for Splice (Spool Side)	0:55
4. Coldweld Splice (Coil Side)	2:35	4. Coldweld Splice (Coil Side)	1:45
5. Coldweld Splice (Spool Side)	2:40	5. Coldweld Splice (Spool Side)	1:45
6. Soldering Splice	3:15	6. Soldering Splice	2:20
TOTAL:	11:50	TOTAL:	8:30
① Determine Splice Loc. (Layer 8)	0:45	① Determine Splice Loc. (Layer 20)	4:20
2. Prep. for Splice (Coil Side)	0:35	2. Prep. for Splice (Coil Side)	0:55
3. Prep. for Splice (Spool Side)	0:35	3. Prep. for Splice (Spool Side)	1:00
4. Coldweld Splice (Coil Side)	1:45	4. Coldweld Splice (Coil Side)	1:25
5. Coldweld Splice (Spool Side)	1:45	5. Coldweld Splice (Spool Side)	1:30
6. Soldering Splice	2:30	6. Soldering Splice	4:00
TOTAL:	8:55	TOTAL:	13:10
1. Determine Splice Loc. (Layer 10)	0:45	1. Determine Splice Loc. (Layer 22)	1:20
2. Prep. for Splice (Coil Side)	1:15	2. Prep. for Splice (Coil Side)	0:45
3. Prep. for Splice (Spool Side)	1:15	3. Prep. for Splice (Spool Side)	0:45
4. Coldweld Splice (Coil Side)	1:05	4. Coldweld Splice (Coil Side)	1:35
5. Coldweld Splice (Spool Side)	1:05	5. Coldweld Splice (Spool Side)	1:35
6. Soldering Splice	3:30	6. Soldering Splice	2:30
TOTAL:	8:55	TOTAL:	8:30
① Determine Splice Loc. (Layer 12)	1:45	① Determine Splice Loc. (Layer 24)	
2. Prep. for Splice (Coil Side)	1:00	2. Prep. for Splice (Coil Side)	
3. Prep. for Splice (Spool Side)	0:35	3. Prep. for Splice (Spool Side)	
4. Coldweld Splice (Coil Side)	1:20	4. Coldweld Splice (Coil Side)	
5. Coldweld Splice (Spool Side)	2:00	5. Coldweld Splice (Spool Side)	
6. Soldering Splice	4:05	6. Soldering Splice	
TOTAL:	10:45	TOTAL:	
AVERAGES			
1. Determine Splice Location	1:21		
2. Preparation for Splice (Coil Side)	1:02		
3. Preparation for Splice (Spool Side)	0:49		
4. Coldweld Splice (Coil Side)	1:53		
5. Coldweld Splice (Spool Side)	1:54		
6. Soldering Splice	3:18		
TOTALS:	10:17		

① Spool Change not included in average.

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APPENDIX E

MFTF-B AXICELL COIL WINDING TIMES

PERFORMANCE LOG

**AXICELL COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. A2000

1. Pancake	14:05 (1)	1. Layer 8	10:15
2. Splice & Shim	N/A, N/A	2. Splice & Shim	12:00, 8:35
		3. Filler & Shim	4:40
TOTALS	14:05	TOTALS	35:30
1. Layer 1	16:55 (2)	1. Layer 9	7:55 (14)
2. Splice & Shim	14:50, 21:35 (3)	2. Splice & Shim	11:15, N/A
3. Filler & Shim	18:10	3. Filler & Shim	12:30 (10)
TOTALS	71:30	TOTALS	31:40
1. Layer 2	12:30 (4)	1. Layer 10	8:58
2. Splice & Shim	16:10, N/A	2. Splice & Shim	12:52, 14:05
3. Filler & Shim	7:00 (5)	3. Filler & Shim	5:55
TOTALS	35:40	TOTALS	41:50
1. Layer 3	8:50	1. Layer 11	10:35
2. Splice & Shim	10:45, N/A	2. Splice & Shim	10:30, N/A
3. Filler & Shim	15:25 (6)	3. Filler & Shim	5:35
TOTALS	35:00	TOTALS	26:40
1. Layer 4	20:10 (7, 8)	1. Layer 12	11:05 (17)
Splice & Shim	*18:05, N/A	2. Splice & Shim	12:30, 9:15 (15), (16)
.. Filler & Shim	6:00	3. Filler & Shim	5:35
TOTALS	44:15	TOTALS	37:15
1. Layer 5	7:40	1. Layer 13	10:10
2. Splice & Shim	20:20, 13:00 (9)	2. Splice & Shim	10:05, N/A (18)
3. Filler & Shim	13:20 (10)	3. Filler & Shim	5:35
TOTALS	54:20	TOTALS	26:10
1. Layer 6	16:50	1. Layer 14	11:35
2. Splice & Shim	10:00, N/A (11)	2. Splice & Shim	16:35, N/A (19)
3. Filler & Shim	8:10	3. Filler & Shim	4:35
TOTALS	35:00	TOTALS	32:45
1. Layer 7	12:25 (13)	1. Layer 15	14:10
2. Splice & Shim	8:25, N/A (12)	2. Splice & Shim	7:10, N/A
3. Filler & Shim	8:45	3. Filler & Shim	9:15
TOTALS	29:35	TOTALS	29:35

NOTES: ① conductor twisting & flatness problem - unwound (14:10 N/I). ② same as ① plus 2nd shift - (31:35 N/I). ③ Practice splice and tool switching - (10:30 N/I). ④ Turntable electrical problem - (9:00 N/I). ⑤ UH10 for engineering redesign for sample - (6:10 N/I). ⑥ Shim installed over 1st unit to 2nd unit - (4:40 I). ⑦ Held for problem 11 - lost tight - (2:00 N/I). ⑧ When cable installed around splice and button in interference - 11 unwound (10:45 I). ⑨ Held for splice tool (soldering) - (9:30 I). ⑩ Only one man available. ⑪ Had to remove splice - 1st conductor (11:00 N/I). ⑫ Held for tech - hi - 1st shift. ⑬ Held for repair of connection more, stand (11:40 I/I). ⑭ Held for tech belt repair (11:30 N/I). ⑮ One is in Rockwell - cut out & report (3:00 N/I). ⑯ Under E-2 Ann - Rite problem (11:40 N/I). Sample 2nd shift

**AXICELL COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. A20W

1. Layer 16 9:05
2. Splice & Shim 3:10, N/A
3. Filler & Shim 7:30 (20)
TOTALS 24:45

1. Layer 23 10:10
2. Splice & Shim 10:15, N/A
3. Filler & Shim 11:25
TOTALS 31:45

1. Layer 17 10:20
2. Splice & Shim N/A, N/A
3. Filler & Shim 8:40 (21)
TOTALS 19:00

1. Layer 24 9:35
2. Splice & Shim 15:15, N/A (24)
3. Filler & Shim 4:40 (25)
TOTALS 28:30

1. Layer 18 9:55
2. Splice & Shim 11:15, N/A
3. Filler & Shim 4:00
TOTALS 25:10

1. Layer 25 11:05
2. Splice & Shim 8:40, 6:40 (26) (27)
3. Filler & Shim 6:30 14:02
TOTALS 32:55

1. Layer 19 10:55
2. Splice & Shim 12:00, N/A
3. Filler & Shim 5:25
TOTALS 28:20

1. Layer 26 11:40
2. Splice & Shim 11:05, N/A
3. Filler & Shim 3:50
TOTALS 26:35

1. Layer 20 9:25
2. Splice & Shim 12:35, N/A (22)
3. Filler & Shim 5:40
TOTALS 27:40

1. Layer 27 8:35
2. Splice & Shim 7:50, N/A
3. Filler & Shim 9:10 (29)
TOTALS 24:55

1. Layer 21 9:35
2. Splice & Shim 11:35, N/A
3. Filler & Shim 6:45 (23)
TOTALS 27:55

1. Layer 28 10:28 (28)
2. Splice & Shim 13:30, N/A
3. Filler & Shim 10:44
TOTALS 34:42

1. Layer 22 9:30
2. Splice & Shim N/A, N/A
3. Filler & Shim 3:50
TOTALS 13:20

1. Layer 29 14:06
2. Splice & Shim 17:50, 14:00 (30)
3. Filler & Shim 13:35 (31)
TOTALS 59:31

NOTES: (17) Replaced tension air bearings (1:00 N/T). (18) Damaged conductor after splice - cut out & replaced (5:00 N/T). (19) Lost time for UH - bad conductor (4:30 T). (20) Replaced layer-to-layer at high area only splice (1:30 T). (21) QAR-CC08810 high conductor on turn 18 - repairs by modifying shims (1:30 T). (22) Repair mismatch of conductor and splice tags (1:10 T). (23) Replaced layer-to-layer at high area only splice (6:50 T) & held for engineering (5:42 N/T). (24) Replaced splice put in effect (1:35 T) & held for electrical safety (1:50 T). (25) Damaged conductor - unbalanced and cut out splice - removed. Damaged conductor (8:35 N/T). (26) Replaced splice (6:40 T). (27) Held for electrical tech and change tag (1:00 N/T). (28) Held for dimension sketch (11:00 N/T). (29) 1st splice by management personnel. (30) Held for engineering redesign of ramp mit (4:50 N/T).

2nd shift averages: Pancake 14:05 Even layer (down) 11:26
Cycle 31:24 Odd layer (up) 10:55 Filler & Shim 7:57
splice & shim E-3 13:11 layer 11:10

**AXICELL COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. A1W

1. Pancake	12:30	1. Layer 8	8:50
2. Splice & Shim	N/A, N/A	2. Splice & Shim	10:05, N/A
TOTALS	12:30	3. Filler & Shim	5:05
		TOTALS	24:05
1. Layer 1	18:20 (1)	1. Layer (9)	9:10
2. Splice & Shim	17:55, 18:10	2. Splice & Shim	9:30, 9:30
3. Filler & Shim	18:10	3. Filler & Shim	17:20 (12) (13)
TOTALS	73:10	TOTALS	45:30
1. Layer 2	19:05 (2)	1. Layer 10	8:59
2. Splice & Shim	14:05, 14:50 (3) (Repeat)	2. Splice & Shim	12:06, N/A
3. Filler & Shim	8:55 (4)	3. Filler & Shim	2:50
TOTALS	56:50	TOTALS	23:55
1. Layer (3)	17:20	1. Layer 11	7:20
2. Splice & Shim	16:20, N/A	2. Splice & Shim	10:30, 13:45 (14)
3. Filler & Shim	20:25 (4)	3. Filler & Shim	4:40
TOTALS	54:05	TOTALS	36:15
1. Layer 4	15:10 (5)	1. Layer (12)	9:15
Splice & Shim	10:30, N/A	2. Splice & Shim	8:20, N/A
3. Filler & Shim	5:30	3. Filler & Shim	7:10
TOTALS	34:10	TOTALS	24:45
1. Layer 5	15:50	1. Layer 13	10:15
2. Splice & Shim	9:30, 13:05 (6) 15:00 (4)	2. Splice & Shim	9:10, 10:45 (5)
3. Filler & Shim	11:15 (7)	3. Filler & Shim	5:00
TOTALS	64:40	TOTALS	35:10
1. Layer (6)	12:25 (8)	1. Layer 14	9:30 (16)
2. Splice & Shim	19:55, 6:10 (9)	2. Splice & Shim	10:05, N/A
3. Filler & Shim	8:10	3. Filler & Shim	5:10
TOTALS	45:40	TOTALS	24:40
1. Layer 7	13:45 (11)	1. Layer (15)	10:10 (17)
2. Splice & Shim	12:19, N/A (10)	2. Splice & Shim	10:55, N/A
3. Filler & Shim	7:00	3. Filler & Shim	6:25 (13)
TOTALS	33:04	TOTALS	27:30

NOTES: (1) Turntable & Tensioner Problems; (12:15 N/I). (2) Damaged conductor - unwound beyond splice and cut off (5:40 N/I). (3) Repeat splice (14:50 I). (4) Only the main available. (5) Held for Helium in - not that (19:54 N/I). (6) Damaged conductor - ARC across 808 - cut & splice (additional splice) - (13:05 I). (7) Held for electrical short - moisture (15:35 N/I). (8) Conductor twist problem - unwound & re-wound - (15:00 N/I). (9) Rework of splice to correct location - mis-located (8:55). (10) Tensioner problems - replaced load cells & re-calibrated (2:30 N/I). (11) Tensioner problems - replaced springs & re-calibrated (3:50 N/I). (12) Reprint - gap (8:15 I). (13) Held for electrical short - moisture - (5:50 N/I). (14) Held 2nd shift for touch tip (2:20 I). (15) Removal of rust on conductor (10:35 N/I). See next page.

**AXICELL COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. AIW

1. Layer 16 10:27
2. Splice & Shim 10:06, 10:55
3. Filler & Shim 4:30
TOTALS 35:55

1. Layer 23 11:20
2. Splice & Shim 9:25, N/A
3. Filler & Shim 9:55
TOTALS 30:40

1. Layer 17 7:00
2. Splice & Shim 13:00, N/A (19)
3. Filler & Shim 7:00
TOTALS 26:00

1. Layer 24 9:00
2. Splice & Shim 10:30, N/A
3. Filler & Shim 9:25 (26)
TOTALS 29:05

1. Layer 18 11:59
2. Splice & Shim 10:11, N/A
3. Filler & Shim 5:55
TOTALS 28:05

1. Layer 25 12:55
2. Splice & Shim 12:15, N/A
3. Filler & Shim 8:05
TOTALS 33:15

1. Layer 19 14:35 (20)(23)
2. Splice & Shim 17:35, N/A (21)
3. Filler & Shim 7:15
TOTALS 39:25

1. Layer 26 12:42 (27)
2. Splice & Shim 14:00, 16:10 (28)
3. Filler & Shim 8:05
TOTALS 64:12 *13:15g Repair*

1. Layer 20 9:20
2. Splice & Shim 17:30, N/A (23)
3. Filler & Shim 6:40 (24)
TOTALS 33:30

1. Layer 27 11:20
2. Splice & Shim 11:05, N/A
3. Filler & Shim 8:30
TOTALS 30:55

1. Layer 21 12:00
2. Splice & Shim 13:20, N/A
3. Filler & Shim 13:20 (25)
TOTALS 38:40

1. Layer 28 15:10 (30)(31)
2. Splice & Shim 12:25, 9:45
3. Filler & Shim 9:00
TOTALS 46:00

1. Layer 22 9:50
2. Splice & Shim N/A, N/A
3. Filler & Shim 8:35
TOTALS 18:25

1. Layer 29 9:05 (32)
2. Splice & Shim 9:15, N/A
3. Filler & Shim 15:30 (33)
TOTALS 33:50

NOTES: (10) Conductor twist problem - unwound 3 turns and rewound (1:00N/T). (11) Held for out-of-tolerance dimensions and engineering evaluation - grade change (2:35 N/T). (13) Held for then - all 2 problems with T2 (3:40 N/T). (19) New man on splice. (20) Held for Union Strike (11 Days). (21) 1st splice by management person. (23) Conductor twist problem - unwound 4 turns and rewound (3:20 N/T). (23) New man working splice. (24) Held for tack belt and electrical problems (2:10 N/T). (25) Ramp installed incorrectly (2:50 I). (26) Held for factory air (1:00N/T). (27) Held for air bearing (1:00N/T). (28) Conductor twist problem (1:53 N/T). (29) Conductor damaged - repeat splice (3:15 I). (30) Repair damaged air line (2:15 N/T). (31) Conductor caught on spool - held for engineering evaluation (2:00N/T). (32) Held for tack belt repair (4:50N/T). (33) Held for design of ramp (8:15 N/T).
2nd shift
Average Pangako 12:30
Cycle 32:54
Old layer (up) 12:02
Splice & Shim 11:48
E-5 Layer 1
Extra Layer (Down) 11:33
Filler & Shim 8:54
Layer 1 11:48

**AXICELL COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. A20E

1. Pancake	18:50	1. Layer 8	9:20
2. Splice & Shim	N/A, N/A	2. Splice & Shim	17:55, 11:15 (9) (10)
TOTALS	18:50	3. Filler & Shim	7:40
		TOTALS	46:10
1. Layer 1	7:20	1. Layer 9	11:30 (12)
2. Splice & Shim	15:00, N/A	2. Splice & Shim	12:40, N/A
3. Filler & Shim	45:20 (1) (2) (3)	3. Filler & Shim	8:10
TOTALS	67:40	TOTALS	32:20
1. Layer 2	13:35	1. Layer 10	10:05
2. Splice & Shim	19:10, 8:25 (4)	2. Splice & Shim	13:35, 11:00
3. Filler & Shim	12:27 (5)	3. Filler & Shim	9:00
TOTALS	52:37	TOTALS	43:40
1. Layer 3	8:53	1. Layer 11	11:50 (12)
2. Splice & Shim	10:40, N/A	2. Splice & Shim	11:15, N/A
3. Filler & Shim	10:15	3. Filler & Shim	8:15
TOTALS	29:48	TOTALS	31:20
1. Layer 4	10:30 (6)	1. Layer 12	14:00 (13)
Splice & Shim	8:10, N/A	2. Splice & Shim	N/A, N/A
3. Filler & Shim	4:35	3. Filler & Shim	6:25
TOTALS	23:15	TOTALS	30:25
1. Layer 5	9:53	1. Layer 13	11:25 (16)
2. Splice & Shim	9:05, 10:52, 12:50 (7)	2. Splice & Shim	12:50, N/A
3. Filler & Shim	6:30 (repeat)	3. Filler & Shim	8:50
TOTALS	49:10	TOTALS	33:05
1. Layer 6	12:40 (8)	1. Layer 14	14:55 (17) (18)
2. Splice & Shim	10:00, N/A	2. Splice & Shim	9:35, N/A
3. Filler & Shim	6:25	3. Filler & Shim	4:45
TOTALS	28:45	TOTALS	29:15
1. Layer 7	7:05	1. Layer 15	8:35 (19)
2. Splice & Shim	9:20, N/A	2. Splice & Shim	12:20, N/A
3. Filler & Shim	9:25	3. Filler & Shim	12:15
TOTALS	25:50	TOTALS	33:10

NOTES: (1) Only one man available. (2) Held for engineering redesign (19:00 N/T). (3) Ramps and shims for ventilation block installed incorrectly - removed & repaired & reinstalled 19:10. (4) Lost tension - during alt. insulation solder & bonds, wires repaired (15:40 T). (5) Polyurethane foam under ventilation block - removed for repair (11:00 N/T). (6) Held for Helium Hunt Test (32:05 N/T). (7) Replaced drive end of prewired length not removed (12:50 T). (8) Bottom machine replaced (11:55 N/T). (9) Cold weld cracks - cut out splice and reold welded (11:50 N/T). (10) Held for lock lift (16:30 N/T). (11) Cold weld cracks - removed thru 2nd shift and cut out splice - also replaced dies on cold welder (9:30. (12) Changed air bearing (10:30 N/T). (13) Unwound 5 turns & repair loose post insul. E-6, foggl & broken voltage tap wire (10:55 N/T).

(OVER)

**AXICELL COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. A20E

1. Layer 16	<u>7:05</u>
2. Splice & Shim	<u>12:20, N/A</u>
3. Filler & Shim	<u>5:00</u>
TOTALS	<u>24:25</u>

1. Layer 23	<u>12:10</u> (25)
2. Splice & Shim	<u>9:55, N/A</u> (24)
3. Filler & Shim	<u>9:00</u>
TOTALS	<u>30:05</u>

1. Layer 17	<u>6:10</u>
2. Splice & Shim	<u>N/A, N/A</u>
3. Filler & Shim	<u>9:15</u>
TOTALS	<u>15:25</u>

1. Layer 24	<u>8:55</u>
2. Splice & Shim	<u>9:00, N/A</u>
3. Filler & Shim	<u>5:20</u>
TOTALS	<u>23:15</u>

1. Layer 18	<u>11:20</u>
2. Splice & Shim	<u>12:55, N/A</u>
3. Filler & Shim	<u>5:00</u>
TOTALS	<u>29:15</u>

1. Layer 25	<u>7:20</u>
2. Splice & Shim	<u>9:05, N/A</u> (26)(27)
3. Filler & Shim	<u>5:10</u>
TOTALS	<u>24:35</u>

1. Layer 19	<u>8:20</u>
2. Splice & Shim	<u>9:05, N/A</u>
3. Filler & Shim	<u>5:50</u>
TOTALS	<u>23:15</u>

1. Layer 26	<u>12:20</u>
2. Splice & Shim	<u>8:50, N/A</u>
3. Filler & Shim	<u>5:20</u>
TOTALS	<u>26:30</u>

Layer 20	<u>9:30</u> (20)
2. Splice & Shim	<u>14:25, N/A</u>
3. Filler & Shim	<u>5:50</u>
TOTALS	<u>29:45</u>

1. Layer 21	<u>12:35</u> (28)
2. Splice & Shim	<u>11:30, N/A</u>
3. Filler & Shim	<u>5:45</u>
TOTALS	<u>29:50</u>

1. Layer 21	<u>9:30</u> (21)(22)
2. Splice & Shim	<u>N/A, N/A</u>
3. Filler & Shim	<u>8:50</u> (23)
TOTALS	<u>18:20</u>

1. Layer 28	<u>11:10</u>
2. Splice & Shim	<u>9:45, N/A</u>
3. Filler & Shim	<u>9:30</u>
TOTALS	<u>29:25</u>

1. Layer 22	<u>7:50</u>
2. Splice & Shim	<u>10:30, N/A</u>
3. Filler & Shim	<u>4:50</u>
TOTALS	<u>23:10</u>

1. Layer 29	<u>11:25</u> (12)
2. Splice & Shim	<u>9:55, N/A</u>
3. Filler & Shim	<u>5:40</u>
TOTALS	<u>26:00</u>

NOTES: (14) Button machine problem (1:00 N/E). (15) Tensioner weight cable broke and damaged to this post drive gear - repaired (11:30 N/E). (16) Conductor came loose on spool - I had to hand wrap (3:00 N/E). (17) altered guide roller assembly to prevent conductor damage (2:30 N/E). (18) Held for tensioner headliner (28:00 N/E). (19) Held for winder repairs (6:10 N/E). (20) Held to tighten conductor on spool (1:20 N/E). (21) Replaced guide rollers (1:00 N/E). (22) Replaced felt on turntable (0:50 N/E). (23) Held due to electrical short in coil (3:50 N/E). (24) Held for fork lift (2:15 N/E). (25) Held for electrical tech and voltage tap (3:35 N/E). (26) Offload rejected conductor (6:30 N/E). (27) Short manpower (3:35 N/E). (28) Tighten loose conductor on spool (6:45 N/E).

2nd shift Averages:	Pancake	<u>15:50</u>	Even layer (down)	<u>10:57</u>	
Cycle	30:14	Odd layer (up)	<u>9:30</u>	Filler & Shim	<u>8:42</u>
		Splice & Shim	<u>11:17</u>	Layer	<u>11:15</u>

**AXICELL COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. A/E

① Pancake	<u>21:55</u> ①	1. Layer 8	<u>9:15</u>
2. Splice & Shim	<u>N/A</u> , <u>N/A</u>	2. Splice & Shim	<u>10:05</u> , <u>N/A</u>
TOTALS	<u>21:55</u>	3. Filler & Shim	<u>9:00</u>
		TOTALS	<u>28:20</u>
1. Layer 1	<u>16:10</u>	1. Layer ⑨	<u>10:55</u>
2. Splice & Shim	<u>10:30</u> , <u>11:50</u> ② (Repeat)	2. Splice & Shim	<u>8:40</u> , <u>13:35</u> ⑨
3. Filler & Shim	<u>15:10</u> ③	3. Filler & Shim	<u>12:30</u> ⑩
TOTALS	<u>53:40</u>	TOTALS	<u>45:40</u>
1. Layer 2	<u>8:10</u> ⑤	1. Layer 10	<u>13:10</u>
2. Splice & Shim	<u>11:25</u> , <u>N/A</u> ④	2. Splice & Shim	<u>17:05</u> , <u>N/A</u> ⑪
3. Filler & Shim	<u>6:45</u>	3. Filler & Shim	<u>3:40</u>
TOTALS	<u>26:20</u>	TOTALS	<u>33:55</u>
1. Layer ③	<u>8:30</u> ⑥	1. Layer 11	<u>10:20</u>
2. Splice & Shim	<u>12:35</u> , <u>11:25</u>	2. Splice & Shim	<u>13:00</u> , <u>N/A</u> ⑫ ⑬
3. Filler & Shim	<u>10:35</u>	3. Filler & Shim	<u>11:10</u> ⑭
TOTALS	<u>43:05</u>	TOTALS	<u>34:30</u>
1. Layer 4	<u>10:30</u> ⑦	1. Layer ⑫	<u>7:40</u>
Splice & Shim	<u>23:05</u> , <u>N/A</u>	2. Splice & Shim	<u>12:35</u> , <u>12:05</u>
3. Filler & Shim	<u>7:45</u>	3. Filler & Shim	<u>7:40</u>
TOTALS	<u>41:20</u>	TOTALS	<u>40:00</u>
1. Layer 5	<u>12:00</u>	1. Layer 13	<u>9:35</u>
2. Splice & Shim	<u>12:35</u> , <u>N/A</u>	2. Splice & Shim	<u>12:05</u> , <u>N/A</u>
3. Filler & Shim	<u>8:45</u>	3. Filler & Shim	<u>6:10</u>
TOTALS	<u>33:20</u>	TOTALS	<u>27:50</u>
1. Layer ⑥	<u>13:05</u> ⑧	1. Layer 14	<u>10:35</u> ⑯
2. Splice & Shim	<u>16:40</u> , <u>11:45</u>	2. Splice & Shim	<u>12:35</u> , <u>10:25</u> ⑮
3. Filler & Shim	<u>6:50</u>	3. Filler & Shim	<u>5:40</u>
TOTALS	<u>48:20</u>	TOTALS	<u>39:15</u>
1. Layer 7	<u>10:10</u>	1. Layer ⑮	<u>6:50</u>
2. Splice & Shim	<u>13:10</u> , <u>N/A</u>	2. Splice & Shim	<u>11:00</u> , <u>N/A</u> ⑰
3. Filler & Shim	<u>7:00</u>	3. Filler & Shim	<u>6:15</u>
TOTALS	<u>30:20</u>	TOTALS	<u>24:05</u>

NOTES: ① Installation of inner ring grid insulation, polyurethane for Kapton, and winding clamp (11:00 N/T). ② Splice mislocated - cut out and repeated (11:50 N/T). ③ Held for O.S.P. insulation parts (10:20 N/T). ④ Helped charal error on other line (11:45 N/T). ⑤ aluminum particle damage from counter - wrapped with tape for cleaning and repair (23:00 N/T). ⑥ modified grid barrier (2:45 N/T). ⑦ Held for helium purget test (21:35). ⑧ Repair damage conductor (11:00 N/T). ⑨ Unwound to correct twist problem but damaged conductor - removed splice and repeated holdweld (7:10 N/T). ⑩ mislocated voltage tap - had to remove and reinstall (2:45 N/T). ⑪ Conducted conductor twist problem - (10:45 N/T). ⑫ Damage to holdweld caused by broken die - replaced die and re-E-8 pinter. holdweld (5:20 N/T). OVER

**AXICELL COIL WINDING TIMES
PERFORMANCE LOG**

COIL NO. A1E

1. Layer 16	6:55 (18)	1. Layer 23	9:10
2. Splice & Shim	6:30, 5:55	2. Splice & Shim	11:06, N/A (24)
3. Filler & Shim	3:50 (19)	3. Filler & Shim	6:40
TOTALS	23:10	TOTALS	26:56
1. Layer 17	7:20 (20)	1. Layer 24	9:50 (23)
2. Splice & Shim	6:40, N/A	2. Splice & Shim	6:20, 9:40
3. Filler & Shim	4:20	3. Filler & Shim	6:10
TOTALS	18:20	TOTALS	32:00
1. Layer 18	6:55	1. Layer 25	10:55 (23)
2. Splice & Shim	6:40, N/A	2. Splice & Shim	9:30, N/A (25)
3. Filler & Shim	5:05	3. Filler & Shim	6:35
TOTALS	18:40	TOTALS	27:00
1. Layer 19	8:00	1. Layer 26	4:35 (23)
2. Splice & Shim	8:30, N/A (21)	2. Splice & Shim	N/A, N/A
3. Filler & Shim	6:00	3. Filler & Shim	6:05
TOTALS	22:30	TOTALS	10:40
1. Layer 20	8:10	1. Layer 27	6:45
2. Splice & Shim	5:10, N/A	2. Splice & Shim	7:15, 8:00
3. Filler & Shim	6:05	3. Filler & Shim	4:00
TOTALS	19:25	TOTALS	26:00
1. Layer 21	10:15	1. Layer 28	7:20
2. Splice & Shim	N/A, N/A	2. Splice & Shim	7:35, 9:15
3. Filler & Shim	7:15	3. Filler & Shim	4:30
TOTALS	17:30	TOTALS	28:40
1. Layer 22	8:50 (23)	1. Layer 29	9:00
2. Splice & Shim	8:35, N/A (22)	2. Splice & Shim	6:55, N/A
3. Filler & Shim	5:30	3. Filler & Shim	8:05
TOTALS	22:55	TOTALS	24:00

NOTES: (13) Tensioner repair (1:20 N/T). (14) Whorl ramp installed - replaced (1:20 N/T). (15) Replaced tensioner pulley (0:55 N/T). (16) Replaced winding belt (1:00 N/T). (17) Worked other line (1:00 N/T). (18) Tensioner problems (1:15 N/T). (19) Held for electrical tech (1:00 N/T). (20) Held for tensioner repairs (1:20 N/T). (21) High area in splice removed (2:45 T). (22) Repair splice tank (1:00 N/T). (23) Replaced Tach belt (0:40 N/T). (24) Stopped to remove A3 (1:24 N/T). (25) Held for ketopost repairs (1:15 N/T).

*2nd shift Averages: Paycycle 21:55 Even Layer (Down) 8:56
 Cycle 26:59 Odd Layer (Up) 9:44 Filler & Shim 7:04
 Splice & Shim 10:35 Layer 9:20

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APPENDIX F

5/17/85

MTF-B SURPLUS HAND TOOLS AND SUPPORT TOOLING

DEACTIVATION PLAN

RECOMMENDED DISPOSITION CODE

- Legend:
- 1 - Scrap at GDC
 - 2 - Purchase by GDC
 - 3 - Store and Protect at GDC
 - 4 - Transfer to Other DOE Programs
 - 5 - Ship to LLNL
 - 6 - Transfer to CBI

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET TRANS.			DISP. CODE	STATUS	
				T1	T2	SOLN			
Shipping Reel Conductor Support	SK-032	HDT0				X	1	Comp1. ↑	
Coil Form MIC Holder	SK-033	HDT0				X	6		
Compaction Clamp	SK-033	HDT0				X	6		
Entering Lead Sol- dering Fixture	SK-038	HDT0				X	6		
Prep Station Pro- tective Cover	SK-039	HDT0				X	6		
Conductor Bend Test Fixture	SK-043	HDT0				X	1		
Solder Stripper Acid Dip Tank	SK-045	HDT0				X	6		
Conductor Reel Handling Fixture	SK-051	HDT0				X	1		
Leak Detector/- Pumping Station Shroud	SK-052	HDT0				X	1		
Helium Hi-Pot Pump- ing Test Adapter	SK-053	HDT0				X	X		1
Solenoid Filler & Shim Insulation Tool	SK-055	HDT0				X			1
Solenoid Layer- to-Layer Insulation Trim Fixture	SK-058	HDT0				X			1
Plenum Insulation Layer Forming Tool	SK-061	HDT0				X			6
Axicell (Barrier Coil) Splice Test Fixture	SK-062	HDT0					X		1
Solenoid Closeout Weld Ring Clamp	SK-064	HDT0				X			6
Exiting Lead Tension Clamp	SK-065	HDT0				X		6	Comp1.

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET		SOLN	BARR	DISP. CODE	STATUS
				TRANS. T1	T2				
Plenum Wire Run Insulation Layup Forming Tool	SK-066	HDT0				X		6	Comp1. ↓
Stack Adapter/ Helium Fill Leak Test Fixtures	SK-067	HDT0				X		6	
Stack Hat Kapton Applicator	SK-070	HDT0				X		1	
Closeout Weld Leak Test Fixture	SK-073	HDT0				X		6	
Alignment Target Locator	SK-075	HDT0				X		1	
Trans. Coil (T2) True-Up Fixture	SK-078	HDT0			X			6	
Barrier Coil True-Up Fixture	SK-079	HDT0					X	6	
Barrier Coil Layer Winding Clamps	SK-085	HDT0					X	6	
Shoulder Bushing Kapton Trim Template	SK-086	HDT0				X		1	
Shield Bracket Test Fixture	SK-088	HDT0					X	1	
Trans. Coil Winder Adapter (Drive Side) Drill Plate	SK-101	HDT0		X	X			2*	
Trans. Coil Winder Adapter (Support Side)	SK-102	HDT0		X	X			2*	
Closeout Weld Leak Test Fixture	SK-104	HDT0					X	6	
Stack & Helium Fill Tube Leak Test Fixture	SK-105	HDT0					X	6	

* Potential purchase by GDC
Refer to page F-31.

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET			DISP. CODE	STATUS
				TRANS. T1	T2	SOLN	BARR	
True-Up Check Gage	SK-107	HDT0					X	6
Plenum Insul. Layup Forming Tool	SK-108	HDT0					X	1
Wire Run Insul Layup Forming Tool	SK-109	HDT0					X	6
T2 Coil Splice Soldering Fixture	SK-110	HDT0			X			6
T2 Clamp Plate Drill Plate	SK-111	HDT0		X				6
Pancake Winding Clamp	SK-114	HDT0					X	6
Pancake Holddown Clamp	SK-115	HDT0					X	6
Axiceil Coil Splice Fixture	SK-117	HDT0					X	6
T2 Coil Closeout Weld Leak Test Fixture	SK-118	HDT0			X			6
Conductor Spool Handling Fixture	SK-119	HDT0		X	X		X	5
Pancake Anchor Block Clamp	SK-120	HDT0					X	6
T1 Coil Closeout Weld Leak Test Fixture	SK-122	HDT0		X				6
Pancake Pigtail Clamp	SK-124	HDT0					X	6
Kapton Locator	SK-125	HDT0					X	6
T1 Coil True-Up Fixture	SK-127	HDT0		X				6
T1 Clamp Plate Drill Fixture	SK-128	HDT0		X				6

Compl.

Compl.

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET		DISP. CODE	STATUS
				TRANS. T1	SOLN T2	BARR	
Splice Forming Tools	SK-130	HDT0			X		6
Splice Support Stand	SK-131	HDT0				X	6
T2 Plenum Layup Forming Tool	SK-132	HDT0			X		1
Glue Block Machine Tool (T2)	SK-133	HDT0			X		6
Closeout Station Handling Sling	SK-134	HDT0		X	X		2*
T2 Closeout Holddown Clamp	SK-137	HDT0			X		6
T2 Coil Vent and Stack Leak Test Fixture	SK-138	HDT0			X		6
T1 Coil Splice Fixture	SK-139	HDT0		X			6
Inlet Lead Cover Router Tool	SK-140	HDT0			X		6
Entering/Exiting Lead Splice Tether Post Weight Stand	SK-142	HDT0		X	X		6
Glue Block Machine Tool (T1)	SK-143	HDT0		X			6
Clamp Block Drill Fixture (T2)	SK-144	HDT0		X			6
Closeout Station Protective Tent (T2)	SK-145	HDT0			X		6

* Potential purchase by GDC.
Refer to page F-31

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET				DISP. CODE	STATUS
				TRANS. T1	T2	SOLN	BARR		
Plenum Layout Forming Tool (T1)	SK-147	HDT0		X				1	Comp1.
Inlet Lead Forming Tool	SK-148	HDT0		X	X			6
Inlet Lead Cover Router Tool (T1)	SK-149	HDT0		X				6	
Coil Plate Leak Test Tools	SK-151	HDT0		X	X			6	

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET			DISP. CODE	STATUS
				TRANS.	SOLN	BARR		
A-Cell Coil Winder Adapter	710777	MCAC	X	T1	T2		6	Comp1.
A-Cell Button Dispenser	710778	MCAC	X	X	X		2*	
Solenoid Winding Line Protective Cover (Tent)	711913	PRCR				X	2*	
Master Mill Accessory Stand	711958	MCAC				X	6	
Solenoid Coil Form Tru-Up Mold - 90° (1)	711959	PDMO				X	6	
Solenoid Coil Winding and Mock-up	712020	TSTO				X	1	
Master Mill Accessory Stand (2)	712024	MCAC				X	6	
Side-Wall Insulation Cut-Outs	712048	MKTP				X	6	
Solenoid Splice Doubler Solder Fixture Clamshell Furnace	712049	WLFX				X	5	
Lincoln Welder (K 1170)	712067	MAID	X				5	
Clamping Details Test Set-Up	712097	TSTO	X				6	
Solenoid Coil Winding Compaction Tool	712385	HNTD				X	6	
Compaction Check Gage (1)	712512	CKGA				X	6	
Compaction Check Gage (2)	712513	CKGA				X	6	
Conductor File Fixture (1)	714498	TOAC				X	6	Comp1.

* Potential purchase by GDC
Refer to F-31/32

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET TRANS.				DISP. CODE	STATUS
				T1	T2	SOLN	BARR		
Conductor File Fixture (?)	714567	TOAC				X		6	Comp1.
Solenoid Tension Clamp (2)	714899	HNTC				X		6	
Solenoid Conductor Slot Router Fix- ture (Handle)	714900	TOAC				X		6	
Trans. Coil Winding Machine/ Tensioner w/work platform, stair- well, base plates, gantry crane, and Koldweld Press (LLNL)	715472	SPMC		X	X			4*	
Trans. (T2) Coil Form Support (1)	716291	MCAC			X			6	
Trans. (T2) Coil Form Support (2)	716292	MCAC			X			6	
Trans. (T1) Coil Form Support (1)	716294	MCAC		X				6	
Trans. (T1) Coil Form Support (1)	716293	MCAC			X			6	
Axicell Holding Fixture (1)	716538	MCAC					X	6	
Axicell Holding Fixture (2)	716539	MCAC					X	6	
Axicell Coil Form Leak Test Fixture (1)	716540	MCAC					X	6	
Axicell Holding Fixture (3)	716542	MCAC					X	6	
Axicell Holding Fixture (4)	716548	MCAC					X	6	
Transition Coil Tent (1)	716549	PRCR		X	X			2**	Comp1.

*Refer to detail sheets F-13 and F-14

** Potential purchase by GDC. (Refer to page F-32).

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET				DISP. CODE	STATUS
				TRANS.	T1	T2	SOLN	BARR	
Transition Coil Tent (2)	716550	PRCR		X	X			2*	Compl.
Transition Coil Button Dispenser (2)	717387	MCAC		X	X			2*	
Axical Anchor Block Drill Plate	718320	DRPE						X	6
Shim Bladder Test Article Hydro- Press Form - End Cap Major Radius	761153	HPFM	X						6
Shim Bladder Test Article Hydro- Press Form - Minor Radius	761154	HPFM	X						6
A-Cell Handling Tool (A-2)	762096	HATO	X						6
A-Cell Dimple Bladder - Major Radius (-1) - Sush for PDTA TA3941	762099	SUSH	X						1
A-Cell Dimple Bladder - Major Radius. NC Production Tape Proof for PDTA	762100	PDTA	X						1
A-Cell Dimple Bladder - Hydro- Press Form - Major Radius (-1)	762103	HPFM	X						6
A-Cell Bead Bladder - Hydro- Press Form - Major Radius (-3)	762104	HPFM	X						6
A-Cell Handling Tool (A-1)	762105	HATO	X						6

* Potential purchase by GDC.
(Refer to Enclosure 6)

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET				DISP. CODE	STATUS
				TRANS. T1	T2	SOLN	BARR		
A-Cell Clamp - Plate and Plenum Installation Drill Plate	762119	DRPE	X					6	Compl.
Shim Bladder Pressure Test Fixture - Minor Radius	762120	TSAC	X					6	
A-Cell/Transition Coil Winding Mach. w/Work Platform, Stairwell, Base Plates, and Gantry Crane (GDC)	762126	SPMC	X	X	X			2*	
Mock-Up A-Cell Minor Radius Coil Packs	762250	MAID	X					1	
Mock-Up A-Cell Minor Radius Coil Form	762251	TSTO	X					1	
Mock-Up A-Cell Major Radius Coil Pack	762252	MAID	X					1	
Solenoid Coil Form True-Up Mold 90° (2)	762554	PDMD				X		6	
Solenoid Coil Form True Up Mold 180° (Opposite)	762257	PDMD				X		6	
Solenoid Tension Clamp (1)	762675	HNTD				X		6	
Entering Lead 90° Bend Fixture	762687	FMMD				X		6	
Master Mill Exten- sion Support Stand	762714	MCAC				X		6	
Solenoid Conductor Cutoff File Fixture	762715	TOAC				X		6	Compl.

*Potential purchase by GDC. Refer to
detail sheets F-15 and F-16, and page
F-31.

NOMENCLATURE	TOOL NUMBER	SYMBOL	A- CELL	MAGNET			BARR	DISP. CODE	STATUS
				TRANS. T1	T2	SOLN			
Solenoid Coil Form Leak Test Fixture (2)	762716	TSAC				X		6	Comp1.
Plenum Insulation Cut-Out Template	762772	MKTP				X		6	
Solenoid Splice Solder Fixture	762782	WLFX				X		6	Comp1.

LLNL COIL WINDER/TENSIONER
SPMC 715471
COMPONENT DISPOSITION

<u>Item</u>	<u>Nomenclature</u>	<u>Part Number</u>	<u>Remarks</u>	<u>Disp. Code</u>	<u>Status</u>
1.	Foundation Base Plates w/Rail Segments	77-104343-08	11,800#	4	Compl.
2.	"A" Frame w/Stow Pin Tilt Gear Assy.	550-011974	31,000#	4	
3.	Table w/Rollers	550-011997	83,000#	4	
4.	"A" Frame w/Drive	550-011975	36,400#	4	
5.	Winder Base w/Spindle Spacer	550-012014	36,400*	4	
6.	Winder Platform Assy.	550-012032	12,000#	4	
7.	Portable Gantry Wallace Tri-Adjustable with One 1-Ton Hoist	4000#	\$3,000	2*	
8.	Fixed Platform and Stairwell Assy.	77-109359-08	18,400#	5	
9.	Tensioner	MEL 77-001342	16,000#	5	
10.	Koldweld Press w/Load Bar	HPB-22	4,000#	5	
11.	75 KVA Transformer w/Mounting Plates	S/N 74F6175	3000#	5	Compl.
		Total Weight	255,000# (128 tons)		

* Potential purchase by GDC.
(Refer to Enclosure D)

INVENTORY OF SPARE ELECTRICAL PARTS

Comp1.

Potential purchase by GDC (Refer to page F-31).

Controls. One part was originally received from LLNL with the winder and repaired by GDC for an additional spare.

GDC COIL WINDER
SPMC 762126*
COMPONENT DISPOSITION

<u>Item</u>	<u>Nomenclature</u>	<u>Part Number</u>	<u>Remarks</u>	<u>Disp. Code</u>	<u>Status</u>
1.	Foundation Base Plates w/Rail Segments	77-104343-08	11,800#	2	Compl.
2.	Yoke	550-011890	67,500#	2	
3.	Counter Weight	550-011891	60,000#	2	
4.	"A" Frame w/Stow Pin Tilt Gear Coil Adapter Assembly	550-011974	42,000#	2	
5.	Table with Rollers	550-011997	83,000#	2	
6.	"A" Frame with Drive Assembly	550-011975	39,000#	2	
7.	Winder Base with Spindle Spacer	550-012014	42,000#	2	
8.	Platform Complete	550-014602	8,600#	2	
9.	Miscellaneous Parts/ Remains from Modification -- A-Cell Configuration	--	6,000#	2	
10.	Portable Gantry with One 1-Ton Hoist	M# L3522 4000# Capacity	3,000#	2	
11.	Fixed Platform Assy. and Stairwell	77-109359-08	18,400#	2	Compl.
		Total Weight	381,300# (191 tons)		

* Potential purchase by GDC.
Refer to page F-31.

GDC WINDER
SPMC 762126 *
INVENTORY OF SPARE PARTS

<u>Item</u>	<u>Nomenclature</u>	<u>Part Number</u>	<u>Qty.</u>	<u>Replacement Cost</u>	<u>Status</u>
1.	25-HP Motor Fincor	M# 28800450004	1	\$ 2,594.65	Compl.

* Disposition Code 2.
Potential Purchase by GDC.
Refer to page F-31.

MFTF-B CLOSING INVENTORY OF PARTS

DEACTIVATION PLAN

RECOMMENDED DISPOSITION CODE

LEGEND:

- 1 Scrap at GDC
- 2 Purchase by GDC
- 3 Store and Protect at GDC
- 4 Transfer to Other DOE Programs
- 5 Ship to LLNL
- 6 Transfer to CBI

A-Cell	200 & 300 Series
Solenoid	600 & 800 Series
T1 Coils	3200 Series
T2 Coils	3300 Series
Axicell	3400 Series

Part Number	Part Name	Qty.	Remarks	Disp. Code	Status
Length 3093	A-Cell Super-	396 ft.	Sp. 5, Layer 1 (Inner)	6	Compl.
3034	Conductor	379 ft.	2	6	
* 3019		837 ft.	Sp. 31, Layer 1	5	
4253		363 ft.	Sp. 32, Layer 1	6	
4283		1398 ft.	Sp. 45, Layer 1 (Inner)	5	
4368		849	2	5	
4388		311	3	5	
4324		165 ft.	4	5	
4005		981 ft.	Sp. 46, Layer 1 (Inner)	5	
4020		985 ft.	2	5	
4021		280 ft.	3	5	Compl.

Total 6944 ft.

- * Length rejected by GDC (WARF-030) due to disbands between
 299 ft. and 347 ft.
 (299 ft. good at start, 490 ft. good at end.)

Part Number	Part Name	Qty.	Remarks	Disp. Code	Status
Length					
6153	Solenoid	2894 ft.	Sp.1, Spec. Length 2768 ft.	5	Compl.
6154	Conductor	2895 ft.	2768	5	✓
6155		2779 ft.	Sp.2, Spec. Length 2710 ft.	5	
6156		2764 ft.	2710	5	
6157		2683 ft.	Sp.3, Spec. Length 2652 ft.	5	
6158		2655 ft.	2655	5	
* 6148		842 ft.	Sp.4, Spec. Length 2652 ft.	5	
		1820 ft.		5	
6168		2610 ft.	2593	5	
6159		2748 ft.	Sp.5, Spec. Length 2710 ft.	5	
6160		2657 ft.	2652	5	
6161		2588 ft.	Sp.6, Spec. Length 2535	5	
6162		2585 ft.	2535 ft.	5	
6163		2826 ft.	Sp.7, Spec. Length 2768 ft.	5	
6164		2849 ft.	2768	5	
6165		1424 ft.	Sp.8, Spec. Length 1408 ft.	5	
6166		1454 ft.	1408	5	
6167		1450 ft.	1408	5	
6169		2728 ft.	Sp.9, Spec. Length 2593 ft.	5	
6170		2564 ft.	2535	5	
6171		2607 ft.	Sp.10, Spec. Length 2593 ft.	5	
6172		2538 ft.	2535 ft.	5	
6173		2737 ft.	Sp.11, Spec. Length 2710 ft.	5	
6174		2602 ft.	2593	5	
**6118		2714 ft.	Sp.12, Spec. Length 2710 ft.	5	Compl.

* Two pieces, shorter length (842 ft.) on top.

** Length rejected by GDC for disbands
(WARF-089 at 2102 ft. and 2395 ft.)

Part No.	Part Name	Qty.	Remarks	Disp. Code	Status
71E0202-1	Coil Form Assy.	2		6	Compl.
71E0203-1	Closure - Side	4		6	
-2	- End	2		6	
-3	- End	4		6	
-10	- End	2		6	
-16	- End	4		6	
-17	- End	4		6	
71E0223	Coil Stock	209 ft.	304, .012 x 24 in.	5	
71E0209-3	Flat Stock	24 ft.	304L, 1/4 x 2 in.	5	
-10		216 ft.	304L, 3/4 x 1 in.	5	
71E0220-1	Bar Stock	110 in.	304L, 1.5 in. dia.	5	
-2		114 in.		5	
71E0221-1	Flat Stock	4 ft.	304L, 2 x 2 in.	5	
71E0228-1	Bar Stock	110 in.	304L, 3/4 x 3/4 in.	5	
71E0233-1	Conductor Splice	51		6	
-2		101		6	
-3		45		6	
-4		6		6	
71E0234-1	Conductor Offset-RE	51		5	
-2		52		5	
-7		51		5	
-11		51		5	
-12		48		5	
-13		50		5	
-14		52		5	
-15		52		5	
-16		51		5	
-17		50		5	
-18		38		5	
71E0234-19		50		5	
-20		52		5	
-21		91		5	
-22		104		5	
-23		103		5	
-24		103		5	
71E0240-1	Turn/Turn	105 reels		5	
71E0241-1	Filler Side	650		5	Compl.

Part No.	Part Name	Qty.	Remarks	Disp. Code	Status
71E0243-1	Glue Block	101		5	Compl.
-2		100		5	
-3		95		5	
-4		100		5	
-5		100		5	
-6		2		5	
-8		2		5	
-9		2		5	
-10		1		5	
-11		1		5	
-12		49		5	
-13		49		5	
-14		56		5	
-15		54		5	
-16		51		5	
-17		52		5	
-18		42		5	
-19		51		5	
-20		52		5	
-21		192		5	
-22		97		5	
-23		211		5	
71E0246-1	Clamp Block	116		5	
-2		104		5	
-3		122		5	
71E0254-1	Ramp Details	102		5	
-2	Wedge	102		5	
-3	Ramp	91		5	
-4	Filler	100		5	
-5	Wedge	97		5	
-6	Wedge	99		5	
-7	Ramp	93		5	
-8	Filler	98		5	
71E0311-1	Layer/Layer	13		5	
-2		71		5	
-4		48		5	Compl.

Part No.	Part Name	Qty.	Remarks	Disp. Code	Status
71E0312-1	Plenum Insulation	29		5	Compl. ↑
-2		63		5	
-5		4		5	
-6		70		5	
-7		6		5	
-9		36		5	
-10		3			
71E0314-3	Ground Insulation	2		5	
-4		4		5	
-5		7		5	
-7		5		5	
-8		6		5	
-9		7		5	
-10		3		5	
-11		10		5	
-12		9		5	
-13		13		5	
71E0315-1	Filler Insulation	4		5	
-2		21		5	
-3		9		5	
-4		6		5	
71E0318	500-H Kapton	9 Spools		5	
MS35206-276	Screw	400		5	
71E0610-6	Alignment Washer	19		5	
71E0621-1	Layer Insulation	90		5	
71E0628-4	Lead Insulation	3		5	
-5		3		5	
-7		3		5	
-8		3		5	
-10		3		5	
71E0638-2	Turn Insul-Side Wall	179		5	
71E0639-1	Side Wall Shim	2200		5	
-2		1398		5	
-3		1067		5	
-4		246		5	
-5		36		5	
-6		15		5	
-7		1445		5	
71E0646-1	Cond. Splice Doubler	90		6	
-2		88		6	
71E0648-1	Riser Insulation	3		5	Compl. ✓
-2		27			
71E0649-1	Riser Conductor	5		5	
-2		33			

Part No.	Part Name	Qty.	Remarks	Disp. Code	Status
71E0650-2	Riser Ventilated Insulation	16		5	Compl. ↑
71E0651-3	Plenum Insulation	363		5	
71E0653-1	Taper Insulation	3		5	
-2		2		5	
71E0661-1	Joggle Insulation	72		5	
71E0662-1	Joggle Insulation	65		5	
-2		487		5	
71E0663-1	Shim Insulation	253		5	
71E0686-1	Cover Insulation	3		5	
-2		3		5	
-3		3		5	
-4		3		5	
-5		3		5	
-6		3		5	
-7		3		5	
-8		3		5	
-9		3		5	
-10		14		5	
71E0595-1	Shoulder Bushing	2		5	
71E0801-1	Conductor Splice Insulation	360		5	
71E0805-2	Cover Pocket	2		5	
-3		45		5	
71E0806-1	Exit Lead Vent Insulation	3		5	
71E0807-1	Exit Lead Shim Insulation	3		5	
71E0812-6	Plate Stock	1	Size 304L, 1-1/2" x 4' x 8'	5	
71E0819-1	Plenum Insulation	45		5	
NAS1581C3T17	Bolt	100		5	
71E0810-1	Lead Splice	3		1	

Part No.	Part Name	Qty.	Remarks	Disp. Code	Status
71E3253-1	Kapton	61		5	Compl. ↑
-2		90		5	
-3		153		5	
-4		84		5	
-5		3		5	
-6		234		5	
731AA-1/32	Milled Fibers	91 Box		5	
731DA-1/4	Milled Fibers	5 Box		5	
71E3256-1	Layer-to-Layer	3		5	
-2		1		5	
-3		2		5	
-4		2		5	
-5		2		5	
-6		1		5	
-7		1		5	
-8		1		5	
-9		1		5	
-10		1		5	
-11		1		5	
-12		2		5	
-14		2		5	
-15		53		5	
-16		7		5	
71E3257-1	Plenum Insulation	8		5	
-2	Detail	8		5	
-3		36		5	
-4		2		5	
-5		2		5	
-6		3		5	
-7		2		5	
-8		2		5	
-9				5	
-10		2		5	
-12		2		5	
-14		12		5	
-15		2		5	
71E3262-1	Clamp Rod	3		5	
71E3263-1	Shim	12		5	
-2		24		5	
-3		40		5	
-4		44		5	
71E3265-1	Glue Blocks	8		5	
-2		4		5	
-5		5		5	
-6		5		5	
-8		2		5	
					Compl. ↓

Part No.	Part Name	Qty.	Remarks	Disp. Code	Status
71E3266-1	Instrumentation Wire Guide	1		5	Compl.
71E3269-1	Clamp Blocks	7		5	
-2		12		5	
-3		3		5	
71E3270-1	Clamp Plate	1		5	
-2		3		5	
71E3271-1	Filler Insulation	8		5	
-2		4		5	
-3		8		5	
-4		8		5	
-5		8		5	
71E3274-1	Ramp Details	7		5	
-5		4		5	
71E3275-1	Conductor Splice	4		5	
-2		2		6	
71E3299-2	Spare G-10 Sheet	10		5	
71E3353-1	Kapton	39		5	
-2		248		5	
-3		128		5	
-4		55		5	
-6		34		5	
-8		23		5	
-10		2		5	
-11		102		5	
-12		7		5	
71E3357-10	Plenum Ins. Det.	12		5	
71E3360-1	Clamp Block	3		5	
-2		5		5	
71E3362-1	• Clamp Rod	3		5	
71E3363-2	Shim	60		5	
-3		12		5	
-4		20		5	
71E3365-1	Radial Glue Block	2		5	
-2		2		5	
-3		6		5	
-6		6		5	
-9		1		5	
71E3366-2	Inst. Wire Guide	1		5	
71E3374-1	Ramp Details	1		5	
-5		3		5	
-6		2		5	Compl.

Part No.	Part Name	Qty.	Remarks	Disp. Code	Status
71E3432-1	Splice Spacer	29		5	↑ Compl.
-2		71		5	
-3		51		5	
-5		2		5	
71E3433-1	Shims at Sidewalls	514		5	↑ Compl.
-2		800		5	
-3		1000		5	
-4		1446		5	
-5		100		5	
71E3435-7	Wire Cover	1		5	↑ Compl.
MS51831CA201	Insert	14		5	
MS51832CA202	Insert	118		5	
71E3438-1	Support Block	16		5	
71E3440-1	Anchor Block Shim	9		5	
-5		24		5	
-6		22		5	
-7		4		5	
-8		16		5	
71E3443-1	Turn Insul. at	5		5	
-2	Ramp Up	26		5	
-3		13		5	
71E3447-1	Enter/Exit Cond.	1		5	
-2	Brace	1		5	
71E3448-1	Exit Lead	5		5	
-2		13		5	
71E3455-1	Lead Support	1		5	↓ Compl.
-2		1		5	
-3		1		5	
-4		1		5	

MFTF-B MISCELLANEOUS SURPLUS

DEACTIVATION PLAN

RECOMMENDED DISPOSITION CODE

- Legend:
- 1 - Scrap at GDC
 - 2 - Purchase by GDC
 - 3 - Store and Protect at GDC
 - 4 - Transfer to Other DOE Programs
 - 5 - Ship to LLNL
 - 6 - Transfer to CBI

Item	Nomenclature	Qty.	Remarks	Disp. Code	Status
1.	Solenoid Conductor Storage Reels	29	Argonne Natl. Laboratory Dwg. No. 03-810-44-3 13 Reels hold usable conductor lengths	6 5	Compl. ↑
2.	Solenoid Conductor Reel Storage Stands	4	Argonne Natl. Laboratory Dwg. No. 03-810-44-13 3 Stands hold usable conductor lengths.	6 5	
3.	Axicell/Transition Conductor Wooden Spools	39	36 are empty. 3 spools hold usable conductor lengths.	1 5	
4.	Solenoid Conductor	144	Approx. 50-foot lengths, remainder from winding.	6	
5.	Axicell/Transition Conductor	100	Approx. 50-foot lengths, remainder from winding.	6	
6.	Axicell/Transition Conductor	224	5-foot test samples	6	
7.	LN ₂ Cold Trap with Mating Flange	1	5-in I.D. x 2-ft long	5	
8.	ASTM B152 Copper	1 1 1	1/2" x 36" x 48" 3/4" x 19-1/2" x 96" 6" x 10-1/4" x 16-1/2"	5 5 5	Compl. ↓
9.	Conductor Spool Payoff Station Tripod	1	Equipment left from tin coil line - not returned to LLNL	5	

MFTF-B SURPLUS TOOLING AND RESIDUAL MATERIALS

PURCHASE PLAN

GDC BUY

<u>Item</u>	<u>Nomenclature</u>	<u>Part Number</u>	<u>Remarks</u>
<u>SPMC 762126</u>			
1.	Foundation Base Plates with Rail Segments	77-104343-08	12,000# (HM)
2.	Yoke	550-011890	68,000# (HM)
3.	Counter Weight	550-01189	60,000# (HM)
4.	"A" Frame with Stow Pin Tilt Gear Coil Adapter Assembly	550-011974	42,000# (HM)
5.	Table w/Rollers	550-011997	83,000# (HM)
6.	"A" Frame with Drive Assembly	550-011975	39,000# (HM)
7.	Winder Base with Spindle Spacer	550-012014	42,000# (HM)
8.	Platform, Complete	550-014602	12,000# (HM)
9.	Miscellaneous Parts/ Remains from Modification, A-Cell Config.; Drill Plates (SK-101 and SK-102)	--	6,000# (HM)
10.	Two (2) Port. Gantries w/(2) 1-ton Hoists KoldWeld Head Load Bar (SK-013) and Sling (SK-134)	M# L3522 (GDC) Wallace Tri- Adjustable (LLNL) 4000# Capacity Ea.	6,000# (HM)
11.	Fixed Platform Assy. and Stairwell	77-109359-08	26,000# (LM)
12.	Controller/D.C. Motors (6), Gearboxes (2)	25 HP - (3) ⁽³⁾ 40 HP - (1) 60 HP - (2)	8,000#
	Total		404,000#