DCA323 Production Report

TS-SSC 92-086
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DCA323 is the last SSC 50 mm aperture collider dipole magnet built at Fermilab by Fermilab staff. Its assembly followed the baseline as stated in the 50 mm Collider Dipole Magnet Requirements and Specifications Book (the "Yellow Book.") This report will summarize the production history of DCA323 and any relevant discrepancies from the baseline design. Particular attention will be made to describe anomalies that are judged to have a possible influence on performance. Note that this magnet had relatively few problems throughout production. More detailed information on all assembly and testing steps may be found in the Specific Data Summary Traveler (SDST) and the Fermilab Advanced Magnet R&D Group's technical note series. Notes in the latter series are indicated by the prefix TS-SSC.

Coil winding and Inspection

An Apical tape insulating system was used on this magnet. The required 0.030" shim for the lower inner coil was made up of a 0.010" and a 0.020" shim. The wedge shim for the inner middle and upper wedges was too wide. The shim was modified from 0.485 +/- 0.002 -> 0.480 +/- 0.002 to prevent insulation damage [1]. An incorrect wedge shim was used in outer coil 15M-50-2029. The wedge was replaced and the coil was recured [2].

Collared Coil Assembly

No problems were encountered.

cc: B. Jensen, J. Kuzminski, P. Mazur

Yoking and Shell Welding

No problems were encountered.

Final Assembly and Cryostatting

The electrical wiring configuration was changed [3]. Reference drawings 0102-ME-292803 Rev. B and 0102-MB-292794. The coil failed the 20 MΩ to ground test. This was caused by solder flux contamination of the G-10 lower-inner lead insulators. The lead insulators were replaced. The cryostat of DCA323 was instrumented with various thermometers to map the temperature profile of the cryostat and with strain gauges to monitor stresses induced on the support system during thermal cycling and cryostat transport [4]. As was common on many magnets, tabs were welded to the 20K and 80K shields to control shld shape and minimize thermal shorts between the 80K shield and the 20K MLI blanket [5]. Sensor #5 (CGR-1-1000, SN# C12189 on the ASST board is out of calibration range. Its status will be evaluated on the MTF test stand. If the sensor is found to be bad it will be replaced after the magnet is shipped to Dallas [6].

References

1. DR493
2. DR502
3. DR508, DR541
4. DR548
5. DR553, DR554
6. DR556

SSC Short Models Built at Fermilab

R. Bossert 12-17-92
TS-SSC 92-088

Magnet No.	F1	F2	F3	F4	F5
Bore Diameter	4cm	4cm	4cm	4cm	4cm
Cross Section	NC9	NC9	NC9	NC9	NC9
Cable Insulation - Inner Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.
Cable Insulation - Outer Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.
Wedge Insulation	Same as coils.	Same as coils.	Same as coils.	Same as coils.	Same as coils.
Inner to Outer Coil Splice	External	External	External	External	External
End Part Configuration	LBL designed "empirically determined"	LBL designed "empirically determined"	LBL designed "empirically determined"	Ellipse on cylinder/grouped	Ellipse on cylinder/grouped on ret. end. LBL empirically determined on lead end.
End Part Matl.	G-10	G-10	G-10	N/A	G-10
End Key Design	N/A	All 1 piece	All 1 piece	N/A	All 1 piece
Collaring shims	Yes	Yes	Yes	Yes	No
Collaring shoe	Yes	Yes	Yes	Yes	Yes
Strip HeaterType	None	Tevatron Style, handmade by FNAL technicians.	Tevatron Style, handmade by FNAL technicians.	None	Tevatron Style, handmade by FNAL technicians.
Coil Strain Gauges	LBL design	LBL design	See "notes" column below.	None	Beam Gauges
Collar Matl.	7075-T6 Aluminum	7075-T6 Aluminum	7075-T6 Aluminum	7075-T6 Aluminum	7075-T6 Aluminum
End Can	Aluminum/Clamp style	Aluminum/Clamp style	Aluminum/Clamp style	Aluminum/Clamp style	Aluminum/Clamp style
Yoke Split	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Shell Strain Gauge	N/A	Yes	None	N/A	
Harmonic Measurements Available	None	None	Cold only	None	Cold only.
Cold Tested	No	No	Yes	No	Yes
Notes	Potted and sectioned after assembly.	Magnet developed a coil-to-ground short during final hipot. It was never cold tested.	This magnet had both the LBL design "hotel" gauges and the BNL design "beam gauges" similar to those ultimately used in the ASST dipoles. Response of the two types of gauges were compared during testing.	Used for construction studies only, particularly concerning the coil insulation system. It was potted and sectioned after assembly. Study of this magnet resulted in the elimination of the collaring shims and shoes in later magnet designs.	First magnet which did not include collaring shims. Extra kapton was added in many places to take the space otherwise occupied by the shims.

SSC Short Models Built at Fermilab

Magnet No.	DS0307	DS0308	DSO309	DS0310	DS0311	DS0312
Bore Diameter	4cm	4cm	4cm	4cm	4cm	4cm
Cross Section	C358	C358	C358	C358	C358	C358
Cable Insulation - Inner Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.
Cable Insulation - Outer Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.
Wedge Insulation	Same as coils.	Same as coils.	Same as coils.	Same as coils.	Same as coils.	Same as coils.
Inner to Outer Coil Splice	External	External	External	External	External	External
End Part Configuration	Ellipse on cylinder/individually determined.	Ellipse on cylinder/individually determined.	Ellipse on cylinder/individually determined.	Ellipse on cylinder/individually determined.	Ellipse on cylinder/individually determined.	Ellipse on cylinder/individually determined on inner coil. Developable surface/grouped on outer coil.
End Part Matl.	G-10	G-10	G-10	G-10	G-10	G-10
End Key Design	All 1 piece	All 1 piece	All 1 piece	All 1 piece	All 1 piece	All 1 piece
Collaring shims	No	No	No	No	No	No
Collaring shoe	No	No	No	No	No	No
Strip HeaterType	None	None	None?	None?	None?	None
Coil Strain Gauges	Beam Gauges	Beam Gauges	Beam Gauges	Beam Gauges	Beam Gauges	Beam Gauges
Collar Matl.	304 stainless	304 stainless	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40
End Can	304 Stainless/Collet style	304 Stainless/Collet style	304 Stainless/Collet style	304 Stainless/Collet style	304 Stainless/Collet style	304 Stainless/Collet style
Yoke Split	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Shell Strain Gauge	None			Yes		
Harmonic Measurements Available	Collared Coil Only No Cold	Yoked Warm Cold	Collared Warm Yoked Warm Cold	Collared Warm Yoked Warm Cold	Collared Warm Yoked Warm Cold	None No Cold
Cold Tested	No	Yes	Yes	Yes	Yes	No
Notes	Used for construction studies only, particularly collaring studies.	304 stainless collars were used because of the unavailability of Nitronic 40. No performance problems resulted.	Built and tested to ensure viability of 40mm design.	Built and tested to ensure viability of 40mm design.	Built and tested to ensure viability of 40mm design.	Used for collaring studies only.

SSC Short Models Built at Fermilab

Magnet No.	DS0313	DS0314	DS0315
Bore Diameter	4cm	4cm	4cm
Cross Section	C358	C358	C358
Cable Insulation - Inner Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.
Cable Insulation - Outer Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.
Wedge Insulation	Same as coils.	Same as coils.	Same as coils.
Inner to Outer Coil Splice	External	External	External
End Part Configuration	Ellipse on cylinder/individually determined on inner coil. Developable surface/grouped on outer coil.	Ellipse on cylinder/individually determined on inner coil. Developable surface/grouped on outer coil.	Ellipse on cylinder/individually determined on inner coil. Developable surface/grouped on outer coil.
End Part Matl.	G-10	G-10	G-10/Spaulding RTM
End Key Design	All 1 piece	All 1 piece	All 1 piece
Collaring shims	No	No	No
Collaring shoe	No	No	No
Strip HeaterType	Four strip heaters. SSC style in two quadrants (II and IV), BNL style in quadrant I and Tevatron style hand made at FNAL in quadrant III.	None	Six strip heaters. SSCL style?
Coil Strain Gauges	Beam Gauges	Beam Gauges	Beam Gauges
Collar Matl.	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40
End Can	304 Stainless/Collet style	304 Stainless/Collet style	304 Stainless/Collet style
Yoke Split	Vertical	Vertical	Vertical
Shell Strain Gauge			
Harmonic Measurements Available	Yoked Warm Cold	Collared Warm Yoke Warm 1,2 Cold	Collared Warm Yoked Warm, Cold
Cold Tested	Yes.	Yes.	Yes.
Notes	First in a series of three magnets built for the purpose of testing the vertically split yoke design.	Second in a series of three magnets built for the purpose of testing the vertically split yoke design. Did not perform well in first cold test. Was successfully rebuilt to repair an instability in the end key area.	Third in a series of three magnets built for the purpose of testing the vertically split yoke design.

SSC Short Models Built at Fermilab

Magnet No.	DSA320	DSA321	DSA322	DSA323	DSA324	DSA326
Bore Diameter	5cm	5cm	5cm	5cm	5cm	5cm
Cross Section	W6733	W6733	W6733	W6733	W6733	W6733
Cable Insulation - Inner Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.
Cable Insulation - Outer Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.
Wedge Insulation	Same as coils.	Same as coils.	Same as coils.	Same as coils.	Same as coils.	Same as coils.
Inner to Outer Coil Splice	External	External	External	External	External	External
End Part Configuration	N/A	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"
End Part Matl.	N/A	G-10	G-10	G-10	G-10	G-10
End Key Design	N/A	All 1 piece	All 1 piece	All 1 piece	All 1 piece	All 1 piece
Collaring shims	No	No	No	No	No	No
Collaring shoe	Yes	Yes	Yes	Yes	Yes	Yes
Strip HeaterType	None	None	None	4 Lars single element. 2 - 10 inches long "SSC2EA" and 2 - 24 inches long "SSC2"	4 Lars single element "SSC2"	4 Lars single element. 2 - "SSC1" and 2 - "SSC2"
Coil Strain Gauges	Beam Gauges	Beam Gauges	Beam Gauges	Beam Gauges	Beam Gauges	Beam Gauges
Collar Matl.	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40
End Can	N/A	304 Stainless/Collet style	304 Stainless/Collet style	304 Stainless/Collet style	6061-T6 Aluminum on both assy/Collet style	6061-T6 Aluminum/Collet style
Yoke Split	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Shell Strain Gauge					Yes	
Harmonic Measurements Available	Collared Warm No Cold	Collared Warm Yoked Warm, Cold	Collared Warm No Cold	Collared Warm Yoked Warm, Cold	Collared Warm Yoked Warm, Cold	Collared Warm Yoked Warm, Cold
Cold Tested	No	Yes.	No	Yes.	Yes.	Yes.
Notes	Used for construction practice. Potted and sectioned after completion.	First cold tested 5cm. magnet. Collared with "non standard tooling" because regular collaring tooling was not yet available.	Used for collaring studies.	This magnet was disassembled, reassembled and retested several times. This was done in an attempt to understand the reason for anomolous quenches on the down ramp. This phenomenon did not occur on any other magnet.	This magnet was disassembled after cold testing , reassembled and retested.	This magnet was potted and sectioned after cold testing.

SSC Short Models Built at Fermilab

Magnet No.	DSA327	DSA328	DSA329	DSA330	DSA331	DSA332
Bore Diameter	5cm	5cm	5cm	5cm	5cm	5cm
Cross Section	W6733	W6733	W6733	W6733 modified with wedge shims. .015 added to upper and middle inner coil wedge, .03 added to lower inner coil wedge and .010 added to outer coil wedge.	W6733 modified with wedge shims. .015 added to upper and middle inner coil wedge, .03 added to lower inner coil wedge and .010 added to outer coil wedge.	W6733 modified with wedge shims. .015 added to upper and middle inner coil wedge, .03 added to lower inner coil wedge and .010 added to outer coil wedge.
Cable Insulation - Inner Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	One layer of .001 x .375 bare kapton H film with 50% overlap surrounded by one layer of .001 x .375 kapton LT film with 2290 on one side butt lap.	One layer of .001 x .375 Apical NP with Cryorad adhesive on one side with 67% overlap.	One layer of .001 x .375 bare kapton H film with 50% overlap surrounded by one layer of .001 x .375 kapton LT film with 2290 on one side butt lap.
Cable Insulation - Outer Coils	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	1 layer of .001 x .375 kapton H film with 50% overlap surrounded by one layer of .004 x .375 glass tape with 90% coverage.	One layer of .001 x .375 bare kapton H film with 50% overlap surrounded by one layer of .001 x .375 kapton LT film with 2290 on one side with 50% overlap.	One layer of .001 x .375 Apical NP with 50% overlap with Cryorad adhesive on one side surrounded by one layer of .001 x .375 Apical NP with 50% overlap with Cryorad adhesive on one side.	One layer of .001 x .375 bare kapton H film with 50% overlap surrounded by one layer of .001 x .375 kapton LT film with 2290 on one side with 50% overlap.
Wedge Insulation	Same as coils.	2 layers of .001 x .375 bare kapton 50% overlap.	2 layers of .001 x .375 bare kapton 50% overlap.	Same as coils.	Same as coils.	Same as coils.
Inner to Outer Coil Splice	External	External	External	External	External	External
End Part Configuration	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"
End Part Matl.	G-10	G-10	G-10	G-10/ Spaulding RTM	G-10	G-10
End Key Design	All 1 piece	All 1 piece	All 1 piece	One piece on inner coils. Two piece on outer coils.	All 2 piece.	All 2 piece
Collaring shims	No	No	No	No	No	No
Collaring shoe	Yes	Yes	Yes	Yes	Yes	Yes
Strip HeaterType	None	4 Lars "CH023 rev. NC" (Eight heaters, two per quadrant)	None	None	None	2 Lars single element, 2 Sheldahl single element
Coil Strain Gauges	Beam Gauges	Beam Gauges	Beam Gauges	Beam Gauges	Beam Gauges	Beam Gauges
Collar Matl.	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40
End Can	6061-T6 Aluminum/Collet style	6061-T6 Aluminum/Collet style	6061-T6 Aluminum/Collet style	6061-T6 Aluminum/Collet style	6061-T6 Aluminum/Collet style	6061-T6 Aluminum/Collet style
Yoke Split	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical
Shell Strain Gauge						
Harmonic Measurements Available	Collared Warm Yoked Warm, No Cold	Collared Warm Yoked Warm, Cold	Collared Warm Yoked Warm, Cold	Collared Warm Yoked Warm, Cold	Collared Warm Yoked Warm, Cold	Collared Warm Yoked Warm, Cold
Cold Tested	No.	Yes.	Yes.	Yes.	Yes.	Yes.
Notes	Used for collaring studies.	This magnet was potted and sectioned after cold testing.	Performed well on 1st cold test. Magnet was then rebuilt with 2 piece keys on inner coils in an attempt to replicate the low current quenches in some long magnets.	First of 2 magnets built to test the insulation system used in long magnets DCA320 and DCA321. Also used to test the Spaulding/RTM engineering parts.	First magnet built to test Apical/Cryorad insulation system. Inner coil system is similar to FNAL's Low Beta Quads.	Second of 2 magnets built to test the insulation system used in long magnets DCA320 and DCA321.

SSC Short Models Built at Fermilab

Magnet No.	DSA333	DSA334	DSI340	DSI341	DSI342
Bore Diameter	5cm	5cm	5cm	5cm	5cm
Cross Section	W6733 modified with wedge shims. .015 added to upper and middle inner coil wedge, .03 added to lower inner coil wedge and .010 added to outer coil wedge.	W6733 modified with wedge shims. .015 added to upper and middle inner coil wedge, .03 added to lower inner coil wedge and .010 added to outer coil wedge.	W6733	W6733 modified with wedge shims. .015 added to upper and middle inner coil wedge, .03 added to lower inner coil wedge and .010 added to outer coil wedge.	W6733 modified with wedge shims. .015 added to upper and middle inner coil wedge, .03 added to lower inner coil wedge and .010 added to outer coil wedge.
Cable Insulation - Inner Coils	One layer of .001 x .375 bare kapton H film with 50% overlap surrounded by one layer of .001 x .375 kapton LT film with 2290 on both sides butt lap.	One layer of .001 x .375 bare Apical NP with 50% overlap surrounded by one layer of .001 x .375 Apical NP with Cryorad adhesive on both sides butt lap.	One layer of .001 x .375 bare kapton H film with 67% overlap surrounded by on layer of .001 x .375 kapton H film with 2290 on one side with 50% overlap.	One layer of .001 x .375 bare kapton H film with 50% overlap surrounded by one layer of .001 x .375 kapton LT film with 2290 on one side butt lap.	One layer of .001 x .375 bare Apical NP with 50% overlap surrounded by one layer of .001 x .375 Apical NP with Cryorad adhesive on both sides butt lap.
Cable Insulation - Outer Coils	One layer of .001 x .375 bare kapton H film with 50% overlap surrounded by one layer of .001 x .375 kapton LT film with 2290 on both sides with 50% overlap.	One layer of .001 x .375 bare Apical NP with 50% overlap surrounded by one layer of .001 x .375 Apical NP with Cryorad adhesive on both sides with 50% overlap.	One layer of .001 x .375 bare kapton H film with 67% overlap surrounded by one layer of .001 x .375 kapton H film with 2290 on one side with 50% overlap	One layer of .001 x .375 bare kapton H film with 50% overlap surrounded by one layer of .001 x .375 kapton LT film with 2290 on one side with 50% overlap.	One layer of .001 x .375 bare Apical NP with 50% overlap surrounded by one layer of .001 x .375 Apical NP with Cryorad adhesive on both sides with 50% overlap.
Wedge Insulation	Same as coils.	Same as coils.	Same as coils.	Same as coils.	Same as coils.
Inner to Outer Coil Splice	External	External	External	External	External
End Part Configuration	Developable surface/grouped. "Iteration #1"	Developable surface/grouped. "Iteration #1"	N/A	N/A	N/A
End Part Matl.	G-10/ Torlon	G-10/ Cryorad RTM	N/A	N/A	N/A
End Key Design	All two piece except return end inner coils are one piece	All 2 piece except return end outer coils are one piece.	N/A	N/A	N/A
Collaring shims	No	No	No	No	No
Collaring shoe	Yes	Yes	Yes	Yes	Yes
Strip HeaterType	2 Sheldahl single element, 2 Sheldahl triple element. Coil insulation modified to move strip heaters one layer closer to outer coils	All Sheldahl single element. 2 standard .001 thick, 2 .0005 thick. Coil insulation modified to move strip heaters one layer closer to outer coils.	None	None	None
Coil Strain Gauges	Beam Gauges	Beam Gauges	None.	None.	None.
Collar Matl.	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40	90K Nitronic 40
End Can	6061-T6 Aluminum/Collet style	6061-T6 Aluminum/Collet style			
Yoke Split	Vertical	Vertical	N/A	N/A	N/A
Shell Strain Gauge				N/A	N/A
Harmonic Measurements Available	Collared Warm Yoked Warm, Cold	Collared Warm Yoked Warm, Cold	None	None	None
Cold Tested	Yes.	Yes.	No.	No.	No.
Notes	Magnet built to test kapton insulation system with adhesive on both sides as well as Torlon end parts.	Magnet built to test Apical/Cryorad insulation system with adhesive on both sides as well as Cryorad /RTM end parts.	Magnet used for insulation studies only. Potted and sectioned after assembly.	Magnet used for insulation studies only. Potted and sectioned after assembly.	Magnet used for insulation studies only. Potted and sectioned after assembly.