



Fermilab

TS-SSC 90-106

12/17/90

To: John Carson
From: Jim Strait
Subject: Collaring Shims for DC0304 with New Coils

The Kapton collaring shims for DC0304 with replacement inner coils[1] should be 17 mils in the inner coil and 10 mils in the outer coil. These thicknesses include the adhesive and represent the thickness that would be measured with a flat anvil micrometer. The thickness, with and without adhesive, of each of the layers used to make the shim packages should be measured and recorded in the traveller. The Kapton should be placed on the outer surface of the ground wrap insulation and should be extended as far as possible into the region of the G-10 end keys. The ends of the different Kapton layers used to make the pole shim should be staggered by about 1/8 inch.

The inner (new) and outer coils in DC0304 are, on the average, 1.5 mils (at 10 kpsi) and 0.8 mils (at 8 kpsi) larger than those in DC0303, the last successfully keyed magnet. The average prestress in DC0303 following keying[2] was 8.6 kpsi in the inner coil and 8.5 kpsi in the outer coil. The shims specified above will make the sum of the inner coil plus shim be 1.5 mils larger and the sum of the outer coil plus shims 1.6 mils smaller than in DC0303[3]. The expected prestress in DC0304 with the replacement coils should be on the order of 2 kpsi larger in the inner and 2 kpsi smaller in the outer coil than in DC0303.

The new inner coils for DC0304 are, on the average, 1.2 mils (at 10 kpsi) larger than the old but the same shims are specified here. Therefore the press gaps may be 1-2 mils larger than on the previous (unsuccessful) pressing.

Footnotes

- | | | | | |
|-----|-------------|-----------|-------------|----------|
| [1] | Upper Inner | 17M-1013 | Upper Outer | 17M-2005 |
| | Lower Inner | 17M-1014R | Lower Outer | 17M-2007 |
- [2] J. Strait, Keying of DC0303: Strain Gage Data, TS-SSC 90-079, 10/5/90.
- [3] J. Strait, DC0303 Collaring Shims, TS-SSC 90-074, 10/16/90.

cc: Rodger Bossert
Steve Delchamps
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----- Magnet Number DC0304 -----

Collar Parameters:

Undefl. Cavity Oversize (nom.) = 2.00 mils
 d(cavity_in)/d(stress_in) = 0.28 mils/kpsi
 d(cavity_in)/d(stress_out) = 0.28 mils/kpsi
 d(cavity_out)/d(stress_in) = 0.28 mils/kpsi
 d(cavity_out)/d(stress_out) = 0.28 mils/kpsi
 Ground wrap thickness (inner) = 30.00 mils
 Ground wrap thickness (outer) = 53.00 mils
 Compressive modulus of Kapton = 300.00 kpsi
 Compressive modulus of shims = 300.00 kpsi
 Collar cavity "error" (inner) = 13.40 mils
 Collar cavity "error" (outer) = 7.30 mils
 Friction fudge factor (inner) = 1.00
 Friction fudge factor (outer) = 1.00

Average Coil Parameters:

Undefl. Inner Coil Oversize = 10.57 mils
 Undefl. Outer Coil Oversize = 7.54 mils
 d(coil_in)/(dstress_in) = -0.53 mils/kpsi
 d(coil_out)/(dstress_out) = -0.44 mils/kpsi

shim (mils)		prestress (kpsi)	
inner	outer	inner	outer
17.0	10.0	10.9	5.6
17.0	8.0	11.6	3.2
17.0	12.0	10.3	7.9
17.0	10.0	10.9	5.6
19.0	10.0	13.1	4.9
15.0	10.0	8.7	6.2

from linear fits:

	DC0303	DC0304	DC0304(OLD)
(INNER) 11 kpsi	3.3	4.7 (+1.4)	3.6 (0.3)
10	3.8	5.3 (+1.5)	4.1 (0.3)
8	4.8	6.3 (1.5)	5.0 (0.2)
(OUTER) 10	1.9	3.1 (1.2)	*
8	3.2	4.0 (0.8)	
6	4.5	4.9 (0.4)	

* SAME OUTER COILS

----- Magnet Number DC0304 -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_inner_17m1014R.dat

Coil # 17M-1014R Coil type: INNER Coil location: Lower Inner
COIL # 17M-1014R COIL TYPE: INNER DATE: 12/10/90

MEAS. BY: SANDERS

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0074	0.0063	0.0052	0.0040
sigma	0.0015	0.0013	0.0015	0.0024
minimum	0.0041	0.0035	0.0020	-0.0118
maximum	0.0098	0.0082	0.0073	0.0428
range	0.0057	0.0047	0.0053	0.0544
#points	20	20	20	446

Fit $avg = avg_0 + (dl/dsig) * stress$
 $avg_0 = 10.8$ $dl/dsig = -0.56$

----- Magnet Number DC0304 -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_inner_17m1013.dat

Coil # 17M-1013 Coil type: INNER Coil location: Upper Inner
COIL # 17M-1013 COIL TYPE: INNER DATE: 11/12/90

MEAS. BY: SANDERS

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0072	0.0064	0.0054	0.0041
sigma	0.0018	0.0014	0.0014	0.0012
minimum	0.0028	0.0030	0.0019	0.0007
maximum	0.0095	0.0083	0.0072	0.0070
range	0.0069	0.0053	0.0053	0.0063
#points	20	20	20	446

Fit $avg = avg_0 + (dl/dsig) * stress$
 $avg_0 = 10.3$ $dl/dsig = -0.51$

----- Magnet Number DC0304 -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_outer_17m2007.dat

Coil # 17M2007

Coil type: OUTER

Coil location: Lower Outer

COIL #

17M2007

COIL TYPE:

OUTER DATE:

MEAS. BY:

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0059	0.0048	0.0038	0.0029
sigma	0.0008	0.0007	0.0008	0.0008
minimum	0.0047	0.0038	0.0025	0.0012
maximum	0.0074	0.0060	0.0051	0.0049
range	0.0027	0.0024	0.0026	0.0037
#points	20	20	20	108

Fit $avg = avg_0 + (dl/dsig) * stress$

$avg_0 = 8.7$ $dl/dsig = -0.50$

----- Magnet Number DC0304 -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_outer_17m2005.dat

Coil # 17M2005

Coil type: OUTER

Coil location: Upper Outer

COIL #

17M2005

COIL TYPE:

OUTER DATE:

3/30/90 MEAS. BY:

SANDERS

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0042	0.0033	0.0025	0.0019
sigma	0.0009	0.0009	0.0009	0.0010
minimum	0.0026	0.0015	0.0008	-0.0023
maximum	0.0056	0.0045	0.0039	0.0048
range	0.0030	0.0030	0.0031	0.0069
#points	20	20	20	108

Fit $avg = avg_0 + (dl/dsig) * stress$

$avg_0 = 6.3$ $dl/dsig = -0.38$

----- Magnet Number DC0303 -----

Collar Parameters:

Undefl. Cavity Oversize (nom.) = 2.00 mils
 d(cavity_in)/d(stress_in) = 0.28 mils/kpsi
 d(cavity_in)/d(stress_out) = 0.28 mils/kpsi
 d(cavity_out)/d(stress_in) = 0.28 mils/kpsi
 d(cavity_out)/d(stress_out) = 0.28 mils/kpsi
 Ground wrap thickness (inner) = 30.00 mils
 Ground wrap thickness (outer) = 53.00 mils
 Compressive modulus of Kapton = 300.00 kpsi
 Compressive modulus of shims = 300.00 kpsi
 Collar cavity "error" (inner) = 13.40 mils
 Collar cavity "error" (outer) = 7.30 mils
 Friction fudge factor (inner) = 1.00
 Friction fudge factor (outer) = 1.00

Average Coil Parameters:

Undefl. Inner Coil Oversize = 8.91 mils
 Undefl. Outer Coil Oversize = 8.23 mils
 d(coil_in)/(dstress_in) = -0.51 mils/kpsi
 d(coil_out)/(dstress_out) = -0.63 mils/kpsi

shim (mils)		prestress (kpsi)	
inner	outer	inner	outer
17.0	13.0	8.6	8.4
17.0	11.0	9.2	8.6
17.0	15.0	8.1	10.3
19.0	13.0	10.8	7.9
15.0	13.0	6.4	9.0
13.0	12.0	4.4	8.6
14.0	12.0	5.5	8.3
15.0	12.0	6.7	8.1
14.0	11.0	5.8	7.4
14.0	13.0	5.3	9.3
11.0	11.0	2.4	8.3
15.0	13.0	6.4	9.0

----- Magnet Number DC0303 -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_inner_17m1010.dat

Coil # 17M-1010 Coil type: INNER Coil location: Lower Inner

COIL # 17M-1010 COIL TYPE: INNER DATE:

MEAS. BY:

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0054	0.0048	0.0035	0.0025
sigma	0.0014	0.0008	0.0008	0.0011
minimum	0.0005	0.0029	0.0020	-0.0005
maximum	0.0074	0.0062	0.0051	0.0124
range	0.0069	0.0033	0.0031	0.0129
#points	20	20	20	441

Fit $avg = avg_0 + (dl/dsig) * stress$
 $avg_0 = 8.4$ $dl/dsig = -0.48$

----- Magnet Number DC0303 -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_inner_17m1012.dat

Coil # 17M-1012 Coil type: INNER Coil location: Upper Inner

COIL # 17M-1012 COIL TYPE: INNER DATE: 8/7/90

MEAS. BY: SANDERS

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0063	0.0052	0.0040	0.0032
sigma	0.0010	0.0009	0.0009	0.0010
minimum	0.0047	0.0038	0.0028	0.0001
maximum	0.0084	0.0071	0.0061	0.0124
range	0.0037	0.0035	0.0033	0.0123
#points	20	20	20	444

Fit $avg = avg_0 + (dl/dsig) * stress$
 $avg_0 = 9.4$ $dl/dsig = -0.53$

----- Magnet Number DC0303 -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_outer_17m2012.dat

Coil # 17M-2012

Coil type: OUTER

Coil location: Lower Outer

COIL #

17M-2012

COIL TYPE:

OUTER

DATE:

8/30/90 MEAS. BY: PHILLIPS

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0042	0.0027	0.0014	0.0004
sigma	0.0009	0.0010	0.0010	0.0009
minimum	0.0025	0.0008	-0.0002	-0.0047
maximum	0.0059	0.0044	0.0032	0.0034
range	0.0034	0.0036	0.0034	0.0081
#points	20	20	20	444

Fit $avg = avg_0 + (dl/dsig) * stress$

$avg_0 = 7.9$ $dl/dsig = -0.64$

----- Magnet Number DC0303 -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_outer_17m2011.dat

Coil # 17M-2011

Coil type: OUTER

Coil location: Upper Outer

COIL #

17M-2011

COIL TYPE:

OUTER

DATE:

8/17/90 MEAS. BY:

SANDERS

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0048	0.0037	0.0023	0.0012
sigma	0.0009	0.0012	0.0008	0.0008
minimum	0.0035	0.0021	0.0009	-0.0017
maximum	0.0084	0.0075	0.0038	0.0030
range	0.0029	0.0054	0.0029	0.0047
#points	20	20	20	443

Fit $avg = avg_0 + (dl/dsig) * stress$

$avg_0 = 8.5$ $dl/dsig = -0.61$

----- Magnet Number DC0304 (OLD) -----

Collar Parameters:

Uninfl. Cavity Oversize (nom.) = 2.00 mils
d(cavity_in)/d(stress_in) = 0.28 mils/kpsi
d(cavity_in)/d(stress_out) = 0.28 mils/kpsi
d(cavity_out)/d(stress_in) = 0.28 mils/kpsi
d(cavity_out)/d(stress_out) = 0.28 mils/kpsi
Ground wrap thickness (inner) = 30.00 mils
Ground wrap thickness (outer) = 53.00 mils
Compressive modulus of Kapton = 300.00 kpsi
Compressive modulus of shims = 300.00 kpsi
Collar cavity "error" (inner) = 13.40 mils
Collar cavity "error" (outer) = 7.30 mils
Friction fudge factor (inner) = 1.00
Friction fudge factor (outer) = 1.00

Average Coil Parameters:

Uninfl. Inner Coil Oversize = 8.87 mils
Uninfl. Outer Coil Oversize = 7.54 mils
d(coil_in)/(dstress_in) = -0.48 mils/kpsi
d(coil_out)/(dstress_out) = -0.44 mils/kpsi

shim (mils)		prestress (kpsi)	
inner	outer	inner	outer
17.0	10.0	9.8	6.0
17.0	8.0	10.4	3.6
17.0	12.0	8.9	8.3
19.0	10.0	12.0	5.3
15.0	10.0	7.3	6.7

----- Magnet Number DC0304(OLD) -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_inner_17m1008.dat

Coil # 17M-1008 Coil type: INNER Coil location: Lower Inner

COIL # 17M-1008 COIL TYPE: INNER DATE:

MEAS. BY:

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0065	0.0058	0.0047	0.0042
sigma	0.0016	0.0007	0.0007	0.0010
minimum	0.0004	0.0048	0.0035	-0.0019
maximum	0.0085	0.0075	0.0065	0.0089
range	0.0081	0.0027	0.0030	0.0108
#points	20	20	20	443

Fit $avg = avg_0 + (dl/dsig) * stress$

$avg_0 = 9.0$ $dl/dsig = -0.40$

----- Magnet Number DC0304(OLD) -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_inner_17m1011R.dat

Coil # 17M-1011R Coil type: INNER Coil location: Upper Inner

COIL # 17M-1011R COIL TYPE: INNER DATE: 10/27/90

MEAS. BY: SANDERS

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0052	0.0048	0.0037	0.0019
sigma	0.0010	0.0011	0.0023	0.0011
minimum	0.0029	0.0026	0.0012	-0.0015
maximum	0.0072	0.0074	0.0128	0.0114
range	0.0043	0.0048	0.0116	0.0129
#points	20	20	20	446

Fit $avg = avg_0 + (dl/dsig) * stress$

$avg_0 = 8.8$ $dl/dsig = -0.55$

----- Magnet Number DC0304(OLD) -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_outer_17m2007.dat

Coil # 17M2007 Coil type: OUTER Coil location: Lower Outer

COIL # 17M2007 COIL TYPE: OUTER DATE:

MEAS. BY:

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0059	0.0046	0.0038	0.0029
sigma	0.0008	0.0007	0.0008	0.0008
minimum	0.0047	0.0036	0.0025	0.0012
maximum	0.0074	0.0060	0.0051	0.0049
range	0.0027	0.0024	0.0026	0.0037
#points	20	20	20	108

Fit $avg = avg_0 + (dl/dsig) * stress$

$avg_0 = 8.7$ $dl/dsig = -0.50$

----- Magnet Number DC0304(OLD) -----

Data file: ts_ssc_prj\$root:[ts_ssc_prj.data.coil_size]ssc_outer_17m2005.dat

Coil # 17M2005 Coil type: OUTER Coil location: Upper Outer

COIL # 17M2005 COIL TYPE: OUTER DATE: 3/30/90

MEAS. BY:

SANDERS

coil stress (kpsi)	6.0	8.0	10.0	12.0
average size (mils)	0.0042	0.0033	0.0025	0.0019
sigma	0.0009	0.0009	0.0009	0.0010
minimum	0.0026	0.0015	0.0008	-0.0023
maximum	0.0056	0.0045	0.0039	0.0046
range	0.0030	0.0030	0.0031	0.0069
#points	20	20	20	108

Fit $avg = avg_0 + (dl/dsig) * stress$

$avg_0 = 6.3$ $dl/dsig = -0.38$