

Choosing Collaring "Shims" for DS0309

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3/29/90

DS0307 and DS0308 preloads are substantially lower than predicted from the measured coil sizes, the measured collar dimensions and the elastic properties of the coils and collars. The current speculation is that this is because the effective collar cavity size is larger than expected either because of collar dimension errors or because the kapton ground insulation is flowing into the die break of the collars. This is suggested by the large sextupole moment in DS0308. (See e-mail 3/28/90 "DS0307 and DS0308 preloads explained?") To explain both the observed preloads and the observed sextupole require that the collar cavity be too large by 7 mils per quadrant in both the inner and outer coils. (This is in addition to the 1.5 mils that the outer coil cavity is oversize according to Cordax measurements.) Additional kapton must be added to the ground insulation to take up the extra space.

To achieve the desired prestress (10 kpsi) the coils must be 7.4 mils larger than the design size at 10 kpsi. (This is the amount by which the collars deflect under a load of 10 kpsi.) If the coils are smaller than this and additional amount of kapton must be added to build the coils up to the desired dimension. The amount of kapton is based on the average size of the series of coils cured under identical conditions. The inner coils for DS0309 (#108 and #109) were cured with the nominal cavity size. I had data from 6 coils cured under these conditions: 104 - 109. At 10 kpsi the average size of these coils ranges between +2.7 mils and + 7.0 mils with an average of +4.3 mils. Thus 3 mils of kapton is required to bring the coil package to the desired size. The outer coils were wound with the mold cavity increased by 8 mils from its nominal size. I had data from 3 coils molded under these conditions: 308 - 310. At 10 kpsi the average size of these coils ranges from +7.0 to +7.8 mils with an average of +7.5 mils. Thus no additional kapton is required for these coils.

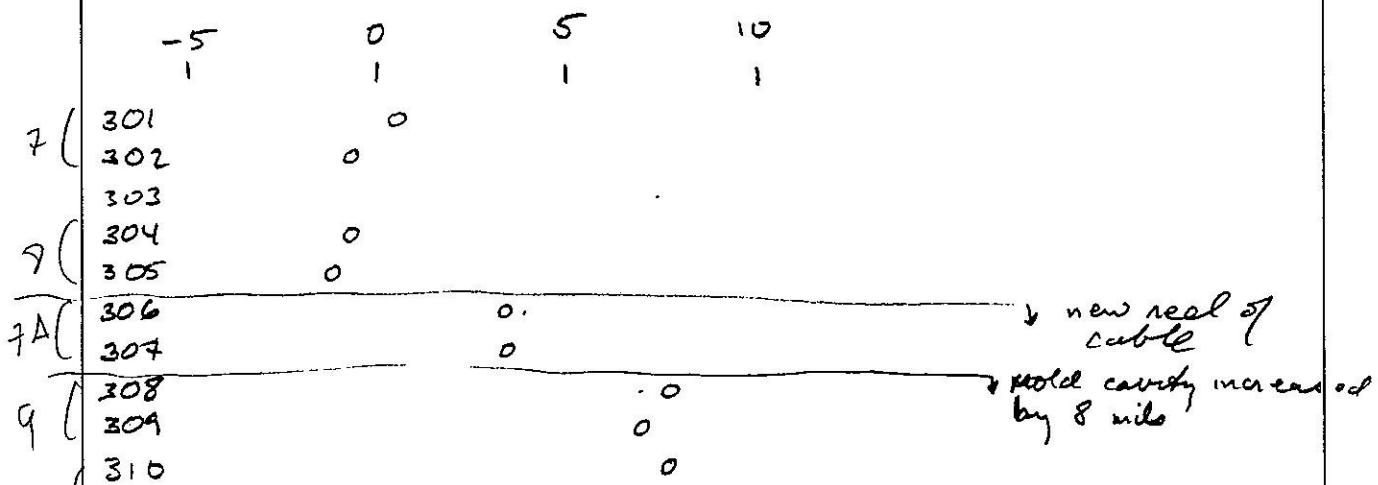
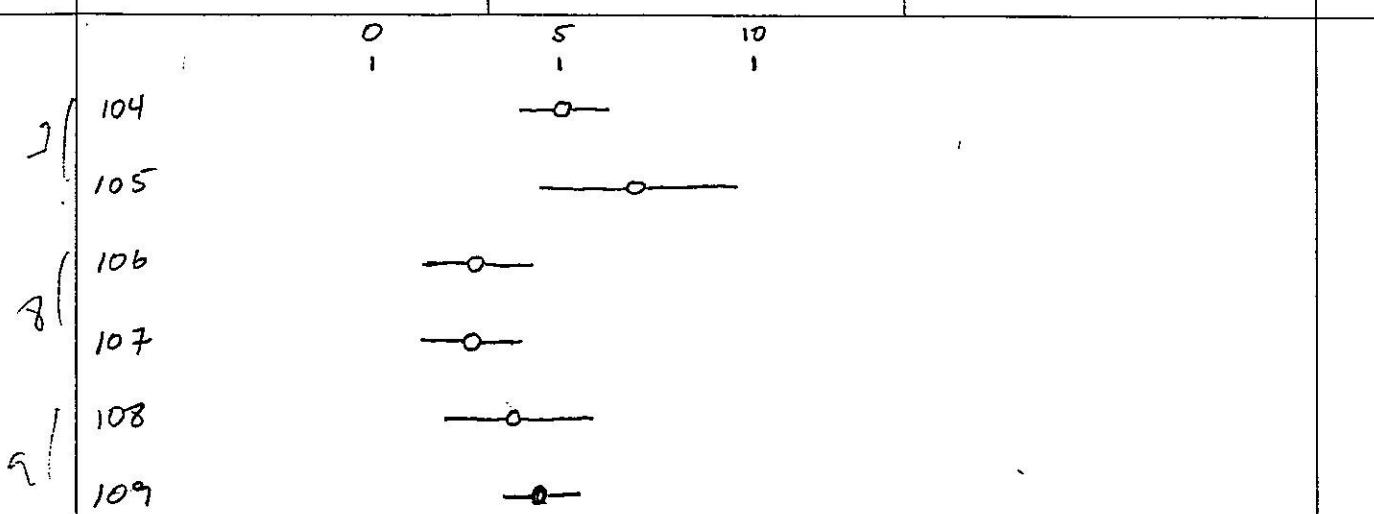
The total azimuthal kapton "shim" amount is $7 + 3 = 10$ mils for the inner coil and $7 + 1.5 + 0 = 8.5$ mils for the outer. The outer coil shim was rounded down to 8 mils because this will tend to increase the inner coil stress at the expense of a small loss of outer coil stress.

Attached are

- 1) A table of the average coil sizes on which this calculation was based,
- 2) The spread sheet used to calculate the expected DS0309 coil prestress and collar deflection using the specified shims and collar dimensions,
- 3) A graph of the expected prestress and collar deflection as a function of position along the coil, and
- 4) A copy of the memo instructing Imre Gonczy of the chosen shim thicknesses.

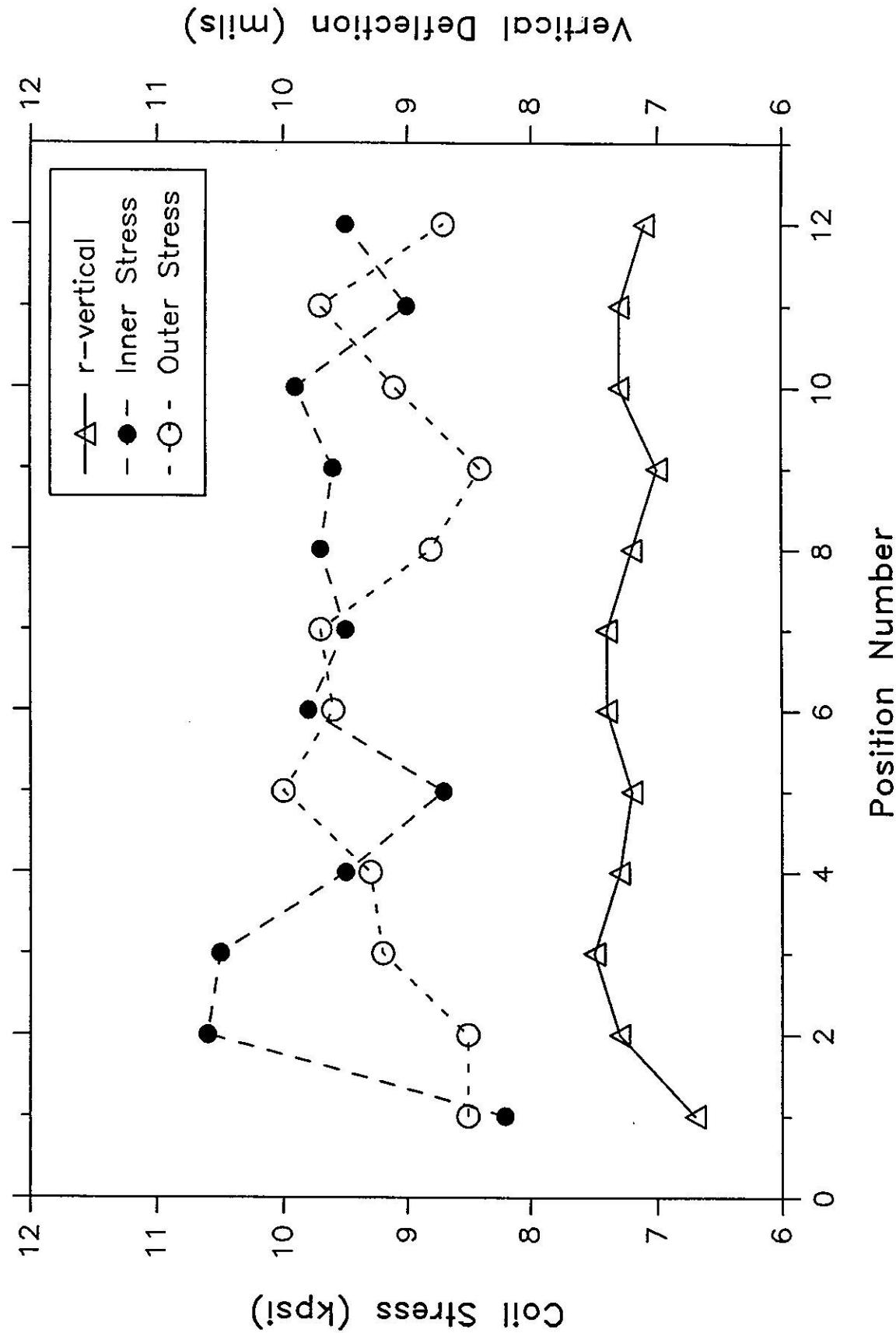
<u>INNER</u>		② 10 kpsi			12 kpsi		
COIL #	MAGNET	$\langle \text{size} \rangle$	Γ	Range	$\langle \text{size} \rangle$	Γ	Range
108	DS0309	+3.9	1.4	4.0	2.9	1.2	5.0
109	DS0309	4.4	0.8	1.8	3.1	1.2	4.5
104	DS0307(A)	5.1	0.7	2.2	4.0	0.9	3.7
105	DS0307(A)	7.0	2.2	5.3	5.3	2.0	7.3
106	DS0308	2.8	1.1	3.2	1.7	1.1	4.2
107	DS0308	<u>2.7</u>	1.2	3.0	1.5	1.5	5.7
		4.3 ± 0.7					

<u>OUTER</u>		10 kpsi			12 kpsi		
COIL #	Magnet	$\langle \text{size} \rangle$	Γ	Range	$\langle \text{size} \rangle$	Γ	Range
308	DS0309	7.8	0.7	2.1	6.6	0.7	2.4
309	DS0309	+8.0	0.8	2.1	6.9	0.9	3.6
310	DS0310	7.7	0.9	2.6	6.7	0.5	2.5
301	DS0307	0.5	1.3	3.5	-1.7	1.3	5.0
302	DS0307	-0.7	1.6	3.9	-1.0	1.2	4.1
304	DS0308	-0.7	1.4	3.6	-1.5	1.3	4.2
305	DS0308	-1.1	1.0	3.4			
306	DS0307A	3.4	0.9	2.4	2.5	0.8	2.8
307	DS0307A	3.5	1.0	2.2	2.6	0.9	3.4



DS0309 Prestress and Collar Deflections

Predicted from Coil Size Measurements



Coil #	108	Mag	1/4 loc	Inner	Date	2/8/90
Pos #	6000	8000	10000	12000		
	coil master					
1	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0181	0.0151
2 up	0.0272	0.0192	0.0249	0.0180	0.0225	0.0166
2 dn	0.0246	0.0165	0.0228	0.0173	0.0212	0.0163
3	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0206	0.0151
4	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0198	0.0151
5 up	0.0266	0.0192	0.0242	0.0180	0.0220	0.0168
5 dn	0.0241	0.0185	0.0222	0.0175	0.0207	0.0166
6	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0192	0.0151
7	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0184	0.0151
8 up	0.0255	0.0192	0.0281	0.0190	0.0207	0.0166
8 dn	0.0280	0.0185	0.0206	0.0175	0.0195	0.0184
9	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0179	0.0151
10	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0196	0.0151
11 up	0.0259	0.0192	0.0284	0.0180	0.0211	0.0168
11 dn	0.0288	0.0185	0.0215	0.0175	0.0200	0.0164
12	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0184	0.0151
13	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0171	0.0151
14 up	0.0286	0.0192	0.0214	0.0180	0.0192	0.0166
14 dn	0.0218	0.0185	0.0196	0.0175	0.0181	0.0164
15	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0177	0.0151
16	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0178	0.0151
17 up	0.0243	0.0192	0.0216	0.0180	0.0195	0.0164
17 dn	0.0216	0.0185	0.0198	0.0175	0.0184	0.0164
18	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0175	0.0151
19	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0176	0.0151
20 up	0.0226	0.0192	0.0207	0.0180	0.0184	0.0166
20 dn	0.0210	0.0185	0.0190	0.0175	0.0176	0.0164
21	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0170	0.0151
22	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0178	0.0151
23 up	0.0250	0.0192	0.0226	0.0180	0.0202	0.0166
23 dn	0.0225	0.0185	0.0206	0.0175	0.0190	0.0164
24	Xxxxxxx	Xxxxxxx	Xxxxxxx	Xxxxxxx	0.0155	0.0151
Pos #	6000	8000	10000	12000	S(X=0)	str
	coil-master	coil-master	coil-master	coil-master	(collar)	avg str (inner)
1				0.0080	24.17	6.7
2 up	0.0080	0.0069	0.0059	0.0047	27.52	7.8
2 dn	0.0061	0.0055	0.0049	Xxxxxxx	Xxxxxxx	12.8 10.6
3				0.0054	29.04	7.5
4				0.0042	26.50	7.8
5 up	0.0074	0.0062	0.0054	0.0042	26.80	7.2
5 dn	0.0056	0.0047	0.0048	Xxxxxxx	Xxxxxxx	11.9 8.7
6				0.0041	26.40	7.4
7				0.0038	24.78	7.4
8 up	0.0068	0.0051	0.0041	0.0031	24.37	7.2
8 dn	0.0045	0.0081	0.0081	Xxxxxxx	Xxxxxxx	9.8 9.7
9				0.0028	28.76	7.0
10				0.0035	25.18	7.8
11 up	0.0067	0.0056	0.0045	0.0038	25.79	7.3
11 dn	0.0048	0.0040	0.0036	Xxxxxxx	Xxxxxxx	11.1 9.0
12				0.0038	24.78	7.1
13				0.0020	22.14	7.7
14 up	0.0044	0.0084	0.0026	0.0018	21.74	7.0
14 dn	0.0028	0.0021	0.0017	Xxxxxxx	Xxxxxxx	
15				0.0026	23.36	8.5
16				0.0027	23.56	9.8
17 up	0.0061	0.0086	0.0029	0.0021	22.34	7.8
17 dn	0.0031	0.0028	0.0020	Xxxxxxx	Xxxxxxx	
18				0.0024	22.95	8.0
19				0.0025	23.15	8.1
20 up	0.0084	0.0027	0.0018	0.0010	20.11	5.4
20 dn	0.0025	0.0015	0.0012	Xxxxxxx	Xxxxxxx	
21				0.0019	21.94	7.2
22				0.0022	22.56	7.8
23 up	0.0058	0.0046	0.0036	0.0026	23.36	8.5
23 dn	0.0040	0.0081	0.0026	Xxxxxxx	Xxxxxxx	
24				0.0004	18.90	5.4

UP:

< 2-11>	0.0071	0.0060	0.0050	0.0040
sig	0.0008	0.0008	0.0008	0.0007
range	0.0017	0.0018	0.0018	0.0016

<14-23>

0.0047	0.0086	0.0027	0.0019
sig	0.0010	0.0008	0.0007
range	0.0024	0.0019	0.0016

< 2-23>

0.0059	0.0048	0.0089	0.0029
sig	0.0015	0.0015	0.0014
range	0.0046	0.0042	0.0041

DOWN:

< 2-11>

0.0058	0.0048	0.0040
sig	0.0007	0.0010
range	0.0016	0.0024

<14-23>

0.0081	0.0028	0.0019
sig	0.0006	0.0007
range	0.0015	0.0016

< 2-23>

0.0042	0.0083	0.0029
sig	0.0018	0.0014
range	0.0036	0.0040

ALL

<1-24>

0.0029	
sig	0.0012
range	0.0050

Coil #	109	Magf	DS0309	1/4 loc	INNER	Date	2/8/90
Pos #	6000	8000	10000	12000			
	coil master						
1	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0177	0.0151
2 up	0.0268	0.0192	0.0245	0.0180	0.0220	0.0166	0.0155
2 dn	0.0241	0.0184	0.0225	0.0178	0.0210	0.0162	0.0155
3	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0205	0.0151
4	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0189	0.0151
5 up	0.0251	0.0192	0.0227	0.0180	0.0205	0.0162	0.0150
5 dn	0.0226	0.0184	0.0210	0.0178	0.0194	0.0162	0.0150
6	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0177	0.0151
7	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0172	0.0151
8 up	0.0245	0.0189	0.0222	0.0178	0.0200	0.0164	0.0149
8 dn	0.0219	0.0183	0.0202	0.0171	0.0185	0.0161	0.0149
9	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0159	0.0150
10	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0182	0.0150
11 up	0.0239	0.0191	0.0220	0.0177	0.0202	0.0163	0.0150
11 dn	0.0225	0.0182	0.0208	0.0171	0.0198	0.0161	0.0150
12	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0185	0.0150
13	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0175	0.0151
14 up	0.0245	0.0191	0.0224	0.0177	0.0202	0.0163	0.0151
14 dn	0.0222	0.0182	0.0204	0.0171	0.0190	0.0161	0.0151
15	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0188	0.0151
16	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0201	0.0151
17 up	0.0272	0.0191	0.0246	0.0177	0.0222	0.0163	0.0151
17 dn	0.0245	0.0182	0.0226	0.0171	0.0210	0.0161	0.0151
18	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0197	0.0151
19	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0192	0.0151
20 up	0.0250	0.0191	0.0225	0.0177	0.0202	0.0168	0.0150
20 dn	0.0224	0.0182	0.0207	0.0171	0.0191	0.0161	0.0150
21	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0171	0.0150
22	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0170	0.0150
23 up	0.0252	0.0191	0.0230	0.0177	0.0207	0.0161	0.0150
23 dn	0.0225	0.0182	0.0208	0.0171	0.0194	0.0161	0.0150
24	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX	0.0151	0.0150
Pos #	6000	8000	10000	12000	S(X=0)	str	
	coil master	coil master	coil master	coil master			
1	0.0076	0.0065	0.0054	0.0044	0.0026	22.98	9.9
2 up	0.0067	0.0052	0.0048	XXXXXXXXXX	XXXXXXXXXX	26.45	12.1
2 dn	0.0067	0.0052	0.0048	XXXXXXXXXX	XXXXXXXXXX		
3					0.0064	28.40	18.7
4					0.0088	25.28	11.1
5 up	0.0069	0.0047	0.0089	0.0029	0.0028	23.52	9.4
5 dn	0.0042	0.0037	0.0082	XXXXXXXXXX	XXXXXXXXXX		
6					0.0028	22.98	8.4
7					0.0021	21.98	7.8
8 up	0.0056	0.0048	0.0036	0.0024	0.0024	22.54	8.5
8 dn	0.0066	0.0061	0.0024	XXXXXXXXXX	XXXXXXXXXX		
9					0.0009	19.81	5.9
10					0.0032	24.10	9.8
11 up	0.0048	0.0048	0.0039	0.0029	0.0029	23.52	9.4
11 dn	0.0048	0.0087	0.0082	XXXXXXXXXX	XXXXXXXXXX		
12					0.0035	24.89	10.8
13					0.0025	22.74	8.9
14 up	0.0054	0.0047	0.0089	0.0025	0.0025	22.74	8.6
14 dn	0.0040	0.0038	0.0029	XXXXXXXXXX	XXXXXXXXXX		
15					0.0087	25.08	10.8
16					0.0050	27.62	13.9
17 up	0.0081	0.0069	0.0069	0.0046	0.0046	26.84	12.8
17 dn	0.0068	0.0066	0.0049	XXXXXXXXXX	XXXXXXXXXX		
18					0.0041	25.86	11.8
19					0.0041	25.86	11.8
20 up	0.0069	0.0048	0.0089	0.0022	0.0022	22.15	8.0
20 dn	0.0042	0.0036	0.0030	XXXXXXXXXX	XXXXXXXXXX		
21					0.0021	21.98	7.8
22					0.0020	21.76	7.1
23 up	0.0061	0.0058	0.0044	0.0027	0.0027	28.18	8.8
23 dn	0.0048	0.0037	0.0082	XXXXXXXXXX	XXXXXXXXXX		
24					0.0011	20.00	7.0
UP:							
< 2-11>	0.0080	0.0060	0.0042	0.0082			
sig	0.0012	0.0010	0.0008	0.0009			
range	0.0028	0.0022	0.0018	0.0020			
<14-28>	0.0064	0.0064	0.0045	0.0080			
sig	0.0012	0.0010	0.0009	0.0011			
range	0.0027	0.0022	0.0020	0.0024			
< 2-28>	0.0062	0.0062	0.0044	0.0081			
sig	0.0011	0.0010	0.0008	0.0009			
range	0.0028	0.0022	0.0018	0.0022			
DOWN:							
< 2-11>	0.0045	0.0089	0.0084				
sig	0.0009	0.0009	0.0010				
range	0.0021	0.0021	0.0024				
<14-28>	0.0047	0.0040	0.0035				
sig	0.0011	0.0010	0.0009				
range	0.0028	0.0022	0.0020				
< 2-28>	0.0046	0.0040	0.0085				
sig	0.0009	0.0009	0.0009				
range	0.0021	0.0021	0.0024				

ALL
(1-24) 0.0081
sig 0.0012
range 0.0048

Cell#	809	Mag#	DS0809	1/4 los OUTER	Date	8-16-90
Pos #	6000	8000	10000	12000		
	coil master	coil master	coil master	coil master		
1	Xxxxxxxxxxxxxxx				1.0080	0.9975
2 up	1.0092	1.0000	1.0071	0.9992	1.0058	0.9965
2 dn	1.0071	0.9970	1.0054	0.9989	1.0042	0.9988
3	Xxxxxxxxxxxxxxx				1.0084	0.9975
4	Xxxxxxxxxxxxxxx				1.0080	0.9975
5 up	1.0108	1.0000	1.0062	0.9920	1.0065	0.9965
5 dn	1.0081	0.9997	1.0065	0.9989	1.0054	0.9988
6	Xxxxxxxxxxxxxxx				1.0047	0.9975
7	Xxxxxxxxxxxxxxx				1.0086	0.9975
8 up	1.0091	1.0000	1.0071	0.9991	1.0058	0.9984
8 dn	1.0071	0.9996	1.0055	0.9988	1.0045	0.9982
9	Xxxxxxxxxxxxxxx				1.0045	0.9975
10	Xxxxxxxxxxxxxxx				1.0050	0.9975
11 up	1.0108	1.0000	1.0088	0.9991	1.0067	0.9984
11 dn	1.0082	0.9996	1.0066	0.9988	1.0055	0.9982
12	Xxxxxxxxxxxxxxx				1.0089	0.9975
13	Xxxxxxxxxxxxxxx				1.0021	0.9975
14 up	1.0086	1.0000	1.0066	0.9991	1.0047	0.9984
14 dn	1.0065	0.9996	1.0048	0.9988	1.0087	0.9982
15	Xxxxxxxxxxxxxxx				1.0029	0.9975
16	Xxxxxxxxxxxxxxx				1.0014	0.9975
17 up	1.0085	1.0000	1.0065	0.9991	1.0046	0.9984
17 dn	1.0065	0.9996	1.0048	0.9988	1.0087	0.9982
18	Xxxxxxxxxxxxxxx				1.0088	0.9975
19	Xxxxxxxxxxxxxxx				1.0085	0.9975
20 up	1.0086	1.0000	1.0071	0.9991	1.0064	0.9984
20 dn	1.0072	0.9996	1.0057	0.9988	1.0044	0.9982
21	Xxxxxxxxxxxxxxx				1.0088	0.9975
22	Xxxxxxxxxxxxxxx				1.0088	0.9975
23 up	1.0085	1.0000	1.0067	0.9991	1.0049	0.9984
23 dn	1.0067	0.9996	1.0050	0.9988	1.0088	0.9982
24	Xxxxxxxxxxxxxxx				1.0024	0.9975
Pos #	6000	8000	10000	12000	S(X=0)	str avg str (outer)
	coil master	coil master	coil master	coil master		
1					0.0055	20.26
2 up	0.0092	0.0079	0.0068	0.0058	20.75	9.2 8.5
2 dn	0.0101	0.0065	0.0059	Xxxxxxxxxx	Xxxxxxxxxx	
3					0.0059	20.92
4					0.0055	20.26
5 up	0.0108	0.0162	0.0080	0.0071	22.90	8.5 9.2
5 dn	0.0084	0.0076	0.0071	Xxxxxxxxxx	Xxxxxxxxxx	
6					0.0072	23.06
7					0.0061	21.25
8 up	0.0091	0.0080	0.0071	0.0062	21.41	9.5 8.8
8 dn	0.0075	0.0067	0.0068	Xxxxxxxxxx	Xxxxxxxxxx	
9					0.0070	22.78
10					0.0075	23.56
11 up	0.0108	0.0092	0.0068	0.0078	23.28	11.5 9.1
11 dn	0.0086	0.0079	0.0073	Xxxxxxxxxx	Xxxxxxxxxx	
12					0.0064	21.74
13					0.0046	18.77
14 up	0.0086	0.0075	0.0068	0.0054	20.09	8.1
14 dn	0.0069	0.0060	0.0056	Xxxxxxxxxx	Xxxxxxxxxx	
15					0.0068	19.92
16					0.0039	17.61
17 up	0.0085	0.0074	0.0062	0.0054	20.09	8.2
17 dn	0.0069	0.0060	0.0055	Xxxxxxxxxx	Xxxxxxxxxx	
18					0.0061	21.25
19					0.0060	21.08
20 up	0.0086	0.0080	0.0070	0.0060	21.08	9.1
20 dn	0.0076	0.0069	0.0062	Xxxxxxxxxx	Xxxxxxxxxx	
21					0.0058	20.75
22					0.0068	21.58
23 up	0.0085	0.0076	0.0065	0.0064	20.09	8.0
23 dn	0.0071	0.0062	0.0056	Xxxxxxxxxx	Xxxxxxxxxx	
24					0.0049	19.26
UP:						
< 2-11>	0.0097	0.0108	0.0076	0.0066		
sig	0.0007	0.0040	0.0007	0.0007		
range	0.0012	0.0068	0.0015	0.0015		
<14-23>	0.0086	0.0076	0.0065	0.0066		
sig	0.0001	0.0008	0.0004	0.0008		
range	0.0001	0.0006	0.0006	0.0006		
< 2-23>	0.0091	0.0090	0.0070	0.0061		
sig	0.0008	0.0080	0.0008	0.0008		
range	0.0018	0.0098	0.0021	0.0019		
DOWN:						
< 2-11>	0.0087	0.0072	0.0067	0.0067		
sig	0.0011	0.0006	0.0007	0.0007		
range	0.0026	0.0018	0.0014	0.0014		
<14-23>	0.0071	0.0068	0.0057	0.0057		
sig	0.0008	0.0004	0.0003	0.0003		
range	0.0007	0.0009	0.0007	0.0007		
< 2-23>	0.0079	0.0067	0.0062	0.0062		
sig	0.0011	0.0007	0.0007	0.0007		
range	0.0082	0.0018	0.0018	0.0018		
					ALL	
					<1-24>	0.0069
					sig	0.0009
					range	0.0036

Cailg 308 Magf DS0809 1/4 loc DUTER Date 8-18-90
 Pos # 6000 8000 10000 12000
 coil meter coil meter coil meter coil meter
 1 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0038 0.9975
 2 up 1.0105 1.0000 1.0064 0.9991 1.0066 0.9984 1.0045 0.9974
 2 dn 1.0081 0.9995 1.0066 0.9988 1.0054 0.9981 1.0045 0.9974
 3 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0043 0.9974
 4 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0043 0.9974
 5 up 1.0100 1.0000 1.0074 0.9991 1.0062 0.9984 1.0042 0.9974
 5 dn 1.0080 0.9995 1.0064 0.9988 1.0052 0.9981 1.0042 0.9974
 6 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0048 0.9974
 7 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0044 0.9974
 8 up 1.0090 1.0000 1.0070 0.9991 1.0051 0.9984 1.0043 0.9974
 8 dn 1.0071 0.9995 1.0056 0.9988 1.0043 0.9981 1.0038 0.9974
 9 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0042 0.9974
 10 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0043 0.9974
 11 up 1.0011 1.0000 1.0088 0.9991 1.0071 0.9984 1.0051 0.9975
 11 dn 1.0081 0.9997 1.0072 0.9986 1.0060 0.9982 1.0051 0.9975
 12 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0050 0.9975
 13 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0027 0.9975
 14 up 1.0096 1.0000 1.0074 0.9991 1.0057 0.9988 1.0046 0.9975
 14 dn 1.0074 0.9997 1.0057 0.9989 1.0048 0.9982 1.0048 0.9975
 15 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0034 0.9975
 16 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0037 0.9975
 17 up 1.0105 1.0000 1.0079 0.9991 1.0061 0.9984 1.0042 0.9975
 17 dn 1.0077 0.9997 1.0062 0.9986 1.0050 0.9982 1.0042 0.9975
 18 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0049 0.9975
 19 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0044 0.9975
 20 up 1.0105 1.0000 1.0068 0.9991 1.0067 0.9988 1.0046 0.9975
 20 dn 1.0084 0.9997 1.0067 0.9989 1.0065 0.9982 1.0046 0.9975
 21 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0045 0.9975
 22 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0047 0.9975
 23 up 1.0090 1.0000 1.0070 0.9991 1.0052 0.9984 1.0038 0.9975
 23 dn 1.0069 0.9997 1.0056 0.9989 1.0040 0.9981 1.0038 0.9975
 24 XXXXXXXXXXXXXXXXXXXXXXXXXX 1.0029 0.9975

Pos # 6000 8000 10000 12000 S(x=0) str
 coil-meter coil-meter coil-meter coil-meter
 1 0.0058 24.94 8.7
 2 up 0.0105 0.0092 0.0082 0.0071 28.12 10.2
 2 dn 0.0086 0.0078 0.0072 XXXXXXXX XXXXXXXX XXXXXXXX
 3 0.0069 27.63 9.8
 4 0.0069 27.63 9.9
 5 up 0.0100 0.0088 0.0078 0.0068 27.39 9.7
 5 dn 0.0086 0.0076 0.0071 XXXXXXXX XXXXXXXX XXXXXXXX
 6 0.0069 27.63 9.5
 7 0.0070 27.87 9.9
 8 up 0.0090 0.0079 0.0067 0.0059 25.19 7.7
 8 dn 0.0076 0.0068 0.0062 XXXXXXXX XXXXXXXX XXXXXXXX
 9 0.0058 24.94 7.7
 10 0.0069 27.63 9.8
 11 up 0.0011 0.0097 0.0088 0.0078 XXXXXXXX XXXXXXXX XXXXXXXX
 11 dn 0.0092 0.0088 0.0078 0.0075 29.10 11.8
 12 0.0062 28.48 8.1
 13 0.0062 25.68 8.0
 14 up 0.0096 0.0088 0.0074 0.0061 25.19 7.8
 14 dn 0.0077 0.0068 0.0064 XXXXXXXX XXXXXXXX XXXXXXXX
 15 0.0059 25.19 7.8
 16 0.0062 25.92 8.7
 17 up 0.0100 0.0088 0.0078 0.0067 27.14 9.6
 17 dn 0.0080 0.0078 0.0068 XXXXXXXX XXXXXXXX XXXXXXXX
 18 0.0074 26.85 10.9
 19 0.0069 27.63 9.5
 20 up 0.0105 0.0092 0.0084 0.0071 26.12 10.4
 20 dn 0.0087 0.0078 0.0078 XXXXXXXX XXXXXXXX XXXXXXXX
 21 0.0070 27.87 10.2
 22 0.0072 28.36 10.0
 23 up 0.0090 0.0079 0.0069 0.0058 24.94 7.0
 23 dn 0.0072 0.0068 0.0066 XXXXXXXX XXXXXXXX XXXXXXXX
 24 0.0054 28.97 7.7

UP:
 < 2-11> 0.0077 0.0089 0.0079 0.0089 26.865 9.20967
 sig 0.0044 0.0008 0.0009 0.0007
 range 0.0094 0.0018 0.0021 0.0017

<14-28> 0.0096 0.0086 0.0076 0.0084
 sig 0.0007 0.0006 0.0006 0.0006
 range 0.0015 0.0018 0.0015 0.0018

< 2-28> 0.0087 0.0087 0.0078 0.0066
 sig 0.0081 0.0006 0.0007 0.0006
 range 0.0094 0.0018 0.0021 0.0018

DOWN:
 < 2-11> 0.0085 0.0076 0.0071
 sig 0.0007 0.0006 0.0007
 range 0.0016 0.0015 0.0016

<14-28> 0.0079 0.0071 0.0066
 sig 0.0006 0.0006 0.0006
 range 0.0015 0.0015 0.0015

< 2-28> 0.0082 0.0078 0.0068
 sig 0.0007 0.0007 0.0007
 range 0.0020 0.0020 0.0020

All
<1-24> 0.0066
sig 0.0007
range 0.0024

```

Coil# 108 Mag# DS0809 1/4 loc INNER Date 2/8/90
Shim: 0.010 Collar error: -0.007
stress 6000 8000 10000 12000
size 0.0089 0.0078 0.0069 0.0059

linear fit stress = f(size)
 $\sigma(0) = 23.91 \text{ kpsi}$   $d\sigma/dx = -2.028 \text{ kpsi/mil}$ 
collared stress 9.2

Coil# 109 Mag# DS0809 1/4 loc INNER Date 2/8/90
Shim: 0.010 Collar error: -0.007
stress 6000 8000 10000 12000
size 0.0092 0.0082 0.0074 0.0061

linear fit stress = f(size)
 $\sigma(0) = 24.06 \text{ kpsi}$   $d\sigma/dx = -1.962 \text{ kpsi/mil}$ 
collared stress 9.9

Coil# 809 Mag# DS0809 1/4 loc OUTER Date 8-18-90
Shim: 0.008 Collar error: -0.0065
stress 6000 8000 10000 12000
size 0.0086 0.0085 0.0085 0.0066

linear fit stress = f(size)
 $\sigma(0) = 21.06 \text{ kpsi}$   $d\sigma/dx = -1.651 \text{ kpsi/mil}$ 
collared stress 9.1

Coil# 808 Mag# DS0809 1/4 loc OUTER Date 8-18-90
Shim: 0.008 Collar error: -0.0065
stress 6000 8000 10000 12000
size 0.0082 0.0082 0.0078 0.0061

linear fit stress = f(size)
 $\sigma(0) = 27.22 \text{ kpsi}$   $d\sigma/dx = -2.442 \text{ kpsi/mil}$ 
collared stress 9.5

Collar compliance (in terms of average inner+outer coil stress)
Collar vertical offset (individual collar away from magnet center)
 $dx/d\sigma = 0.56 \text{ mils/kpsi}$   $x(0) = 2 \text{ mils}$ 

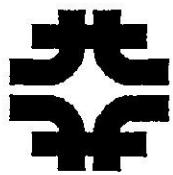
Coil average stress = f(collars deflection)
 $\sigma(0) = -8.57 \text{ kpsi}$   $d\sigma/dx = 1.796 \text{ kpsi/mil}$ 

Average of 4 coils:
 $\sigma(0) = 24.06 \text{ kpsi}$   $d\sigma/dx = -2.02 \text{ kpsi/mil}$ 

Collar vertical radius:
7.3 mils

Average inner stress = 9.5
Average outer stress = 9.3
Average coil stress = 9.4

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Fermilab

3/29/90

To: Imre Gonczy
From: Jim Strait *js*
Subject: DS0309 Collaring Shims

In addition to the normal ground insulation 10 mils of Kapton should be added to the pole faces of the inner coil and 8 mils to the outer coil. This Kapton should be extended as far into the end as possible. The Kapton will consist of two layers whose ends should be staggered by about 1/2".

cc: Rodger Bossert
John Carson
Wayne Koska