

Jan-7-1991

EFFECT OF MANUFACTURING ERRORS ON HARMONICS
IN 5cm SSC MAGNETS

Jim,

Enclosed are computer runs showing the effect of manufacturing errors on harmonic coefficients. The results are from Alan Riddiford's code with some modifications to account for errors.

Each run has a comment section for that run followed by the type of errors used in the coil geometry. The first table shows the skew and normal field component for inner and outer coils (in KGauss) and the ratios of these component to the principal moment in units of 10^{-4} . The second table shows the total coefficients and the ratios.

Third table contains the dipole field variation as a function of X along the x-axis. The errors are all taken to be 10 mils and the insulation is taken as part of the cable cross section.

Note that the current density is assumed to change for cables under compression, i.e., the cross section area is reduced for these cables. The wedge sizes are also changed slightly in each case.

Akbar Mokhtarani

5 cm SSC magnet, new coil geometry, No

(-SNOW2E)

7-JAN-9 08:46:45

NSEGS = 45 SEGMENTS; DIPOLE SYMMETRY
 RIRON = 6.7820 CM
 RIRON = 2.6701 INCHES
 RREF = 1.0000 CM
 RREF = 0.3937 INCHES
 ROFF = 0.0000 CM
 ROFF = 0.0000 INCHES
 CURRENT = 5.0000 KAMPS/TURN
 SEGMENT AREA = 0.0319 SQINS
 CDENSE = 150.7836 KAMPS/SQIN
 FACTOR = 2.4302 KGAUSS*INCH
 SEGMENT AREA = 0.0249 SQINS
 CDENSE = 200.5953 KAMPS/SQIN
 FACTOR = 3.1092 KGAUSS*RREF

 comments for this run:
 original cross section

Multipole coefficients for inner and outer coils
 higher coefficients (n>1) are in 10**-4

pole	a(in)	b(in)	a(out)	b(out)	a(in)/b1	b(in)/b1	a(out)/b1	b(out)/b1
1	0.00000000	22.4493844	0.00000000	29.7782447	0.00000000	4298.3732473	0.00000000	5701.6267527
2	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
3	0.00000000	-0.2820305	0.00000000	0.2832381	0.00000000	-54.0002515	0.00000000	54.2314762
4	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
5	0.00000000	0.0153110	0.00000000	-0.0150151	0.00000000	2.9315998	0.00000000	-2.8749305
6	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
7	0.00000000	-0.0000452	0.00000000	-0.0000810	0.00000000	-0.0088483	0.00000000	-0.0155033
8	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
9	0.00000000	0.0001722	0.00000000	0.0000393	0.00000000	0.0329717	0.00000000	0.0075249

Multipole coefficients (total). Skew, Normal, ratios

1	0.00000000	52.227829081	0.000	10000.000
2	0.00000000	0.000000000	0.000	0.000
3	0.00000000	0.001207632	0.000	0.231
4	0.00000000	0.000000000	0.000	0.000
5	0.00000000	0.000295989	0.000	0.057
6	0.00000000	0.000000000	0.000	0.000
7	0.00000000	-0.000126138	0.000	-0.024
8	0.00000000	0.000000000	0.000	0.000
9	0.00000000	0.000211505	0.000	0.040

	RREF	units	cm	BOTH	AIR	IRON	RATIO	DIFF
X =	0.000	0.000		52.227629081	39.587295473	12.680333608	10000.000	0.000
X =	0.100	0.100		52.227641187	39.587137994	12.680503193	10000.002	0.002
X =	0.200	0.200		52.227677852	39.586666117	12.681011735	10000.009	0.009
X =	0.300	0.300		52.227740087	39.586881485	12.681858602	10000.021	0.021
X =	0.400	0.400		52.227829501	39.584786763	12.683042738	10000.038	0.038
X =	0.500	0.500		52.227948342	39.583385677	12.684582665	10000.061	0.061
X =	0.600	0.600		52.228099853	39.581683373	12.686416481	10000.090	0.090
X =	0.700	0.700		52.228289236	39.559687375	12.688601861	10000.126	0.126
X =	0.800	0.800		52.228525613	39.557409556	12.671118057	10000.172	0.172
X =	0.900	0.900		52.228825459	39.554869564	12.673955895	10000.229	0.229
X =	1.000	1.000		52.229218049	39.552100271	12.677117778	10000.304	0.304
X =	1.100	1.100		52.229753562	39.549155880	12.680597682	10000.407	0.407
X =	1.200	1.200		52.230514577	39.546123419	12.684391158	10000.552	0.552
X =	1.300	1.300		52.231631760	39.543138425	12.688493334	10000.766	0.766
X =	1.400	1.400		52.233304635	39.540405723	12.692898911	10001.087	1.087
X =	1.500	1.500		52.235828436	39.538226269	12.697602167	10001.570	1.570
X =	1.600	1.600		52.239628088	39.537031132	12.702596956	10002.297	2.297
X =	1.700	1.700		52.245300479	39.537423768	12.707876712	10003.384	3.384
X =	1.800	1.800		52.253688256	39.540231808	12.713434450	10004.985	4.985

X =	1.900	1.900	52.265832463	39.546569693	12.719282769	10007.315	7.315
X =	2.000	2.000	52.283267441	39.557913581	12.725353860	10010.653	10.653
X =	2.100	2.100	52.307889468	39.576189964	12.731699503	10015.367	15.367
X =	2.200	2.200	52.342170714	39.603879633	12.738291081	10021.931	21.931
X =	2.300	2.300	52.389258207	39.644138623	12.745119584	10030.947	30.947
X =	2.478	2.478	52.517934827	39.760084960	12.757849867	10055.585	55.585

5 cm SSC magnet, new coil geometry, No

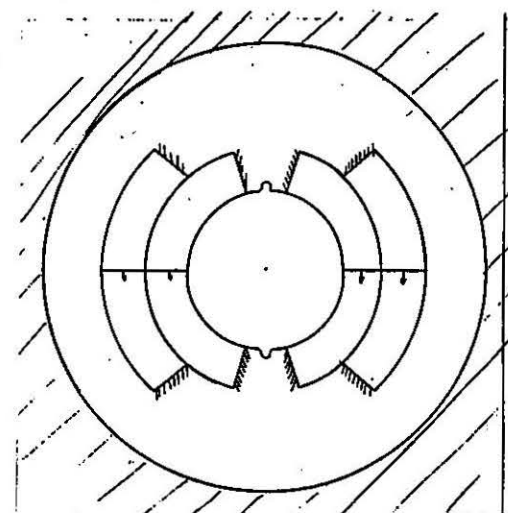
(-SNOW2E)

7-JAN-9 08:47:06

NSEGS = 45 SEGMENTS; DIPOLE SYMMETRY

RIRON =	6.7820	CM
RIRON =	2.6701	INCHES
RREF =	1.0000	CM
RREF =	0.3937	INCHES
ROFF =	0.0000	CM
ROFF =	0.0000	INCHES
CURRENT =	5.0000	KAMPS/TURN
SEGMENT AREA =	0.0319	SQINS
CDENSE =	150.7836	KAMPS/SQIN
FACTOR =	2.4302	KGAUSS*INCH
SEGMENT AREA =	0.0249	SQINS
CDENSE =	200.5953	KAMPS/SQIN
FACTOR =	3.1092	KGAUSS*RREF

 comments for this run:
 run on case 1



 case: 1 L/R symmetric, vertical displacement of the coil mid-plane (poles fixed)
 error= 10.00 mils

 Multipole coefficients for inner and outer coils
 higher coefficients (n>1) are in 10**-4
 pole a(in) b(in) a(out) b(out) a(in)/b1 b(in)/b1 a(out)/b1 b(out)/b1

pole	a(in)	b(in)	a(out)	b(out)	a(in)/b1	b(in)/b1	a(out)/b1	b(out)/b1
1	0.00000000	22.4490609	0.00000000	29.7780579	0.00000000	4298.3533137	0.00000000	5701.6468863
2	0.0418768	0.00000000	0.0292723	0.00000000	0.0181777	0.00000000	5.6048178	0.00000000
3	0.00000000	-0.2821872	0.00000000	0.2831868	0.00000000	-54.0307840	0.00000000	54.2221745
4	0.0018533	0.00000000	0.0012073	0.00000000	0.00000000	0.3548480	0.00000000	0.2311601
5	0.00000000	0.0152895	0.00000000	-0.0150193	0.00000000	2.9275012	0.00000000	-2.8757713
6	0.0001667	0.00000000	0.0000162	0.00000000	0.00319224	0.00000000	0.0034905	0.00000000
7	0.00000000	-0.0000484	0.00000000	-0.0000812	0.00000000	-0.0092704	0.00000000	-0.0155484
8	0.0000348	0.00000000	0.0000011	0.00000000	0.00000000	0.00000000	0.0002098	0.00000000
9	0.00000000	0.0001715	0.00000000	0.0000393	0.00000000	0.0328433	0.00000000	0.0075222

Multipole coefficients (total). Skew, Normal, ratios

1	0.000000000	52.227118867	0.000	10000.000
2	0.071148980	0.000000000	13.623	0.000
3	0.000000000	0.000999577	0.000	0.191
4	0.003060551	0.000000000	0.586	0.000
5	0.000000000	0.000270170	0.000	0.052
6	0.000184951	0.000000000	0.035	0.000
7	0.000000000	-0.000129621	0.000	-0.025
8	0.000035882	0.000000000	0.007	0.000
9	0.000000000	0.000210817	0.000	0.040

	RREF	units	cm	BOTH	AIR	IRON	RATIO	DIFF
X =	0.000	0.000	52.227118867	39.566889364	12.660229502	10000.000	0.000	
X =	0.100	0.100	52.227128889	39.566729848	12.660399041	10000.002	0.002	
X =	0.200	0.200	52.227159274	39.566251828	12.660907446	10000.008	0.008	
X =	0.300	0.300	52.227210936	39.565456852	12.661754084	10000.018	0.018	
X =	0.400	0.400	52.227285323	39.564347423	12.662937899	10000.032	0.032	
X =	0.500	0.500	52.227384445	39.562927033	12.664457412	10000.051	0.051	
X =	0.600	0.600	52.227511222	39.561200501	12.666310721	10000.075	0.075	
X =	0.700	0.700	52.227670431	39.559174930	12.668496501	10000.106	0.106	
X =	0.800	0.800	52.227870648	39.556861647	12.671009001	10000.144	0.144	
X =	0.900	0.900	52.228127647	39.554279599	12.673848048	10000.193	0.193	
X =	1.000	1.000	52.228469810	39.551460768	12.677009042	10000.259	0.259	
X =	1.100	1.100	52.228946185	39.548458226	12.680487958	10000.350	0.350	
X =	1.200	1.200	52.229637911	39.545357583	12.684280348	10000.482	0.482	
X =	1.300	1.300	52.230673829	39.542292494	12.688381335	10000.681	0.681	
X =	1.400	1.400	52.232051154	39.539485535	12.692785820	10000.983	0.983	

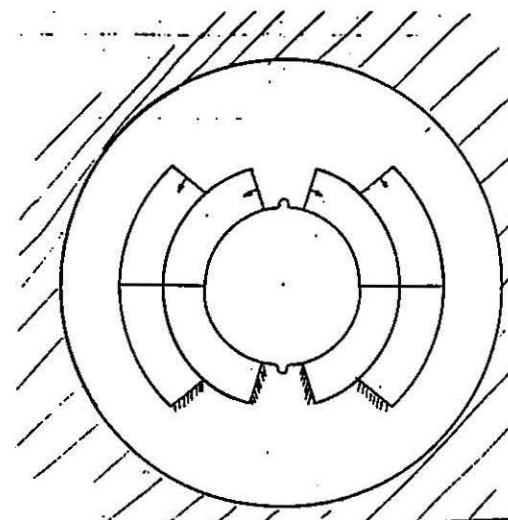
X =	1.500	1.500	52.234682201	39.537174724	12.897487477	10001.444	1.444
X =	1.600	1.600	52.238328222	39.535847462	12.702480760	10002.146	2.146
X =	1.700	1.700	52.243841495	39.536082595	12.707758900	10003.202	3.202
X =	1.800	1.800	52.252016912	39.538702004	12.713314909	10004.767	4.767
X =	1.900	1.900	52.263954370	39.544812986	12.719141384	10007.053	7.053
X =	2.000	2.000	52.281113371	39.555882860	12.725230511	10010.338	10.338
X =	2.100	2.100	52.305401325	39.573827256	12.731574069	10014.989	14.989
X =	2.200	2.200	52.339277120	39.601113684	12.738163436	10021.475	21.475
X =	2.300	2.300	52.385871625	39.640882025	12.744989600	10030.397	30.397
X =	2.478	2.478	52.513388845	39.755673464	12.757715381	10054.813	54.813

5 cm SSC magnet, new coil geometry, No

(-SNOW2E)

7-JAN-9 08:47:28

NSEGS = 45 SEGMENTS; DIPOLE SYMMETRY
 RIRON = 8.7820 CM
 RIRON = 2.6701 INCHES
 RREF = 1.0000 CM
 RREF = 0.3937 INCHES
 ROFF = 0.0000 CM
 ROFF = 0.0000 INCHES
 CURRENT = 5.0000 KAMPS/TURN
 SEGMENT AREA = 0.0319 SQINS
 CDENSE = 156.7836 KAMPS/SQIN
 FACTOR = 2.4302 KGAUSS*INCH
 SEGMENT AREA = 0.0249 SQINS
 CDENSE = 200.5953 KAMPS/SQIN
 FACTOR = 3.1092 KGAUSS*RREF



 comments for this run:
 run on case 2

 case: 2 L/R symmetric, vertical displacement of the pole only (lower pole fixed)
 error= 10.00 mils

Multipole coefficients for inner and outer coils
 higher coefficients (n>1) are in 10**-4

pole	a(in)	b(in)	a(out)	b(out)	a(in)/b1	b(in)/b1	a(out)/b1	b(out)/b1
1	0.00000000	22.4927551	0.00000000	29.8041620	0.00000000	4300.9715195	0.00000000	5699.0284805
2	-0.0035433	0.00000000	0.0072499	0.00000000	-0.6775444	0.00000000	1.3862868	0.00000000
3	0.00000000	-0.2767415	0.00000000	0.2882021	0.00000000	-52.9173715	0.00000000	55.1088054
4	-0.0026122	0.00000000	-0.0009153	0.00000000	-0.4994946	0.00000000	-0.1750107	0.00000000
5	0.00000000	0.0146558	0.00000000	-0.0149703	0.00000000	2.8024288	0.00000000	-2.8625558
6	0.0001762	0.00000000	-0.0000598	0.00000000	0.0336839	0.00000000	-0.0114405	0.00000000
7	0.00000000	0.0000417	0.00000000	-0.0000961	0.00000000	0.0079708	0.00000000	-0.0183737
8	-0.0000429	0.00000000	0.0000021	0.00000000	-0.0082021	0.00000000	0.0004026	0.00000000
9	0.00000000	0.0001542	0.00000000	0.0000393	0.00000000	0.0294810	0.00000000	0.0075126

Multipole coefficients (total). Skew, Normal, ratios

1	0.00000000	52.296917115	0.000	10000.000	
2	0.003706504	0.000000000	0.709	0.000	
3	0.000000000	0.011460524	0.000	2.191	
4	-0.003527455	0.000000000	-0.675	0.000	
5	0.000000000	-0.000314446	0.000	-0.060	
6	0.000118326	0.000000000	0.022	0.000	
7	0.000000000	-0.000054405	0.000	-0.010	
8	-0.000040789	0.000000000	-0.008	0.000	
9	0.000000000	0.000193465	0.000	0.037	

	RREF	units	cm	BOTH	AIR	IRON	RATIO	DIFF
X =	0.000	0.000	52.296917115	39.621351135	12.675585980	10000.000	0.000	
X =	0.100	0.100	52.297031689	39.621292427	12.675739261	10000.022	0.022	
X =	0.200	0.200	52.297375030	39.621116135	12.676258895	10000.088	0.088	
X =	0.300	0.300	52.297945988	39.620821740	12.677124248	10000.197	0.197	
X =	0.400	0.400	52.298742653	39.620408385	12.678334268	10000.349	0.349	
X =	0.500	0.500	52.299762499	39.619875020	12.679887479	10000.544	0.544	
X =	0.600	0.600	52.301002862	39.619220881	12.681781982	10000.781	0.781	
X =	0.700	0.700	52.302462025	39.618448569	12.684015456	10001.060	1.060	
X =	0.800	0.800	52.304141249	39.617556091	12.686585158	10001.381	1.381	
X =	0.900	0.900	52.306048198	39.616580280	12.689487918	10001.746	1.746	
X =	1.000	1.000	52.308202252	39.615482109	12.692720144	10002.158	2.158	
X =	1.100	1.100	52.310642295	39.614364480	12.696277816	10002.624	2.624	
X =	1.200	1.200	52.313437645	39.613281154	12.700156490	10003.159	3.159	
X =	1.300	1.300	52.316702860	39.612351563	12.704351298	10003.783	3.783	
X =	1.400	1.400	52.320417055	39.611476031	12.708856043	10004.532	4.532	

X =	1.500	1.500	52.325449998	39.611782293	12.713867705	10005.456	5.456
X =	1.600	1.600	52.331591794	39.612814354	12.718777440	10006.630	6.630
X =	1.700	1.700	52.339594187	39.615414606	12.724179580	10008.161	8.161
X =	1.800	1.800	52.350217614	39.620350475	12.729867139	10010.192	10.192
X =	1.900	1.900	52.364489433	39.628656725	12.735832709	10012.921	12.921
X =	2.000	2.000	52.383773198	39.641704728	12.742068472	10016.608	16.608
X =	2.100	2.100	52.409850547	39.661284348	12.748566199	10021.595	21.595
X =	2.200	2.200	52.445017159	39.689699901	12.755317257	10028.319	28.319
X =	2.300	2.300	52.492194287	39.729881669	12.762312618	10037.340	37.340
X =	2.478	2.478	52.618118614	39.842760057	12.775358557	10061.419	61.419

5 cm SSC magnet, new coil geometry, No

(-SNOW2E)

7-JAN-9 08:48:45

NSEGS = 45 SEGMENTS; DIPOLE SYMMETRY

RIRON =	6.7820	CM
RIRON =	2.6701	INCHES
RREF =	1.0000	CM
RREF =	0.3937	INCHES
ROFF =	0.0000	CM
ROFF =	0.0000	INCHES
CURRENT =	5.0000	KAMPS/TURN
SEGMENT AREA =	0.0319	SQINS
CDENSE =	156.7836	KAMPS/SQIN
FACTOR =	2.4302	KGAUSS*INCH
SEGMENT AREA =	0.0249	SQINS
CDENSE =	200.5953	KAMPS/SQIN
FACTOR =	3.1092	KGAUSS*RREF

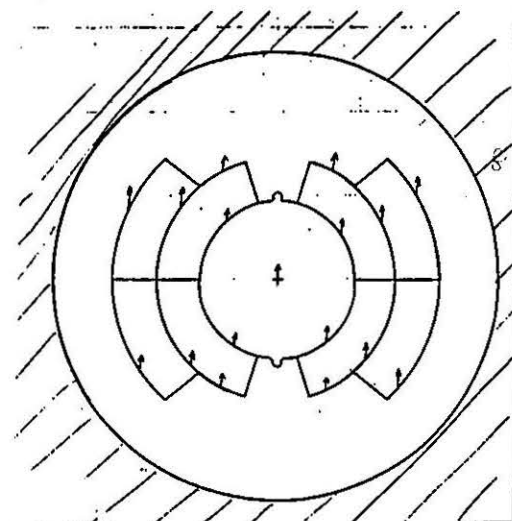
 comments for this run:
 run on case 3

 case: 3 Vertical displacement of the coil with respect to the yoke
 error= 10.00 mils

 Multipole coefficients for inner and outer coils
 higher coefficients (n>1) are in 10**-4

pole	a(in)	b(in)	a(out)	b(out)	a(in)/b1	b(in)/b1	a(out)/b1	b(out)/b1
1	0.00000000	22.4495647	0.00000000	29.7780746	0.00000000	4298.4069316	0.00000000	5701.5930686
2	0.0098874	0.00000000	-0.0230699	0.00000000	1.8931398	0.00000000	-4.4171885	0.00000000
3	0.00000000	-0.2820933	0.00000000	0.2832875	0.00000000	-54.0122674	0.00000000	54.2409245
4	-0.0015492	0.00000000	0.0014637	0.00000000	-0.2966207	0.00000000	0.2802621	0.00000000
5	0.00000000	0.0153115	0.00000000	-0.0150144	0.00000000	2.9316852	0.00000000	-2.8747914
6	0.00000070	0.00000000	0.00000130	0.00000000	0.0013444	0.00000000	0.0024801	0.00000000
7	0.00000000	-0.0000483	0.00000000	-0.0000817	0.00000000	-0.0092427	0.00000000	-0.0156389
8	-0.0000348	0.00000000	-0.0000080	0.00000000	-0.0066713	0.00000000	-0.0015281	0.00000000
9	0.00000000	0.0001700	0.00000000	0.0000393	0.00000000	0.0325500	0.00000000	0.0075228
Multipole coefficients (total). Skew, Normal, ratios								
1	0.000000000	52.227639244	0.000	10000.000				
2	-0.013182511	0.000000000	-2.524	0.000				
3	0.000000000	0.001194222	0.000	0.000		0.229		
4	-0.000085437	0.000000000	-0.016	0.000				
5	0.000000000	0.000297143	0.000	0.057				
6	0.000019974	0.000000000	0.004	0.000				
7	0.000000000	-0.000129951	0.000	-0.025				
8	-0.000042824	0.000000000	-0.008	0.000				
9	0.000000000	0.000209291	0.000	0.040				

	RREF	units	cm	BOTH	AIR	IRON	RATIO	DIFF
X =	0.000	0.000		52.227639244	39.567305636	12.660333608	10000.000	0.000
X =	0.100	0.100		52.227651216	39.567148139	12.660503077	10000.002	0.002
X =	0.200	0.200		52.227687481	39.566676209	12.661011272	10000.009	0.009
X =	0.300	0.300		52.227749050	39.565891490	12.661857559	10000.021	0.021
X =	0.400	0.400		52.227837531	39.564796648	12.663040884	10000.038	0.038
X =	0.500	0.500		52.227955158	39.563395392	12.664559766	10000.060	0.060
X =	0.600	0.600		52.228105126	39.561692822	12.666412304	10000.089	0.089
X =	0.700	0.700		52.228292533	39.559696360	12.668596173	10000.125	0.125
X =	0.800	0.800		52.228526303	39.557417680	12.671108823	10000.170	0.170
X =	0.900	0.900		52.228822551	39.554876071	12.673946480	10000.227	0.227
X =	1.000	1.000		52.229209949	39.552103804	12.677106145	10000.301	0.301
X =	1.100	1.100		52.229737717	39.549154124	12.680583593	10000.402	0.402
X =	1.200	1.200		52.230486900	39.546112584	12.684374376	10000.545	0.545
X =	1.300	1.300		52.231586150	39.543112533	12.688473818	10000.756	0.756
X =	1.400	1.400		52.233231644	39.540355625	12.692876020	10001.071	1.071



X =	1.500	1.500	52.235714202	39.538138344	12.697575857	10001.546	1.546
X =	1.600	1.600	52.239452565	39.536885580	12.702566985	10002.262	2.262
X =	1.700	1.700	52.245035231	39.537192398	12.707842834	10003.331	3.331
X =	1.800	1.800	52.253271652	39.539875235	12.713396418	10004.908	4.908
X =	1.900	1.900	52.265254157	39.546033821	12.719220336	10007.202	7.202
X =	2.000	2.000	52.282431996	39.557125221	12.725306775	10010.491	10.491
X =	2.100	2.100	52.306698992	39.575051477	12.731647515	10015.138	15.138
X =	2.200	2.200	52.340496338	39.602262399	12.738233939	10021.609	21.609
X =	2.300	2.300	52.386932205	39.641875172	12.745057033	10030.500	30.500
X =	2.478	2.478	52.513873594	39.756096551	12.757777043	10054.805	54.805

5 cm SSC magnet, new coil geometry, No

(-SNOW2E)

7-JAN-9 08:49:00

NSEGS = 45 SEGMENTS; DIPOLE SYMMETRY
 RIRON = 6.7820 CM
 RIRON = 2.6701 INCHES
 RREF = 1.0000 CM
 RREF = 0.3937 INCHES
 ROFF = 0.0000 CM
 ROFF = 0.0000 INCHES
 CURRENT = 5.0000 KAMPS/TURN
 SEGMENT AREA = 0.0319 SQINS
 CDENSE = 156.7836 KAMPS/SQIN
 FACTOR = 2.4302 KGAUSS*INCH
 SEGMENT AREA = 0.0249 SQINS
 CDENSE = 200.5953 KAMPS/SQIN
 FACTOR = 3.1092 KGAUSS*RREF

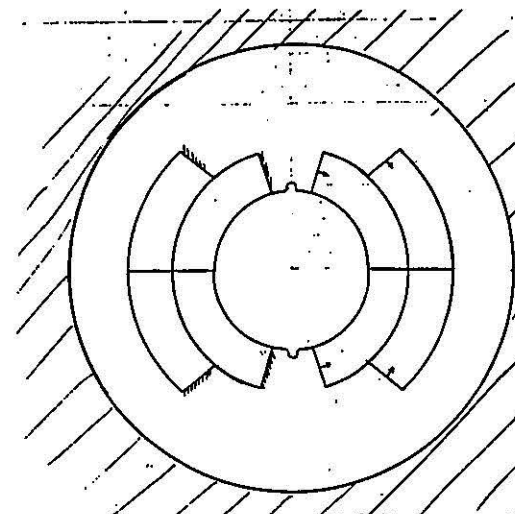
 comments for this run:
 run on case 4

 case: 4 U/D symmetric, displacement of the pole on the right side only
 error= 10.00 mils

Multipole coefficients for inner and outer coils
 higher coefficients (n>1) are in 10**-4

pole	a(in)	b(in)	a(out)	b(out)	a(in)/b1	b(in)/b1	a(out)/b1	b(out)/b1
1	0.00000000	22.4927551	0.00000000	29.8041620	0.00000000	4300.9715195	0.00000000	5699.0284805
2	0.00000000	0.0281171	0.00000000	0.0158541	0.00000000	5.3784289	0.00000000	3.0315607
3	0.00000000	-0.2767415	0.00000000	0.2882021	0.00000000	-52.9173715	0.00000000	55.1088054
4	0.00000000	-0.0013104	0.00000000	0.0009323	0.00000000	-0.2505730	0.00000000	0.1782640
5	0.00000000	0.0146558	0.00000000	-0.0149703	0.00000000	2.8024288	0.00000000	-2.8625558
6	0.00000000	0.0000800	0.00000000	-0.0000379	0.00000000	0.0152912	0.00000000	-0.0072382
7	0.00000000	0.0000417	0.00000000	-0.0000961	0.00000000	0.0079706	0.00000000	-0.0183737
8	0.00000000	-0.0000070	0.00000000	-0.0000028	0.00000000	-0.0013394	0.00000000	-0.0005288
9	0.00000000	0.0001542	0.00000000	0.0000393	0.00000000	0.0294810	0.00000000	0.0075126
Multipole coefficients (total). Skew, Normal, ratios								
1	0.000000000	52.298917115	0.000	10000.000				
2	0.000000000	0.043971193	0.000	8.408				
3	0.000000000	0.011460524	0.000	2.191				
4	0.000000000	-0.000378154	0.000	-0.072				
5	0.000000000	-0.000314446	0.000	-0.060				
6	0.000000000	0.000042115	0.000	0.008				
7	0.000000000	-0.000054405	0.000	-0.010				
8	0.000000000	-0.000009770	0.000	-0.002				
9	0.000000000	0.000193465	0.000	0.037				

	RREF		BOTH	AIR	IRON	RATIO	DIFF
X =	0.000	0.000	52.298917115	39.821351135	12.675585980	10000.000	0.000
X =	0.100	0.100	52.301428430	39.825343898	12.676084533	10000.863	0.863
X =	0.200	0.200	52.306188257	39.829216675	12.676949581	10001.769	1.769
X =	0.300	0.300	52.31127236	39.832966599	12.678160838	10002.717	2.717
X =	0.400	0.400	52.316307344	39.836590553	12.679716791	10003.708	3.708
X =	0.500	0.500	52.321702066	39.840085358	12.681616708	10004.739	4.739
X =	0.600	0.600	52.327306898	39.843448266	12.683858633	10005.811	5.811
X =	0.700	0.700	52.333118427	39.846678042	12.686440385	10006.922	6.922
X =	0.800	0.800	52.339136340	39.849776981	12.689359359	10008.073	8.073
X =	0.900	0.900	52.345368793	39.852754268	12.692612525	10009.264	9.264
X =	1.000	1.000	52.351827636	39.855631211	12.696196424	10010.500	10.500
X =	1.100	1.100	52.358558071	39.858448898	12.700107173	10011.786	11.786
X =	1.200	1.200	52.365619412	39.861278953	12.704340459	10013.137	13.137
X =	1.300	1.300	52.373129668	39.864238127	12.708891542	10014.573	14.573
X =	1.400	1.400	52.381282781	39.867507530	12.713755251	10016.128	16.128

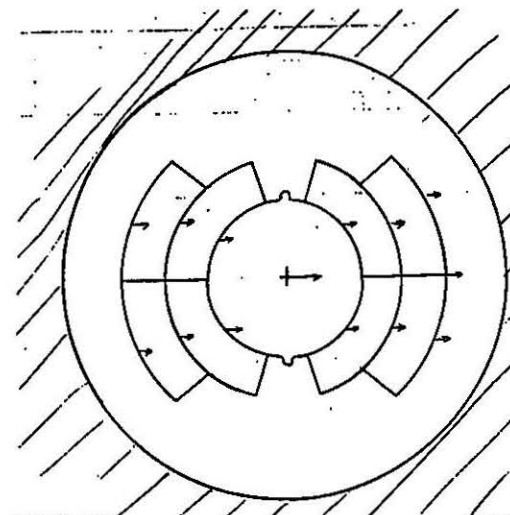


X =	1.500	1.500	52.390283391	39.671367400	12.718925991	10017.853	17.853
X =	1.600	1.600	52.400576119	39.676178384	12.724397735	10019.821	19.821
X =	1.700	1.700	52.412884398	39.682520366	12.730164032	10022.137	22.137
X =	1.800	1.800	52.427357994	39.691139988	12.736218008	10024.942	24.942
X =	1.900	1.900	52.445610402	39.703058045	12.742552357	10028.433	28.433
X =	2.000	2.000	52.468787421	39.719628053	12.749159368	10032.864	32.864
X =	2.100	2.100	52.498648254	39.742617347	12.756030907	10038.574	38.574
X =	2.200	2.200	52.537460569	39.774302139	12.763158430	10045.996	45.996
X =	2.300	2.300	52.588111056	39.817578062	12.770532993	10055.681	55.681
X =	2.478	2.478	52.719662095	39.935400182	12.784261913	10080.836	80.836

5 cm SSC magnet, new coil geometry, No

(-SNOW2E)

7-JAN-9 08:49:20



NSEGS = 45 SEGMENTS; DIPOLE SYMMETRY
 RIRON = 8.7820 CM
 RIRON = 2.6701 INCHES
 RREF = 1.0000 CM
 RREF = 0.3937 INCHES
 ROFF = 0.0000 CM
 ROFF = 0.0000 INCHES
 CURRENT = 5.0000 KAMPS/TURN
 SEGMENT AREA = 0.0319 SQINS
 CDENSE = 158.7836 KAMPS/SQIN
 FACTOR = 2.4302 KGAUSS*INCH
 SEGMENT AREA = 0.0249 SQINS
 CDENSE = 200.5953 KAMPS/SQIN
 FACTOR = 3.1092 KGAUSS*RREF

 comments for this run:
 run on case 5

 case: 5 Horizontal displacement of the coil with respect to the yoke
 error= 10.00 mils

 Multipole coefficients for inner and outer coils
 higher coefficients (n>1) are in 10**--4

pole	a(in)	b(in)	a(out)	b(out)	a(in)/b1	b(in)/b1	a(out)/b1	b(out)/b1
1	0.00000000	22.4492041	0.00000000	29.7784148	0.00000000	4298.3395655	0.00000000	5701.6804345
2	0.00000000	0.0185042	0.00000000	-0.0037212	0.00000000	3.5429879	0.00000000	-0.7124984
3	0.00000000	-0.2819677	0.00000000	0.2831887	0.00000000	-53.9882358	0.00000000	54.2220278
4	0.00000000	-0.0015808	0.00000000	0.0015501	0.00000000	-0.2988023	0.00000000	0.2988057
5	0.00000000	0.0153106	0.00000000	-0.0150158	0.00000000	2.9315158	0.00000000	-2.8750691
6	0.00000000	0.0000068	0.00000000	0.0000117	0.00000000	0.0012930	0.00000000	0.0022341
7	0.00000000	-0.0000421	0.00000000	-0.0000803	0.00000000	-0.0080514	0.00000000	-0.0153676
8	0.00000000	-0.0000351	0.00000000	-0.0000080	0.00000000	-0.0067284	0.00000000	-0.0015287
9	0.00000000	0.0001744	0.00000000	0.0000393	0.00000000	0.0333931	0.00000000	0.0075271

Multipole coefficients (total). Skew, Normal, ratios

1	0.0000000000	52.227818918	0.000	10000.000
2	0.0000000000	0.014782972	0.000	2.830
3	0.0000000000	0.001221040	0.000	0.234
4	0.0000000000	-0.000010427	0.000	-0.002
5	0.0000000000	0.000294808	0.000	0.056
6	0.0000000000	0.000018421	0.000	0.004
7	0.0000000000	-0.000122312	0.000	-0.023
8	0.0000000000	-0.000043125	0.000	-0.008
9	0.0000000000	0.000213718	0.000	0.041

	RREF		BOTH	AIR	IRON	RATIO	DIFF
	units	cm					
X =	0.000	0.000	52.227818918	39.587285310	12.860333608	10000.000	0.000
X =	0.100	0.100	52.229109445	39.587207822	12.861901623	10000.285	0.285
X =	0.200	0.200	52.230624741	39.586815688	12.863809053	10000.576	0.576
X =	0.300	0.300	52.232165770	39.586110283	12.866055487	10000.871	0.871
X =	0.400	0.400	52.233734110	39.585094016	12.868840094	10001.171	1.171
X =	0.500	0.500	52.235331949	39.583770333	12.871561616	10001.477	1.477
X =	0.600	0.600	52.236982339	39.582143970	12.874818369	10001.789	1.789
X =	0.700	0.700	52.238629990	39.580221748	12.878408244	10002.108	2.108
X =	0.800	0.800	52.240342981	39.558014258	12.882328703	10002.436	2.436
X =	0.900	0.900	52.242115705	39.55538927	12.888576778	10002.776	2.776
X =	1.000	1.000	52.243974011	39.552824939	12.891149072	10003.132	3.132
X =	1.100	1.100	52.245982481	39.549920706	12.896041755	10003.512	3.512
X =	1.200	1.200	52.248155109	39.546904542	12.701250567	10003.932	3.932
X =	1.300	1.300	52.250670197	39.543899383	12.706770813	10004.414	4.414
X =	1.400	1.400	52.253800782	39.541000207	12.712507388	10004.900	4.900

X =	1.500	1.500	52.267485144	39.538760478	12.718724666	10005.718	5.718
X =	1.600	1.600	52.262449394	39.537302675	12.725146718	10006.669	6.669
X =	1.700	1.700	52.269137786	39.537280686	12.731857099	10007.950	7.950
X =	1.800	1.800	52.278317612	39.539468660	12.738848953	10009.707	9.707
X =	1.900	1.900	52.291028607	39.544913610	12.746114996	10012.141	12.141
X =	2.000	2.000	52.308655369	39.555007845	12.753647524	10015.516	15.516
X =	2.100	2.100	52.333013302	39.571574894	12.761438408	10020.180	20.180
X =	2.200	2.200	52.366449623	39.596970515	12.769479108	10026.582	26.582
X =	2.300	2.300	52.411961101	39.634200428	12.777760675	10035.296	35.296
X =	2.478	2.478	52.535435653	39.742344600	12.793091053	10058.938	58.938

5 cm SSC magnet, new coil geometry, No

(-SNOW2E)

7-JAN-9 08:49:46

NSEGS = 45 SEGMENTS; DIPOLE SYMMETRY

RIRON = 6.7820 CM
 RIRON = 2.6701 INCHES
 RREF = 1.0000 CM
 RREF = 0.3937 INCHES
 ROFF = 0.0000 CM
 ROFF = 0.0000 INCHES
 CURRENT = 5.0000 KAMPS/TURN
 SEGMENT AREA = 0.0319 SQINS
 CDENSE = 156.7836 KAMPS/SQIN
 FACTOR = 2.4302 KGAUSS*INCH
 SEGMENT AREA = 0.0249 SQINS
 CDENSE = 200.5953 KAMPS/SQIN
 FACTOR = 3.1092 KGAUSS*RREF

 comments for this run:
 run on case 6

 case: 6 Vertical displacement of the coil mid-plane on one side only (poles fixed)
 error= 10.00 mils

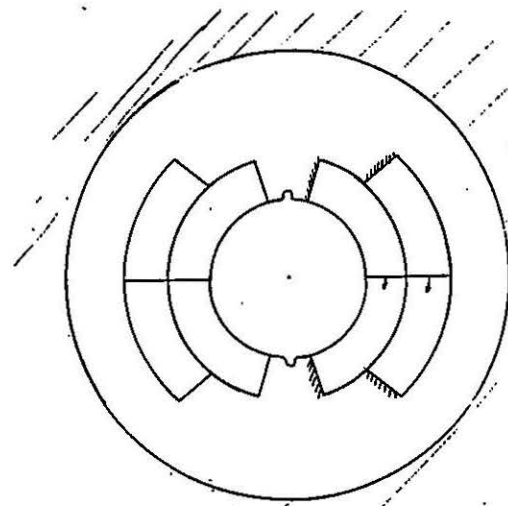
 Multipole coefficients for inner and outer coils
 higher coefficients (n>1) are in 10**-4

pole	a(in)	b(in)	a(out)	b(out)	a(in)/b1	b(in)/b1	a(out)/b1	b(out)/b1
1	0.0541238	22.4492227	0.0462102	29.7781513	10.3631105	4298.3632806	8.8478909	5701.6367194
2	0.0209383	-0.0001499	0.0146362	-0.0000642	4.0090693	-0.0286980	2.8023952	-0.0122998
3	0.0051878	-0.2821089	0.0033433	0.2832125	0.9933083	-54.0155177	0.6401380	54.2268254
4	0.0009266	-0.0000308	0.0008036	-0.0000080	0.1774232	-0.0059022	0.1155795	-0.0015315
5	0.0001961	0.0153003	0.0000843	-0.0150172	0.0375413	2.9295504	0.0161423	-2.8753509
6	0.0000834	-0.0000039	0.0000091	-0.0000005	0.0159611	-0.0007521	0.0017452	-0.0000974
7	0.0000393	-0.0000468	0.0000013	-0.0000811	0.0075333	-0.0089593	0.0002558	-0.0155258
8	0.0000174	-0.0000007	0.0000005	0.0000000	0.0033303	-0.0001405	0.0001049	-0.0000054
9	0.0000082	0.0001719	0.0000002	0.0000393	0.0015764	0.0329075	0.0000453	0.0075236

Multipole coefficients (total). Skew, Normal, ratios

1	0.100334015	52.227373974	19.211	10000.000	
2	0.035574490	-0.000214121	6.811	-0.041	
3	0.008531081	0.001103604	1.633	0.211	
4	0.001530276	-0.000038825	0.293	-0.007	
5	0.000280375	0.000283070	0.054	0.054	
6	0.000092476	-0.000004437	0.018	-0.001	
7	0.000040679	-0.000127880	0.008	-0.024	
8	0.000017941	-0.000000782	0.003	0.000	
9	0.000008470	0.000211161	0.002	0.040	

	RREF	units	cm	BOTH	AIR	IRON	RATIO	DIFF
X =	0.000	0.000		52.227373974	39.567092419	12.660281555	10000.000	0.000
X =	0.100	0.100		52.227363587	39.568913958	12.660449630	9999.998	-0.002
X =	0.200	0.200		52.227375427	39.568418813	12.660956614	10000.000	0.000
X =	0.300	0.300		52.227410218	39.565608342	12.661801875	10000.007	0.007
X =	0.400	0.400		52.227469232	39.564484879	12.662984353	10000.018	0.018
X =	0.500	0.500		52.227554335	39.563051766	12.664502569	10000.035	0.035
X =	0.600	0.600		52.227668313	39.561313693	12.666354620	10000.056	0.056
X =	0.700	0.700		52.227815823	39.559277648	12.668538177	10000.085	0.085
X =	0.800	0.800		52.228005342	39.556954850	12.671050492	10000.121	0.121
X =	0.900	0.900		52.228252557	39.554384170	12.673888387	10000.168	0.168
X =	1.000	1.000		52.228585785	39.551537522	12.677048263	10000.232	0.232
X =	1.100	1.100		52.229054035	39.548527940	12.680526095	10000.322	0.322
X =	1.200	1.200		52.229738440	39.545421010	12.684317430	10000.453	0.453
X =	1.300	1.300		52.230767885	39.542350492	12.688417393	10000.650	0.650
V =	1.400	1.400		52.232330008	39.539519014	12.692820882	10000.951	0.951



X =	1.500	1.500	52.234746392	39.537224819	12.897521673	10001.412	1.412
X =	1.600	1.600	52.238409556	39.535895640	12.702513916	10002.113	2.113
X =	1.700	1.700	52.243921970	39.536130826	12.707791143	10003.168	3.168
X =	1.800	1.800	52.252099249	39.538752984	12.713346265	10004.734	4.734
X =	1.900	1.900	52.264042308	39.544870431	12.719171878	10007.021	7.021
X =	2.000	2.000	52.281212041	39.555951875	12.725260168	10010.308	10.308
X =	2.100	2.100	52.305517722	39.573914813	12.731602909	10014.982	14.982
X =	2.200	2.200	52.339420693	39.601229209	12.738191484	10021.454	21.454
X =	2.300	2.300	52.386055005	39.641038128	12.745016876	10030.383	30.383
X =	2.478	2.478	52.513687909	39.765946575	12.767741335	10054.821	54.821

5 cm SSC magnet, new coil geometry, No

(-SNOW2E)

18-JAN-9 13:03:16

NSEGS = 45 SEGMENTS; DIPOLE SYMMETRY
 RIRON = 8.7820 CM
 RIRON = 2.6701 INCHES
 RREF = 1.0000 CM
 RREF = 0.3937 INCHES
 ROFF = 0.0000 CM
 ROFF = 0.0000 INCHES
 CURRENT = 5.0000 KAMPS/TURN
 SEGMENT AREA = 0.0319 SQINS
 CDENSE = 156.7836 KAMPS/SQIN
 FACTOR = 2.4302 KGAUSS*INCH
 SEGMENT AREA = 0.0249 SQINS
 CDENSE = 200.5953 KAMPS/SQIN
 FACTOR = 3.1092 KGAUSS*RREF

 comments for this run:
 run on case 7

 case: 7 Mid-plane insulation increased by twice the error
 error= 4.00 mils

 Multipole coefficients for inner and outer coils
 higher coefficients (n>1) are in 10**-4

pole	a(in)	b(in)	a(out)	b(out)	a(in)/b1	b(in)/b1	a(out)/b1	b(out)/b1
1	0.00000000	22.4309253	0.00000000	29.7673318	0.00000000	4297.2556086	0.00000000	5702.7443914
2	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
3	0.00000000	-0.2901497	0.00000000	0.2802840	0.00000000	-55.5860818	0.00000000	53.6960393
4	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
5	0.00000000	0.0143953	0.00000000	-0.0152470	0.00000000	2.7578096	0.00000000	-2.9209856
6	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
7	0.00000000	-0.0001490	0.00000000	-0.0000920	0.00000000	-0.0285445	0.00000000	-0.0176294
8	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
9	0.00000000	0.0001579	0.00000000	0.0000387	0.00000000	0.0302537	0.00000000	0.0074178

Multipole coefficients (total). Skew, Normal, ratios

1	0.0000000000	52.198257134	0.000	10000.000
2	0.0000000000	0.0000000000	0.000	0.000
3	0.0000000000	-0.009865693	0.000	-1.890
4	0.0000000000	0.0000000000	0.000	0.000
5	0.0000000000	-0.000851750	0.000	-0.163
6	0.0000000000	0.0000000000	0.000	0.000
7	0.0000000000	-0.000241020	0.000	-0.046
8	0.0000000000	0.0000000000	0.000	0.000
9	0.0000000000	0.000196638	0.000	0.038

	RREF						
	units	cm	BOTH	AIR	IRON	RATIO	DIFF
X =	0.000	0.000	52.198257134	39.543969684	12.654287450	10000.000	0.000
X =	0.100	0.100	52.198158392	39.543703940	12.654454452	9999.981	-0.019
X =	0.200	0.200	52.197861129	39.542905885	12.654955244	9999.924	-0.076
X =	0.300	0.300	52.197362160	39.541572978	12.655789182	9999.829	-0.171
X =	0.400	0.400	52.196855960	39.539700769	12.656955191	9999.693	-0.307
X =	0.500	0.500	52.195734479	39.537282710	12.658451769	9999.517	-0.483
X =	0.600	0.600	52.194587156	39.534310175	12.660276981	9999.297	-0.703
X =	0.700	0.700	52.193201420	39.530772958	12.662428462	9999.031	-0.969
X =	0.800	0.800	52.191564023	39.526860607	12.664903416	9998.718	-1.282
X =	0.900	0.900	52.189663648	39.521965035	12.667698614	9998.354	-1.646
X =	1.000	1.000	52.187495310	39.516884914	12.670810395	9997.938	-2.062
X =	1.100	1.100	52.185067128	39.510832462	12.674234666	9997.473	-2.527
X =	1.200	1.200	52.182410174	39.504443275	12.677966899	9996.964	-3.036
X =	1.300	1.300	52.179592111	39.497589978	12.682002133	9996.424	-3.576
X =	1.400	1.400	52.176735489	39.490400516	12.686334974	9995.877	-4.123

X =	1.500	1.500	52.174041594	39.483081999	12.690959595	9995.361	-4.639
X =	1.600	1.600	52.171820833	39.475951095	12.695869737	9994.935	-5.065
X =	1.700	1.700	52.170530747	39.469472034	12.701058712	9994.688	-5.312
X =	1.800	1.800	52.170822783	39.464303380	12.706519403	9994.744	-5.256
X =	1.900	1.900	52.173599065	39.461354799	12.712244266	9995.276	-4.724
X =	2.000	2.000	52.180080460	39.461855122	12.718225338	9996.518	-3.482
X =	2.100	2.100	52.191887346	39.467433108	12.724454239	9998.780	-1.220
X =	2.200	2.200	52.211134528	39.480212353	12.730922176	10002.467	2.467
X =	2.300	2.300	52.240541860	39.502921907	12.737619953	10008.101	8.101
X =	2.478	2.478	52.329491498	39.579392488	12.750099011	10025.142	25.142