

## SSC 40mm Spot Welded Pair Summary

Collar laminations for 40mm SSC magnets are spot welded into pairs as shown in Figure 1. Several vendors have done spot welding for Fermilab magnets. Results have been mixed. This note describes the experience Fermilab has had with 40mm spot welded pairs. It contains two sections:

- 1.) A description of the requirements that have been applied for inspection of spot welded pairs.
- 2.) A summary of the inspection results from the pairs actually used in the 40mm program.

### 1.) Inspection Requirements

Each lamination pair has two spot welds located as shown in Figure 1.

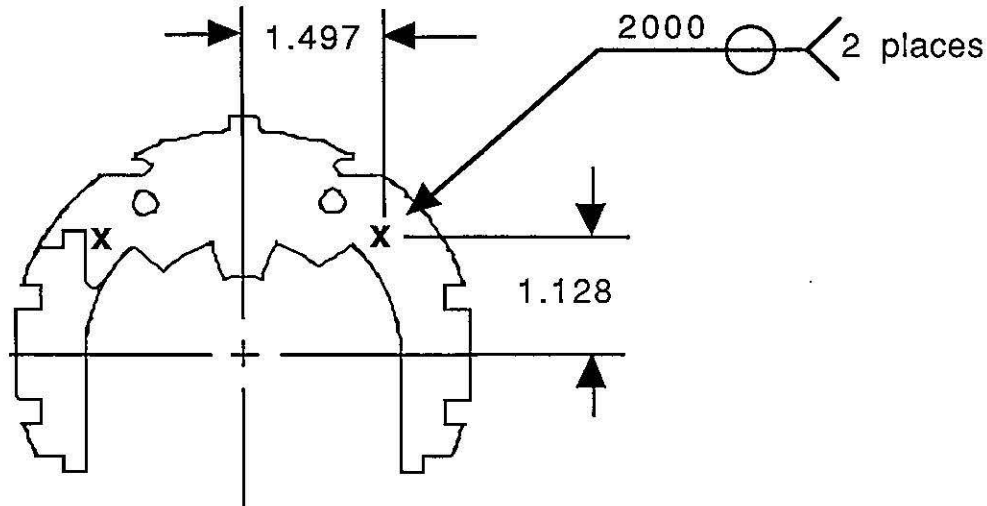


Figure 1

Four tolerances can be applied to this pair:

- a.) Tolerance on location of spots.
- b.) Maximum misregistration of the two pairs.
- c.) Minimum shear strength of the spot.
- d.) Maximum thickness buildup of the spot (in other words, the total thickness increase of the two laminations due to the spot welding).

Since spot welding of collar laminations was initiated at BNL, we at FNAL are duplicating their design unless we have good reason to do otherwise. We therefore begin by looking at the tolerances given on the BNL drawing.

Tolerance on location of spots is given on BNL drawing 22-00.369-3 Rev. "None". The location is specified by a radius, for which no tolerance is applied, and an angle, for which  $\pm 1$  degree is applied. This angle translates to about  $\pm .032$  inches. The FNAL drawing has a  $\pm .005$  inch tolerance applied to the radius and the same  $\pm 1$  degree applied to the angle. In practice inspection has been requiring a  $\pm 1/32$  inch tolerance in all directions to the position of the spot.

Maximum misregistration allowed is not given on the BNL drawing. There is a note which states the the laminations must be "coplanar" but no maximum amount is shown. To determine our tolerance we checked a batch of pairs which were made for BNL by their spot welding vendor, H & J Tool and Die. These laminations were sent to FNAL by BNL for use in our long models, so we assume the misregistration is acceptable and similar to that in BNL long models. Inspection is done by looking across the edges of each pair on an optical comparator. The distance between the flat sheared edge of each lamination is measured. Three places on each pair are measured as shown in Figure 2.

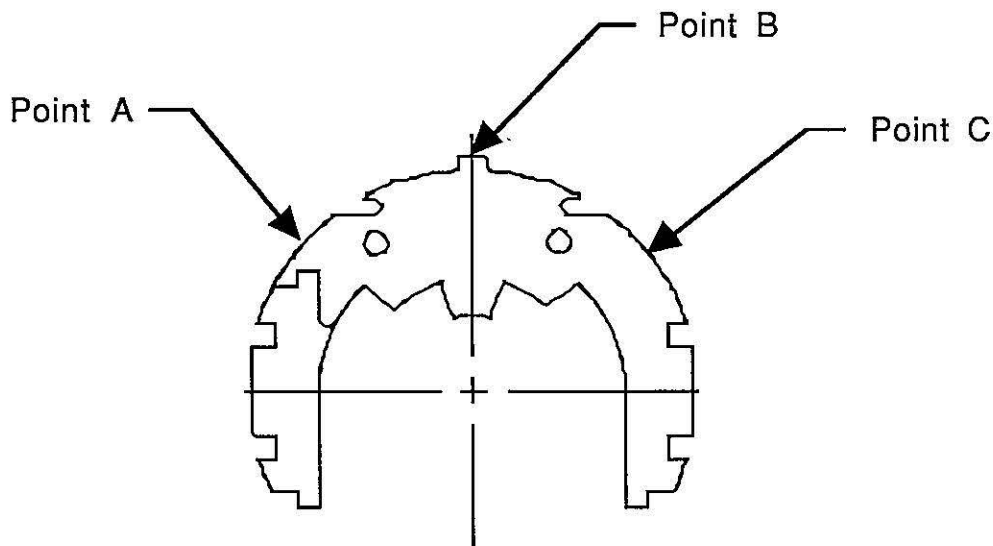


Figure 2.

The misregistrations for the 20 samples checked are shown in Figure 3. The raw data is shown as "Batch 5" in Appendix A.

Batch #5 (Made at H & J for BNL)

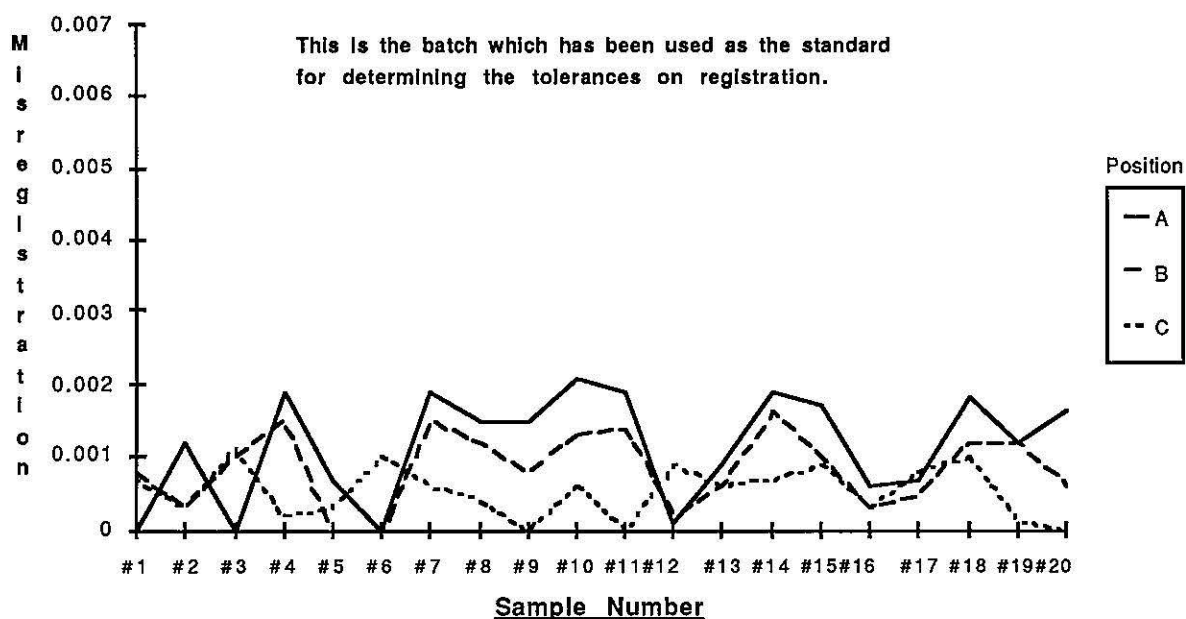


Figure 3.

As can be seen from Figure 3, all the points are coplanar within .002 inches except one point on sample 10, which is .0021. We chose to apply a tolerance of .002 to the misregistration of pairs based on the inspection of this sample. The registration requirement is therefore determined by manufacturing limitations rather than by magnet requirements, such as preload variations. As will be seen in section 2, the actual pairs rarely met the .002 requirement.

Shear strength of the spot weld must also be specified. The BNL drawing requires that each spot have a minimum shear strength of 2000 pounds. These welds should be tested as shown in Figure 4.

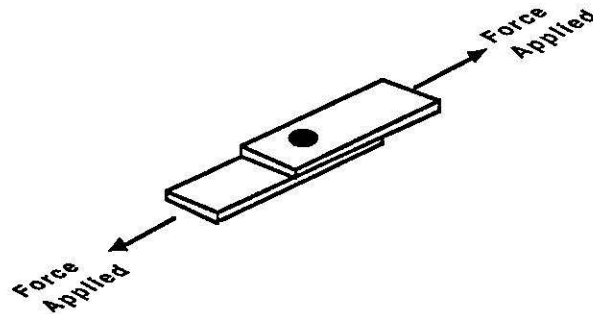


Figure 4

The force should be applied in the same plane as the weld. Sections of pairs which have been welded must be cut away from the rest of the lamination before testing to perform this test properly.

The pull tests which inspection has performed are shown in Figure 5. Force is applied at the midplane of the coil. These tests are easier to do on the existing equipment and apply the load in much the same way that it is applied during coil excitation. They cannot, however, be easily related to the 2000 lb. criteria on the drawing.

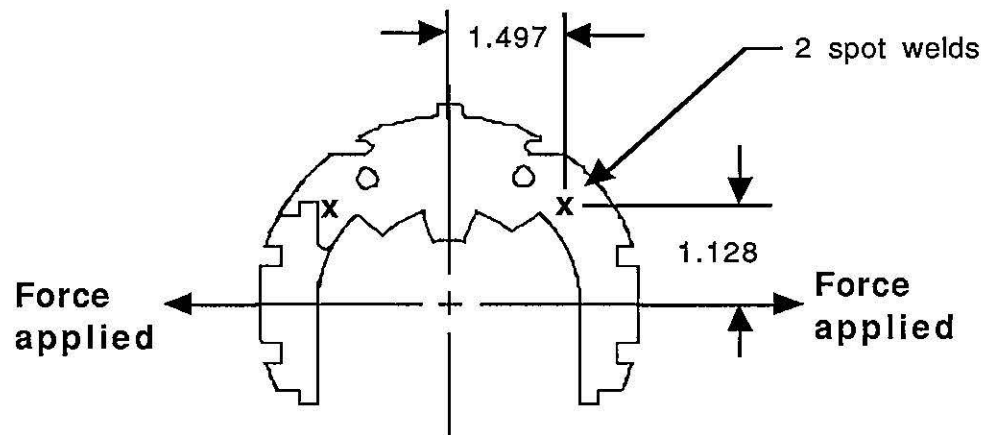


Figure 5.

A study by Alan Koca of SSCL has been done to cross calibrate the two types of pull tests. It has been empirically determined that a pull test applied as in Figure 4 causes a failure at approximately the same force as a pull test applied as in Figure 5. Lamination pairs continue to be tested according to the method shown in Figure 5. Initial tests were supervised by Allen Koca of SSCL.

Maximum thickness buildup of the spot is specified on the BNL drawing as .003 inches. The FNAL drawing is the same. This may be excessive, because the total buildup per pack allowed is then  $.003 \times (47 \text{ pairs}) = .141$  inches. This is more than a lamination pair thickness and would certainly cause problems in pack assembly.

40mm spot welded pairs have been made for FNAL by three vendors. They are Electrometal, Weldfab and H & J. Electrometal only made a few batches near the beginning of the project and was no longer used because of price. The following list shows which vendor made lamination pairs for each magnet:

<u>Magnet</u>	<u>Vendor</u>
DS0307	Electrometal
DS0308	Weldfab
DS0309	Weldfab
DS0310	Weldfab
DS0311	Weldfab
DS0312	Weldfab
DS0313	Weldfab
DS0314	Weldfab
DS0315	Weldfab
DC0300 (PCM#1)	Weldfab
DC0301 (PCM #2)	Weldfab
DC0302 (RCM#1)	Weldfab
DC0303 (RCM#2)	H & J, Weldfab
DC0304 (RCM#3)	H & J, Weldfab
DC0305 (RCM#4)	H & J, Weldfab
DCO306 (RCM#5)	??

#### a.) Registration Inspection

43 separate batches of lamination pairs were inspected for registration. Batch size ranged from 73 to 3000. The inspection sample sizes for the various batches ranged from 4 to 28. Inspection was done as shown in Figure 2. Appendix A shows complete raw data for all registration inspection.

There are three relevant groups of lamination pairs to be compared. They are:

- 1.) The original lamination pairs sent from BNL to FNAL to use in FNAL long magnets. They were stamped and spot welded at H & J Tool and Die. As explained above, none of these laminations were ever used in a magnet at FNAL, but two samples of this type were measured. They are shown in Figure 7 as Batches "5" and "44". Batch 5 was used to determine the tolerance and to use as a "standard" to which future pairs could be compared. Batch 44 was measured later to verify the quality of batch 5. All points in these samples are coplanar within .0021.
- 2.) FNAL pairs spot welded by Weldfab, a shop in St. Charles, Ill. The laminations were stamped at Plainfield Tool and Die in Plainfield, Ill. Fermilab used Weldfab for spot welding for the majority of the project.
- 3.) FNAL pairs spot welded by H & J. These laminations were also stamped at Plainfield. Halfway through the long magnet project, FNAL switched to H & J for spot welding. This was done because the Weldfab pairs were considered at the time to be inconsistent in their registration accuracy.

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\* Magnet DCO306 was not originally on the schedule. It was added after an early magnet failed. The inspection report of each lamination batch designates a magnet for that batch. No laminations were therefore scheduled for DCO306. The laminations in DSO306 were either re-used from DCO305 (which failed during collaring) or taken from extras which were originally scheduled for other magnets.

Figure 6. shows the registration of all pairs welded at Weldfab (these pairs were all stamped at Plainfield Tool). The horizontal lines at the .007 and .008 levels delineate different batches inspected. As can be seen, misregistrations vary between zero and .006 inches and are quite inconsistent from batch to batch. Figure 7 shows all pairs welded at H & J. The same inconsistency between batches is observed. The maximum misregistration exceeds .009 inches.

The first batch shown on the H & J graph is the same batch 5 shown in Figure 3. The last is batch #44. These are the only batches measured which were both stamped and welded at H & J. The rest were stamped at Plainfield. It seems, at least from this small sample, that the batches both stamped and welded at H & J have superior registration. It is unknown why the H & J registration is much poorer when using laminations stamped at Plainfield.

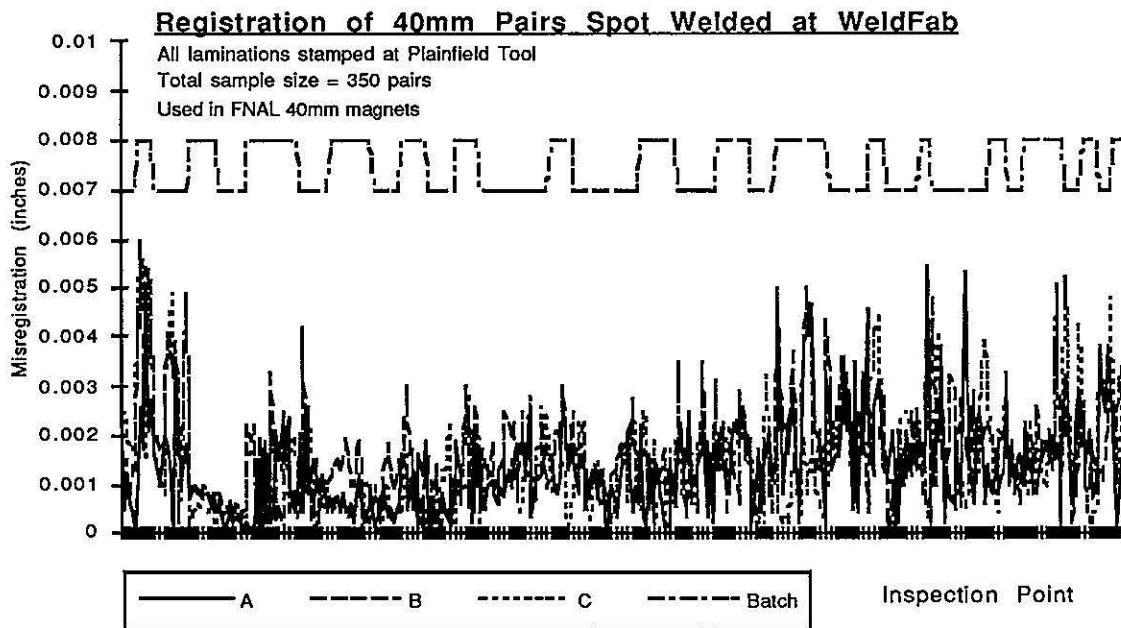


Figure 6.

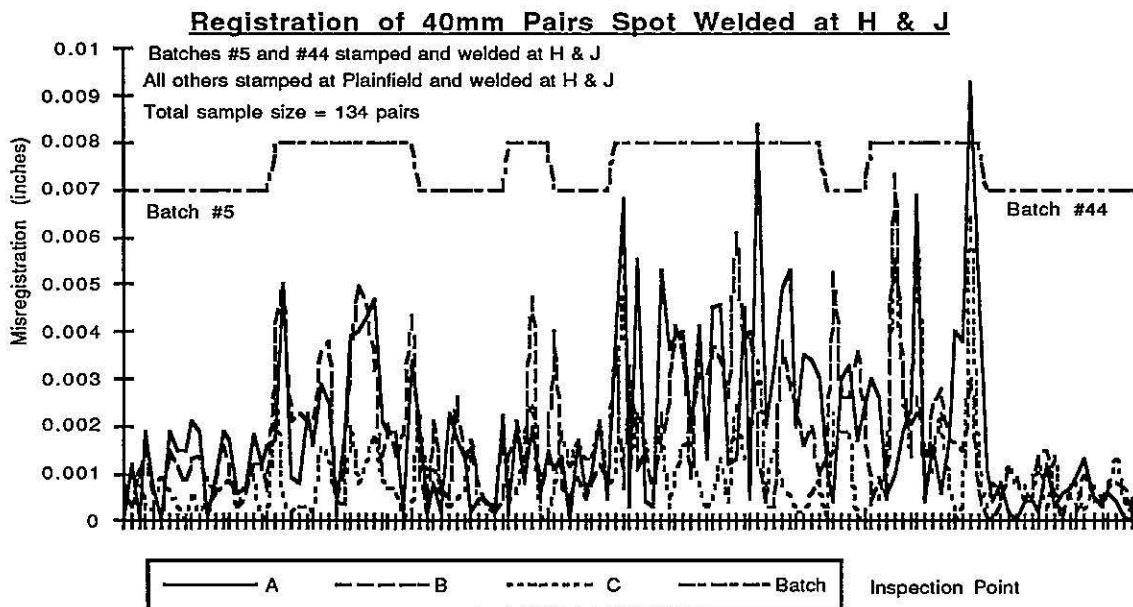


Figure 7.

b.) Pull Strength Inspection

Samples of lamination pairs were tested for spot weld strength as shown in Figure 5. Pairs made by H & J for BNL (the type shown in Batches 5 and 44) typically failed between 1700 and 1800 lbs. The failures were in the parent material and not the weld itself.

The first batches of Weldfab pairs failed at the weld between 1300 - 1400 lbs. They were used in short models DS0308 thru DS0311. The magnets had no performance problems attributable to the "weak" spot welds. Later Weldfab as well as H & J laminations varied. They usually failed in the parent material around 1700 - 1800 lbs., but occasionally failed at lower forces at the welds. Batches were accepted with failures as low as 1500 lbs. If significant numbers of a batch failed at forces lower than 1500 lbs., the batch was sent back to the manufacturer to be rewelded. No known performance problems existed in any magnets due to spot welds.

c.) Thickness buildup.

The thickness of spot welded pairs was not regularly measured. Two samples were measured after the project ended. The results are shown below. A sample of 21 pairs made by H & J for BNL (the same laminations shown as batch #44 in the registration data) and a sample of Weldfab laminations are shown in Table 1.

No assembly problems developed in the long program as a result of spot weld thickness buildup. Some intermittent problems in short magnets with WeldFab pairs resulted in excess buildup on some pairs. These problems were corrected and did not reoccur.

	H & J Batch #44	Weldfab Sample
	.001	.003
	.002	.003
	.001	.001
	.003	.001
	.003	.001
	.002	.002
	.003	.001
	.001	.001
	.001	.002
	.002	.002
	.002	.002
	.002	.002
	.004	.002
	.002	.001
	.001	.001
	.002	.002
	.001	.001
	.003	.001
	.003	.002
	.002	.002
	.002	.001
	Mean	.0016

Conclusion:

Spot welded pairs for 40mm SSC magnets can be separated into three categories. They are listed below in order of "best to worst" registration.

- Pairs stamped and welded at H & J.
- Pairs stamped at Plainfield and welded at WeldFab.
- Pairs stamped at Plainfield and welded at H & J.

No magnet performance problems were observed due to misregistration, spot weld strength or spot weld thickness. Misregistration, however, varies quite drastically from vendor to vendor and batch to batch, creating a potential for problems. The spot welding process should be monitored carefully if it is to be used for production dipoles.

A later tech note, # TS-SSC 91-210, will present similar data on the 50mm SSC spot welded pairs. 50mm data will also be compared to the 40mm data presented in this note.

**Appendix A****SSC Collar Spot Welding Data****Batch #1**

217854 - Collar Lamination Pair Right Hand - 304N Welded by Elecrometal Inspected by Bill Pritchard 1-10-90 Lams from this batch used in DS0307 Magnet body					
Point No.	A	B	C		
# 1	0.0013	0.0002	0.0008		
# 2	0.0017	0.0000	0.0016		
# 3	0.0016	0.0001	0.0012		
# 4	0.0015	0.0002	0.0020		
# 5	0.0010	0.0000	0.0015		
# 6	0.0013	0.0001	0.0008		
Mean	0.0014	0.0001	0.0013	Overall Mean	0.0009
Std. Dev.	0.0002	0.0001	0.0004	Overall SD	0.0007

**Batch #2**

217907 - Strain Gage Lam Pairs - 304N Welded by Electrometal Inspected by Bill Pritchard 1-11-90 Lams from this batch used in DS0307 Strain Gage Pack					
Point No.	A	B	C		
# 1	0.0042	0.0019	0.0073		
# 2	0.0019	0.0048	0.0028		
# 3	0.0005	0.0047	0.0035		
# 4	0.0030	0.0031	0.0018		
# 5	0.0067	0.0016	0.0043		
# 6	0.0036	0.0041	0.0015		
# 7	0.0027	0.0029	0.0064		
# 8	0.0043	0.0017	0.0021		
# 9	0.0006	0.0027	0.0030		
# 10	0.0013	0.0026	0.0032		
Mean	0.0029	0.0030	0.0036	Overall Mean	0.0032
Std. Dev.	0.0018	0.0011	0.0018	Overall SD	0.0016

**Batch #3**

217856 - Collar pin Lam Pairs - 304N Welded by Electrometal Inspected by Bill Pritchard 1-11-90 We will probably not use lams from this batch.					
Point No.	A	B	C		
# 1	0.0008	0.0020	0.0019		
# 2	0.0054	0.0012	0.0032		
# 3	0.0036	0.0011	0.0041		
# 4	0.0030	0.0010	0.0028		
Mean	0.0032	0.0013	0.0030	Overall Mean	0.0025
Std. Dev.	0.0019	0.0005	0.0009	Overall SD	0.0014

**Batch #4**

217907 - Strain Gage Pack Lam Pairs - 304N Welded by WeldFab with kapton sleeve (Iteration #1) Inspected by Bill Pritchard 1-16-90 Lams from this batch scheduled to be used in DS0308 & PCM#2				
Point No.	A	B	C	
# 1	0.0022	0.0002	0.0016	
# 2	0.0005	0.0015	0.0025	
# 3	0.0012	0.0015	0.0023	
# 4	0.0006	0.0008	0.0017	
# 5	0.0004	0.0015	0.0017	
# 6	0.0000	0.0013	0.0019	
Mean	0.0008	0.0011	0.0020	Overall Mean 0.0013
Std. Dev.	0.0007	0.0005	0.0003	Overall SD 0.0007

**Batch #5**

Brookhaven Laminations - 90K Nitronic 40 Stamped and Welded by H & J Inspected by Bill Pritchard 1-23-90 Lams from this batch were sent from BNL to use in Fermi long models This batch has been used as the standard for tolerances on spot welded pairs.				
Point No.	A	B	C	
# 1	0.0000	0.0008	0.0007	
# 2	0.0012	0.0003	0.0003	
# 3	0.0000	0.0010	0.0011	
# 4	0.0019	0.0015	0.0002	
# 5	0.0007	0.0000	0.0003	
# 6	0.0000	0.0000	0.0010	
# 7	0.0019	0.0015	0.0006	
# 8	0.0015	0.0012	0.0004	
# 9	0.0015	0.0008	0.0000	
# 10	0.0021	0.0013	0.0006	
# 11	0.0019	0.0014	0.0000	
# 12	0.0001	0.0002	0.0009	
# 13	0.0009	0.0006	0.0006	
# 14	0.0019	0.0016	0.0007	
# 15	0.0017	0.0010	0.0009	
# 16	0.0006	0.0003	0.0003	
# 17	0.0007	0.0005	0.0008	
# 18	0.0018	0.0012	0.0010	
# 19	0.0012	0.0012	0.0001	
# 20	0.0016	0.0006	0.0000	
Mean	0.0012	0.0009	0.0005	Overall Mean 0.0008
Std. Dev.	0.0007	0.0005	0.0004	Overall SD 0.0006

**Batch #6**

217854 - Collar Lamination Pair Right Hand - 304N Welded by WeldFab with soft ceramic sleeves Inspected by Bill Pritchard 1-24-90 Lams from this batch of 2000 will be used in PCM#1.					
Point No.	A	B	C		
# 1	0.0011	0.0043	0.0051		
# 2	0.0026	0.0060	0.0057		
# 3	0.0017	0.0023	0.0055		
# 4	0.0049	0.0054	0.0015		
# 5	0.0021	0.0051	0.0054		
# 6	0.0027	0.0050	0.0049		
Mean	0.0025	0.0047	0.0047	Overall Mean	0.0040
Std. Dev.	0.0012	0.0012	0.0014	Overall SD	0.0016

**Batch #7**

217907 - Strain Gage Pack Lamination Pairs - 304N Welded by WeldFab with soft ceramic sleeves Inspected by Bill Pritchard 1-24-90 Lams from this batch will be used in PCM#1.					
Point No.	A	B	C		
# 1	0.0016	0.0022	0.0016		
# 2	0.0011	0.0017	0.0013		
# 3	0.0010	0.0017	0.0011		
# 4	0.0020	0.0019	0.0008		
# 5	0.0018	0.0039	0.0041		
# 6	0.0014	0.0039	0.0038		
# 7	0.0000	0.0033	0.0049		
# 8	0.0036	0.0040	0.0015		
# 9	0.0021	0.0016	0.0002		
# 10	0.0010	0.0018	0.0012		
# 11	0.0015	0.0032	0.0034		
# 12	0.0018	0.0046	0.0049		
Mean	0.0016	0.0028	0.0024	Overall Mean	0.0023
Std. Dev.	0.0008	0.0011	0.0016	Overall SD	0.0013

# 40mm Spot Welding Data

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## Batch #8

217861 - Left Hand regular Pairs - 304N Welded by WeldFab with soft ceramic sleeves monitored by feeler gage Inspected by Steve Merkler 1-31-90 From a batch of 30 samples for approval to run 300 for DS0308				
Point No.	A	B	C	
# 1	0.0008	0.0007	0.0000	
# 2	0.0010	0.0010	0.0004	
# 3	0.0009	0.0010	0.0006	
# 4	0.0009	0.0008	0.0006	
# 5	0.0007	0.0009	0.0005	
# 6	0.0008	0.0010	0.0005	
# 7	0.0008	0.0008	0.0004	
# 8	0.0006	0.0006	0.0006	
# 9	0.0008	0.0007	0.0005	
# 10	0.0004	0.0008	0.0000	
Mean	0.0008	0.0008	0.0004	Overall Mean 0.0007
Std. Dev.	0.0002	0.0001	0.0002	Overall SD 0.0003

## Batch #9

217854 - Right Hand regular Pairs - 304N Welded by WeldFab with soft ceramic sleeves monitored by feeler gage Inspected by Steve Merkler 1-31-90 From a batch of 30 samples for approval to run 300 for DS0308				
Point No.	A	B	C	
# 1	0.0006	0.0008	0.0007	
# 2	0.0003	0.0003	0.0006	
# 3	0.0000	0.0004	0.0006	
# 4	0.0002	0.0004	0.0004	
# 5	0.0004	0.0007	0.0003	
# 6	0.0002	0.0000	0.0004	
# 7	0.0003	0.0006	0.0006	
# 8	0.0002	0.0002	0.0004	
# 9	0.0000	0.0004	0.0003	
# 10	0.0002	0.0005	0.0003	
Mean	0.0002	0.0004	0.0005	Overall Mean 0.0004
Std. Dev.	0.0002	0.0002	0.0001	Overall SD 0.0002

40mm Spot Welding Data

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**Batch #10**

217854 - Right Hand regular Pairs - Nitronic 40 Welded by WeldFab with hard ceramic pins Inspected on 2-23-90 For DS0309 and DS0310					
Point No.	A	B	C		
# 1	0.0002	0.0022	0.0015		
# 2	0.0000	0.0019	0.0017		
# 3	0.0002	0.0022	0.0017		
# 4	0.0014	0.0002	0.0003		
# 5	0.0000	0.0020	0.0019		
# 6	0.0017	0.0000	0.0003		
# 7	0.0002	0.0019	0.0018		
# 8	0.0016	0.0002	0.0000		
# 9	0.0002	0.0033	0.0023		
# 10	0.0004	0.0022	0.0017		
# 11	0.0021	0.0002	0.0011		
# 12	0.0015	0.0006	0.0018		
# 13	0.0024	0.0000	0.0010		
# 14	0.0015	0.0008	0.0025		
# 15	0.0024	0.0008	0.0010		
# 16	0.0010	0.0004	0.0016		
# 17	0.0004	0.0009	0.0020		
# 18	0.0008	0.0003	0.0013		
Mean	0.0010	0.0011	0.0014	Overall Mean	0.0012
Std. Dev.	0.0008	0.0010	0.0007	Overall SD	0.0008

**Batch #11**

217854 - Right Hand regular Pairs - Nitronic 40 Welded by WeldFab with hard ceramic pins Inspected on 2-28-90 For DS0309 and DS0310					
Point No.	A	B	C		
# 1	0.0020	0.0015	0.0004		
# 2	0.0004	0.0042	0.0021		
# 3	0.0024	0.0015	0.0008		
# 4	0.0008	0.0022	0.0026		
# 5	0.0012	0.0002	0.0017		
# 6	0.0015	0.0000	0.0010		
# 7	0.0012	0.0015	0.0000		
# 8	0.0008	0.0002	0.0003		
# 9	0.0012	0.0011	0.0006		
# 10	0.0006	0.0010	0.0004		
# 11	0.0005	0.0010	0.0009		
Mean	0.0011	0.0013	0.0010	Overall Mean	0.0011
Std. Dev.	0.0006	0.0011	0.0008	Overall SD	0.0009

**Batch #12**

217861 - Left Hand regular Pairs - Nitronic 40 Welded by WeldFab with hard ceramic pins Inspected on 2-28-90 For DS0309 and DS0310					
Point No.	A	B	C		
#1	0.0007	0.0012	0.0004		
#2	0.0006	0.0013	0.0004		
#3	0.0007	0.0015	0.0008		
#4	0.0005	0.0013	0.0004		
#5	0.0008	0.0015	0.0006		
#6	0.0004	0.0020	0.0005		
#7	0.0005	0.0014	0.0003		
#8	0.0006	0.0010	0.0005		
#9	0.0002	0.0010	0.0005		
#10	0.0008	0.0017	0.0006		
#11	0.0012	0.0019	0.0008		
#12	0.0004	0.0006	0.0000		
#13	0.0002	0.0003	0.0011		
#14	0.0006	0.0002	0.0008		
#15	0.0010	0.0005	0.0009		
Mean	0.0006	0.0012	0.0006	Overall Mean	0.0008
Std. Dev.	0.0003	0.0005	0.0003	Overall SD	0.0005

**Batch #13**

217861 - Left Hand regular Pairs - Nitronic 40 Welded by WeldFab with hard ceramic pins Inspected on 3-16-90 For DS0309 and DS0310					
Point No.	A	B	C		
#1	0.0000	0.0007	0.0000		
#2	0.0002	0.0010	0.0000		
#3	0.0004	0.0002	0.0003		
#4	0.0009	0.0010	0.0002		
#5	0.0006	0.0016	0.0010		
#6	0.0003	0.0018	0.0008		
#7	0.0005	0.0012	0.0002		
#8	0.0002	0.0009	0.0004		
#9	0.0004	0.0011	0.0005		
#10	0.0006	0.0015	0.0004		
Mean	0.0004	0.0011	0.0004	Overall Mean	0.0006
Std. Dev.	0.0002	0.0004	0.0003	Overall SD	0.0005

**Batch #14**

217907 - Strain Gage Pairs - Nitronic 40 Welded by WeldFab with hard ceramic pins Inspected on 2-28-90 For DS0309 and DS0310 Strain Gage Packs				
Point No.	A	B	C	
#1	0.0016	0.0009	0.0005	
#2	0.0013	0.0030	0.0016	
#3	0.0005	0.0024	0.0008	
#4	0.0012	0.0012	0.0012	
#5	0.0005	0.0017	0.0016	
#6	0.0008	0.0001	0.0000	
#7	0.0016	0.0011	0.0001	
#8	0.0012	0.0000	0.0008	
#9	0.0019	0.0015	0.0002	
Mean	0.0012	0.0013	0.0008	Overall Mean 0.0011
Std. Dev.	0.0005	0.0009	0.0006	Overall SD 0.0007

**Batch #15**

217907 - Strain Gage Pairs - Nitronic 40 Welded by WeldFab with hard ceramic pins Inspected on 5-2-90 For DS0311 Strain Gage Pack				
Point No.	A	B	C	
#1	0.0000	0.0016	0.0007	
#2	0.0006	0.0000	0.0008	
#3	0.0004	0.0010	0.0000	
#4	0.0002	0.0014	0.0006	
#5	0.0005	0.0000	0.0008	
#6	0.0008	0.0008	0.0013	
#7	0.0005	0.0004	0.0010	
#8	0.0004	0.0002	0.0023	
#9	0.0000	0.0012	0.0003	
#10	0.0012	0.0006	0.0000	
Mean	0.0005	0.0007	0.0008	Overall Mean 0.0007
Std. Dev.	0.0003	0.0005	0.0006	Overall SD 0.0005

**Batch #16**

217854 - Right Hand Regular Pairs - Nitronic 40 Welded by WeldFab with hard ceramic pins Inspected on 6-22-90 & 6-26-90 For DS0311 and DC0302					
Point No.	A	B	C		
# 1	0.0019	0.0015	0.0014		
# 2	0.0012	0.0013	0.0006		
# 3	0.0009	0.0007	0.0009		
# 4	0.0010	0.0030	0.0020		
# 5	0.0009	0.0008	0.0028		
# 6	0.0005	0.0002	0.0014		
# 7	0.0022	0.0026	0.0004		
# 8	0.0010	0.0022	0.0025		
Mean	0.0012	0.0015	0.0015	Overall Mean	0.0014
Std. Dev.	0.0005	0.0009	0.0008	Overall SD	0.0008

**Batch #17**

217854 - Right Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 8-2-90 For use in DS0311, DS0312 and DC0302					
Point No.	A	B	C		
# 1	0.0015	0.0005	0.0002		
# 2	0.0005	0.0017	0.0012		
# 3	0.0006	0.0014	0.0005		
# 4	0.0010	0.0013	0.0013		
# 5	0.0011	0.0019	0.0011		
# 6	0.0008	0.0008	0.0009		
# 7	0.0006	0.0013	0.0012		
# 8	0.0013	0.0010	0.0013		
# 9	0.0015	0.0007	0.0012		
# 10	0.0008	0.0025	0.0010		
# 11	0.0013	0.0023	0.0012		
# 12	0.0009	0.0020	0.0015		
# 13	0.0016	0.0023	0.0012		
# 14	0.0018	0.0007	0.0007		
# 15	0.0016	0.0018	0.0004		
# 16	0.0019	0.0025	0.0012		
# 17	0.0012	0.0013	0.0011		
# 18	0.0026	0.0010	0.0028		
# 19	0.0006	0.0003	0.0003		
# 20	0.0007	0.0012	0.0015		
# 21	0.0014	0.0011	0.0017		
# 22	0.0014	0.0012	0.0019		
# 23	0.0012	0.0023	0.0026		
# 24	0.0018	0.0009	0.0017		
# 25	0.0016	0.0010	0.0025		
Mean	0.0013	0.0014	0.0013	Overall Mean	0.0013
Std. Dev.	0.0005	0.0006	0.0006	Overall SD	0.0006

**Batch #18**

217861 - Left Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 6-22-90 For use in DS0311 and DC0302					
Point No.	A	B	C		
# 1	0.0016	0.0012	0.0008		
# 2	0.0009	0.0020	0.0009		
# 3	0.0008	0.0021	0.0009		
# 4	0.0011	0.0017	0.0015		
# 5	0.0026	0.0030	0.0015		
# 6	0.0022	0.0019	0.0005		
# 7	0.0013	0.0014	0.0001		
# 8	0.0018	0.0025	0.0009		
Mean	0.0015	0.0020	0.0009	Overall Mean	0.0015
Std. Dev.	0.0006	0.0005	0.0004	Overall SD	0.0007

**Batch #19**

217861 - Left Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 8-2-90 For use in DS0311 and DC0302					
Point No.	A	B	C		
# 1	0.0014	0.0018	0.0009		
# 2	0.0008	0.0014	0.0017		
# 3	0.0015	0.0020	0.0023		
# 4	0.0014	0.0023	0.0009		
# 5	0.0005	0.0015	0.0016		
# 6	0.0010	0.0007	0.0001		
# 7	0.0013	0.0010	0.0008		
# 8	0.0012	0.0014	0.0015		
# 9	0.0007	0.0012	0.0015		
# 10	0.0013	0.0006	0.0011		
# 11	0.0010	0.0013	0.0009		
# 12	0.0001	0.0007	0.0008		
# 13	0.0002	0.0005	0.0007		
# 14	0.0010	0.0012	0.0002		
# 15	0.0006	0.0013	0.0011		
# 16	0.0003	0.0015	0.0015		
# 17	0.0014	0.0018	0.0019		
# 18	0.0014	0.0017	0.0014		
# 19	0.0015	0.0019	0.0017		
# 20	0.0020	0.0020	0.0006		
# 21	0.0004	0.0024	0.0028		
# 22	0.0010	0.0011	0.0017		
# 23	0.0006	0.0012	0.0016		
Mean	0.0010	0.0014	0.0013	Overall Mean	0.0012
Std. Dev.	0.0005	0.0005	0.0006	Overall SD	0.0006

**Batch #20**

217907 - Strain Gage Pack Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 6-20-90 For use in DS0311, DS0312, DC0302, DC0303 and DC0304.					
Point No.	A	B	C		
# 1	0.0022	0.0008	0.0005		
# 2	0.0003	0.0017	0.0025		
# 3	0.0001	0.0016	0.0021		
# 4	0.0016	0.0005	0.0006		
# 5	0.0002	0.0015	0.0019		
# 6	0.0015	0.0008	0.0000		
# 7	0.0012	0.0013	0.0008		
# 8	0.0009	0.0012	0.0009		
# 9	0.0001	0.0017	0.0011		
# 10	0.0002	0.0009	0.0003		
# 11	0.0001	0.0015	0.0017		
# 12	0.0014	0.0011	0.0009		
# 13	0.0006	0.0010	0.0005		
Mean	0.0008	0.0012	0.0011	Overall Mean	0.0010
Std. Dev.	0.0007	0.0004	0.0007	Overall SD	0.0006

**Batch #21**

217854 - Right Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 8-13-90 For use in DC0303 and DC0304.					
Point No.	A	B	C		
# 1	0.0017	0.0024	0.0035		
# 2	0.0023	0.0016	0.0008		
# 3	0.0013	0.0016	0.0018		
# 4	0.0016	0.0003	0.0008		
# 5	0.0025	0.0019	0.0020		
# 6	0.0006	0.0011	0.0013		
# 7	0.0006	0.0012	0.0004		
# 8	0.0014	0.0014	0.0017		
# 9	0.0017	0.0022	0.0025		
# 10	0.0023	0.0035	0.0034		
# 11	0.0003	0.0009	0.0013		
# 12	0.0018	0.0019	0.0018		
# 13	0.0002	0.0010	0.0013		
# 14	0.0019	0.0031	0.0031		
Mean	0.0014	0.0017	0.0018	Overall Mean	0.0017
Std. Dev.	0.0007	0.0008	0.0009	Overall SD	0.0009

40mm Spot Welding Data

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**Batch #22**

217854 - Right Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 8-30-90 For use in DC0303 and DC0304.				
Point No.	A	B	C	
# 1	0.0019	0.0013	0.0017	
# 2	0.0017	0.0022	0.0013	
# 3	0.0014	0.0023	0.0023	
# 4	0.0009	0.0004	0.0014	
# 5	0.0008	0.0019	0.0022	
# 6	0.0019	0.0015	0.0015	
# 7	0.0023	0.0012	0.0013	
# 8	0.0020	0.0006	0.0028	
# 9	0.0024	0.0028	0.0029	
# 10	0.0023	0.0023	0.0015	
# 11	0.0021	0.0020	0.0023	
# 12	0.0015	0.0020	0.0011	
Mean	0.0018	0.0017	0.0019	Overall Mean 0.0018
Std. Dev.	0.0005	0.0007	0.0006	Overall SD 0.0006

**Batch #23**

217854 - Right Hand Regular Pairs.- 90K Nitronic 40 Welded by WeldFab Inspected on 9-5-90 For use in DC0303, DC0304 and DC0305.				
Point No.	A	B	C	
# 1	0.0001	0.0014	0.0020	
# 2	0.0010	0.0004	0.0001	
# 3	0.0017	0.0004	0.0000	
# 4	0.0004	0.0013	0.0012	
# 5	0.0018	0.0006	0.0002	
# 6	0.0016	0.0018	0.0032	
# 7	0.0021	0.0012	0.0016	
# 8	0.0011	0.0005	0.0004	
Mean	0.0012	0.0010	0.0011	Overall Mean 0.0011
Std. Dev.	0.0007	0.0005	0.0011	Overall SD 0.0008

40mm Spot Welding Data

**Batch #24**

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217854 - Right Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on ? For use in DC0303, DC0304 and DC0305					
Point No.	A	B	C		
# 1	0.0017	0.0042	0.0027		
# 2	0.0050	0.0050	0.0004		
# 3	0.0009	0.0021	0.0002		
# 4	0.0008	0.0023	0.0003		
# 5	0.0023	0.0021	0.0003		
# 6	0.0016	0.0021	0.0002		
# 7	0.0029	0.0036	0.0016		
# 8	0.0025	0.0038	0.0013		
# 9	0.0004	0.0002	0.0005		
# 10	0.0018	0.0011	0.0003		
# 11	0.0039	0.0037	0.0020		
# 12	0.0040	0.0050	0.0008		
# 13	0.0043	0.0046	0.0012		
# 14	0.0047	0.0034	0.0018		
# 15	0.0021	0.0010	0.0009		
# 16	0.0019	0.0021	0.0007		
# 17	0.0019	0.0013	0.0006		
# 18	0.0002	0.0018	0.0001		
# 19	0.0034	0.0044	0.0002		
Mean	0.0024	0.0028	0.0008	Overall Mean	0.0020
Std. Dev.	0.0014	0.0014	0.0007	Overall SD	0.0015

**Batch #25**

217861 - Left Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 8-13-90 For use in DC0303, DC0304 and DC0305					
Point No.	A	B	C		
# 1	0.0021	0.0032	0.0031		
# 2	0.0013	0.0019	0.0013		
# 3	0.0016	0.0020	0.0026		
# 4	0.0016	0.0015	0.0017		
# 5	0.0021	0.0036	0.0029		
# 6	0.0031	0.0023	0.0036		
# 7	0.0021	0.0033	0.0025		
# 8	0.0029	0.0025	0.0022		
# 9	0.0005	0.0017	0.0010		
# 10	0.0035	0.0006	0.0019		
# 11	0.0004	0.0025	0.0025		
# 12	0.0033	0.0026	0.0021		
# 13	0.0016	0.0020	0.0018		
# 14	0.0046	0.0004	0.0018		
Mean	0.0022	0.0022	0.0022	Overall Mean	0.0022
Std. Dev.	0.0011	0.0009	0.0007	Overall SD	0.0009

# 40mm Spot Welding Data

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## Batch #26

217861 - Left Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 8-29-90 For use in DC0303, DC0304 and DC0305					
Point No.	A	B	C		
# 1	0.0020	0.0028	0.0031		
# 2	0.0012	0.0013	0.0034		
# 3	0.0026	0.0019	0.0041		
# 4	0.0031	0.0019	0.0044		
# 5	0.0021	0.0027	0.0018		
# 6	0.0013	0.0028	0.0012		
Mean	0.0021	0.0022	0.0030	Overall Mean	0.0024
Std. Dev.	0.0007	0.0006	0.0012	Overall SD	0.0009

## Batch #27

217861 - Left Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 9-5-90 For use in DC0303, DC0304 and DC0305					
Point No.	A	B	C		
# 1	0.0012	0.0001	0.0013		
# 2	0.0016	0.0002	0.0011		
# 3	0.0021	0.0011	0.0007		
# 4	0.0011	0.0003	0.0000		
# 5	0.0002	0.0021	0.0016		
# 6	0.0016	0.0017	0.0023		
# 7	0.0010	0.0017	0.0024		
# 8	0.0021	0.0011	0.0025		
# 9	0.0012	0.0019	0.0020		
# 10	0.0017	0.0023	0.0025		
# 11	0.0013	0.0015	0.0015		
# 12	0.0019	0.0025	0.0026		
Mean	0.0014	0.0014	0.0017	Overall Mean	0.0015
Std. Dev.	0.0005	0.0008	0.0008	Overall SD	0.0007

## Batch #28

217861 - Left Hand Regular Pairs - 90K Nitronic 40 Welded by WeldFab Inspected on 9-24-90 For use in DC0303, DC0304 and DC0305					
Point No.	A	B	C		
# 1	0.0018	0.0008	0.0013		
# 2	0.0013	0.0009	0.0006		
# 3	0.0054	0.0003	0.0040		
# 4	0.0021	0.0013	0.0001		
Mean	0.0027	0.0008	0.0015	Overall Mean	0.0017
Std. Dev.	0.0016	0.0004	0.0015	Overall SD	0.0015

**Batch #29**

271181 - Right Hand Strain Gage Pairs - Vertically split

Welded by WeldFab with hard ceramic

Inspected by John Scott on 10-4-90

From a batch of 300 for use on DS0313

These were welded before K. Ewald added kapton to the pins to tighten the fit.

Point No.	A	B	C		
#1	0.0010	0.0048	0.0014		
#2	0.0023	0.0010	0.0037		
#3	0.0019	0.0023	0.0040		
#4	0.0038	0.0015	0.0022		
#5	0.0002	0.0024	0.0011		
#6	0.0012	0.0012	0.0008		
#7	0.0007	0.0032	0.0010		
#8	0.0006	0.0029	0.0005		
#9	0.0019	0.0013	0.0013		
#10	0.0008	0.0025	0.0005		
#11	0.0007	0.0028	0.0013		
#12	0.0053	0.0017	0.0005		
#13	0.0019	0.0013	0.0011		
#14	0.0011	0.0018	0.0026		
#15	0.0006	0.0029	0.0008		
#16	0.0023	0.0010	0.0010		
#17	0.0025	0.0020	0.0014		
#18	0.0021	0.0019	0.0032		
#19	0.0006	0.0021	0.0039		
#20	0.0014	0.0023	0.0030		
Mean	0.0016	0.0021	0.0032	Overall Mean	0.0019
Std. Dev.	0.0012	0.0009	0.0038	Overall SD	0.0011

40mm Spot Welding Data

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**Batch #30**

217854 - Right Hand Regular Pairs - Horizontally split 90K Nit. 40 Welded by H & J Routing Form #40654 To be used in DC0303 and DC0304					
Point No.	A	B	C		
#1	0.0017	0.0042	0.0027		
#2	0.0050	0.0050	0.0004		
#3	0.0009	0.0021	0.0002		
#4	0.0008	0.0023	0.0003		
#5	0.0023	0.0021	0.0003		
#6	0.0016	0.0021	0.0002		
#7	0.0029	0.0036	0.0016		
#8	0.0025	0.0038	0.0013		
#9	0.0004	0.0002	0.0005		
#10	0.0018	0.0011	0.0003		
#11	0.0039	0.0037	0.0020		
#12	0.0040	0.0050	0.0008		
#13	0.0043	0.0046	0.0012		
#14	0.0047	0.0034	0.0018		
#15	0.0021	0.0010	0.0009		
#16	0.0019	0.0021	0.0007		
#17	0.0019	0.0013	0.0006		
#18	0.0002	0.0018	0.0001		
#19	0.0034	0.0044	0.0002		
Mean	0.0024	0.0028	0.0008	Overall Mean	0.0020
Std. Dev.	0.0014	0.0014	0.0007	Overall SD	0.0015

**Batch #31**

217861 - Left Hand Regular Pairs - Horizontally split 90K Nit. 40 Welded by H & J Routing Form #40655 To be used in DC0303 and DC0304					
Point No.	A	B	C		
#1	0.0020	0.0013	0.0022		
#2	0.0002	0.0001	0.0009		
#3	0.0008	0.0021	0.0011		
#4	0.0002	0.0007	0.0006		
#5	0.0023	0.0005	0.0003		
#6	0.0017	0.0026	0.0004		
#7	0.0013	0.0012	0.0006		
#8	0.0002	0.0017	0.0016		
#9	0.0005	0.0007	0.0003		
#10	0.0004	0.0003	0.0005		
#11	0.0002	0.0002	0.0003		
#12	0.0022	0.0004	0.0018		
Mean	0.0010	0.0010	0.0009	Overall Mean	0.0010
Std. Dev.	0.0008	0.0008	0.0006	Overall SD	0.0007

**Batch #32**

271177 - Hand Regular Pairs - Vertically split 90K Nit. 40 Welded by WeldFab Routing Form #40699 Inspected by J. Scott 10-12-90 To be used in DS0313 body					
Point No.	A	B	C		
# 1	0.0009	0.0019	0.0020		
# 2	0.0008	0.0020	0.0011		
# 3	0.0018	0.0009	0.0004		
# 4	0.0009	0.0021	0.0019		
# 5	0.0013	0.0020	0.0021		
# 6	0.0029	0.0017	0.0033		
Mean	0.0014	0.0018	0.0018	Overall Mean	0.0017
Std. Dev.	0.0007	0.0004	0.0009	Overall SD	0.0007

**Batch #33**

217178 - Hand Regular Pairs - Vertically split 90K Nit. 40 Welded by WeldFab Routing Form #40700 Inspected by J. Scott 10-12-90 To be used in DS0313 body					
Point No.	A	B	C		
# 1	0.0010	0.0014	0.0012		
# 2	0.0019	0.0016	0.0019		
# 3	0.0009	0.0010	0.0008		
# 4	0.0015	0.0012	0.0016		
# 5	0.0016	0.0006	0.0010		
# 6	0.0011	0.0013	0.0014		
Mean	0.0013	0.0012	0.0013	Overall Mean	0.0013
Std. Dev.	0.0004	0.0003	0.0004	Overall SD	0.0004

**Batch #34**

271181 - Strain Gage Pairs - Vertically split 90K Nit. 40 Welded by WeldFab with hard ceramic Routing Form #40701 To be used in DSO313, 314, and 315					
Point No.	A	B	C		
# 1	0.0023	0.0010	0.0013		
# 2	0.0013	0.0020	0.0008		
# 3	0.0015	0.0023	0.0018		
# 4	0.0008	0.0013	0.0008		
# 5	0.0008	0.0026	0.0018		
# 6	0.0016	0.0016	0.0014		
# 7	0.0015	0.0019	0.0012		
# 8	0.0018	0.0018	0.0009		
# 9	0.0015	0.0021	0.0019		
# 10	0.0020	0.0013	0.0017		
# 11	0.0015	0.0021	0.0021		
# 12	0.0018	0.0046	0.0051		
# 13	0.0013	0.0012	0.0000		
# 14	0.0023	0.0015	0.0026		
Mean	0.0016	0.0020	0.0017	Overall Mean	0.0017
Std. Dev.	0.0004	0.0009	0.0011	Overall SD	0.0009

**Batch #35**

217854 - Right Hand regular Pairs - Horizontally split 90K Nit. 40 Welded by H & J Routing Form #40735 Inspected by J. Scott on 10-15-90 To be used in DCO305					
Point No.	A	B	C		
# 1	0.0002	0.0014	0.0004		
# 2	0.0020	0.0021	0.0006		
# 3	0.0008	0.0009	0.0018		
# 4	0.0020	0.0048	0.0025		
# 5	0.0006	0.0004	0.0001		
# 6	0.0015	0.0012	0.0001		
Mean	0.0012	0.0018	0.0009	Overall Mean	0.0013
Std. Dev.	0.0007	0.0014	0.0009	Overall SD	0.0011

**Batch #36**

217861 - Left Hand Regular Pairs - Horizontally split 90K Nit. 40  
 Welded by H & J  
 Routing Form #40736 Inspected by J. Scott on 10-15-90  
 To be used in DCO303, 304, and 305

Point No.	A	B	C		
# 1	0.0011	0.0040	0.0007		
# 2	0.0014	0.0007	0.0019		
# 3	0.0000	0.0005	0.0011		
# 4	0.0017	0.0009	0.0017		
# 5	0.0006	0.0005	0.0013		
# 6	0.0010	0.0008	0.0013		
# 7	0.0021	0.0012	0.0021		
# 8	0.0005	0.0008	0.0007		
Mean	0.0011	0.0012	0.0014	Overall Mean	0.0012
Std. Dev.	0.0006	0.0011	0.0005	Overall SD	0.0008

**Batch #37**

271177 - Hand regular Pairs - Vertically split 90K Nit. 40  
 Welded by WeldFab  
 Routing Form #40783 Inspected by J. Scott on 10-23-90  
 To be used in DS0303, 314 and 315

Point No.	A	B	C		
# 1	0.0032	0.0025	0.0052		
# 2	0.0027	0.0026	0.0030		
# 3	0.0006	0.0002	0.0019		
# 4	0.0011	0.0008	0.0004		
# 5	0.0025	0.0007	0.0016		
# 6	0.0029	0.0028	0.0043		
Mean	0.0022	0.0016	0.0027	Overall Mean	0.0022
Std. Dev.	0.0010	0.0011	0.0016	Overall SD	0.0013

**Batch #38**

271178 - Hand regular Pairs - Vertically split 90K Nit. 40  
 Welded by WeldFab  
 Routing Form #40784 Inspected by J. Scott on 10-23-90  
 To be used in DS0303, 314 and 315

Point No.	A	B	C		
# 1	0.0022	0.0013	0.0022		
# 2	0.0013	0.0009	0.0012		
# 3	0.0021	0.0009	0.0000		
# 4	0.0007	0.0019	0.0004		
# 5	0.0009	0.0014	0.0004		
# 6	0.0013	0.0008	0.0007		
Mean	0.0014	0.0012	0.0008	Overall Mean	0.0011
Std. Dev.	0.0006	0.0004	0.0007	Overall SD	0.0006

40mm Spot Welding Data

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**Batch #39**

217854 -- Right Hand Regular Pairs - Horizontally split 90K Nit. 40  
Welded by H & J  
Routing Form #40793 Inspected by J. Scott on 10-24-90  
To be used in DCO305

Point No.	A	B	C		
# 1	0.0039	0.0036	0.0010		
# 2	0.0068	0.0007	0.0054		
# 3	0.0003	0.0033	0.0011		
# 4	0.0055	0.0011	0.0023		
# 5	0.0004	0.0015	0.0016		
# 6	0.0003	0.0007	0.0006		
# 7	0.0053	0.0015	0.0023		
# 8	0.0036	0.0025	0.0003		
# 9	0.0039	0.0041	0.0010		
# 10	0.0040	0.0035	0.0016		
# 11	0.0019	0.0009	0.0017		
# 12	0.0041	0.0034	0.0008		
# 13	0.0013	0.0031	0.0003		
# 14	0.0045	0.0037	0.0004		
# 15	0.0046	0.0034	0.0013		
# 16	0.0012	0.0026	0.0004		
# 17	0.0013	0.0061	0.0025		
# 18	0.0045	0.0038	0.0013		
# 19	0.0005	0.0040	0.0018		
# 20	0.0084	0.0013	0.0034		
# 21	0.0020	0.0003	0.0005		
# 22	0.0032	0.0003	0.0015		
# 23	0.0049	0.0038	0.0008		
# 24	0.0053	0.0029	0.0005		
# 25	0.0020	0.0023	0.0002		
# 26	0.0035	0.0016	0.0002		
# 27	0.0034	0.0020	0.0006		
# 28	0.0030	0.0009	0.0009		
Mean	0.0033	0.0025	0.0013	Overall Mean	0.0024
Std. Dev.	0.0020	0.0014	0.0011	Overall SD	0.0018

**Batch #40**

217861 - Left Hand regular Pairs - Horizontally split 90K Nit. 40  
 Welded by H & J  
 Routing Form #40794  
 To be used in DCO305

Point No.	A	B	C		
# 1	0.0010	0.0014	0.0000		
# 2	0.0004	0.0053	0.0023		
# 3	0.0030	0.0026	0.0019		
# 4	0.0033	0.0026	0.0019		
# 5	0.0017	0.0036	0.0000		
# 6	0.0025	0.0023	0.0001		
Mean	0.0020	0.0030	0.0010	Overall Mean	0.0020
Std. Dev.	0.0010	0.0012	0.0010	Overall SD	0.0014

**Batch #41**

217907 - Strain gage Pack Pairs - Horizontally split 90K Nit. 40  
 Welded by H & J  
 Routing Form #40795  
 Not scheduled to be used in any magnet

Point No.	A	B	C		
# 1	0.0030	0.0004	0.0005		
# 2	0.0026	0.0009	0.0005		
# 3	0.0006	0.0005	0.0014		
# 4	0.0010	0.0074	0.0056		
# 5	0.0019	0.0032	0.0030		
# 6	0.0024	0.0017	0.0014		
# 7	0.0069	0.0026	0.0064		
# 8	0.0004	0.0011	0.0010		
# 9	0.0016	0.0025	0.0010		
# 10	0.0006	0.0028	0.0023		
# 11	0.0017	0.0017	0.0010		
# 12	0.0040	0.0016	0.0000		
# 13	0.0038	0.0015	0.0003		
# 14	0.0093	0.0030	0.0065		
# 15	0.0048	0.0007	0.0012		
Mean	0.0030	0.0021	0.0021	Overall Mean	0.0024
Std. Dev.	0.0024	0.0017	0.0021	Overall SD	0.0021

### Batch #42

271177 - Hand regular Pairs - Vertically split 90K Nit. 40 Welded by WeldFab Routing Form #40835 Inspected by John Scott To be used in DSO314 & DSO315					
Point No.	A	B	C		
# 1	0.0038	0.0013	0.0036		
# 2	0.0027	0.0011	0.0027		
# 3	0.0025	0.0016	0.0027		
# 4	0.0038	0.0026	0.0035		
# 5	0.0029	0.0035	0.0048		
Mean	0.0031	0.0020	0.0035	Overall Mean	0.0029
Std. Dev.	0.0006	0.0009	0.0008	Overall SD	0.0010

### Batch #43

271178 - Hand regular Pairs - Vertically split 90K Nit. 40 Welded by WeldFab Routing Form #40836 Inspected by John Scott To be used in DSO314 & DSO315					
Point No.	A	B	C		
# 1	0.0015	0.0017	0.0022		
# 2	0.0001	0.0018	0.0010		
# 3	0.0008	0.0032	0.0016		
# 4	0.0015	0.0034	0.0034		
# 5	0.0013	0.0033	0.0032		
Mean	0.0010	0.0027	0.0023	Overall Mean	0.0020
Std. Dev.	0.0005	0.0008	0.0009	Overall SD	0.0010

# 40mm Spot Welding Data

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## Batch #44

Brookhaven Laminations - 90K Nitronic 40 Stamped and Welded by H & J Inspected on 9-23-91 Lams from this batch were sent from BNL to use in Fermi long models				
Point No.	A	B	C	
#1	0.0011	0.0001	0.0003	
#2	0.0004	0.0000	0.0008	
#3	0.0008	0.0005	0.0004	
#4	0.0002	0.0011	0.0012	
#5	0.0000	0.0009	0.0007	
#6	0.0004	0.0004	0.0008	
#7	0.0004	0.0007	0.0004	
#8	0.0002	0.0014	0.0014	
#9	0.0012	0.0015	0.0002	
#10	0.0003	0.0006	0.0014	
#11	0.0006	0.0000	0.0000	
#12	0.0007	0.0006	0.0007	
#13	0.0009	0.0002	0.0008	
#14	0.0013	0.0010	0.0002	
#15	0.0004	0.0005	0.0008	
#16	0.0004	0.0003	0.0004	
#17	0.0006	0.0007	0.0008	
#18	0.0004	0.0008	0.0014	
#19	0.0001	0.0007	0.0004	
#20	0.0000	0.0002	0.0002	
#21	0.0013	0.0009	0.0012	
Mean	0.0006	0.0006	0.0007	Overall Mean 0.0006
Std. Dev.	0.0004	0.0004	0.0004	Overall SD 0.0004

Figure 3

VERTICAL SPLIT YOKE (1/4 INCH SHELL. LORENTZ FORCE EFFECT, COLD)

