SSC-MAG-123
SSC-N- 297
LBID-1266
2/3/87

COIL PRESTRESS BEHAVIOR IN WELDED 15mm S.S. COLLARS

C. Peters

During the past year, several tests of welded 15mm S.S. collars have been completed at LBL and BNL. The goal of these tests was to measure and compare prestress losses for coils collared using standard 15mm S.S. collars and welded 15mm S.S. collars. Similar types of pressure gages were used at LBL and BNL in both inner and outer coil layers. The BNL tests compared 6 standard collar packs to 6 spot-welded collar packs (Fig. 1). Room temperature prestresses were measured. The results were reported by R. LeRoy in a Dipole Program Review meeting in July , 1986, and are reproduced here as Table I. The first LBL test, completed in Jan. , 1986, tested two standard collar packs and 1 fully-welded collar pack (Fig. 2). During this test only the inner coil prestress was measured. The second LBL test, completed in Jan. , 1987, tested 1 standard collar pack and 1 spot-welded collar pack. Warm and cold coil prestress measurements were made in each LBL test. Results of the 2 LBL tests are shown in Table II. Table III summarizes the BNL and LBL results with the data normalized to 18 Kpsi starting assembly prestress. Also, Table III includes the average measured prestress losses for 10 1-M models from Ref. 1, Table I. Although welding, particularly in the fully welded case, decreases springback prestress loss, the more rigid welded structure results in larger cooldown prestress loss due to its inability to elastically follow the contracting coil during cooldown. The net gain in cold prestress on the inner layer produced by welding is 0.9 Kpsi and 1.7 Kpsi, for the fully-welded and spot-welded collars, respectively, over the average 1-M model cold prestress.

(1) C. Peters, "Springback, Creep, and Cooldown Prestress Losses in Nineteen Collared 1-M Dipole Models Constructed at LBL," LBID-1265, SSC-MAG-122, SSC-N- 296 (2/3/87).

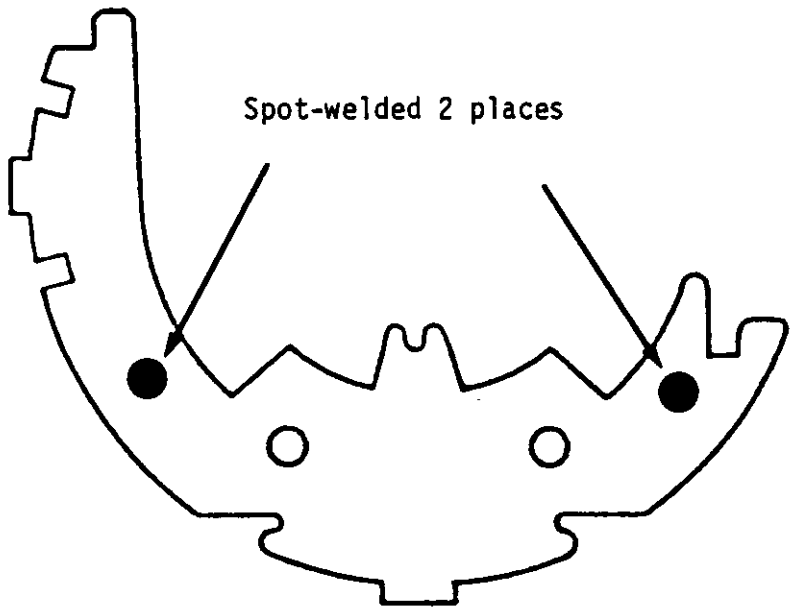

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FIG. L. Spot-welded 15mm S.S. Collars

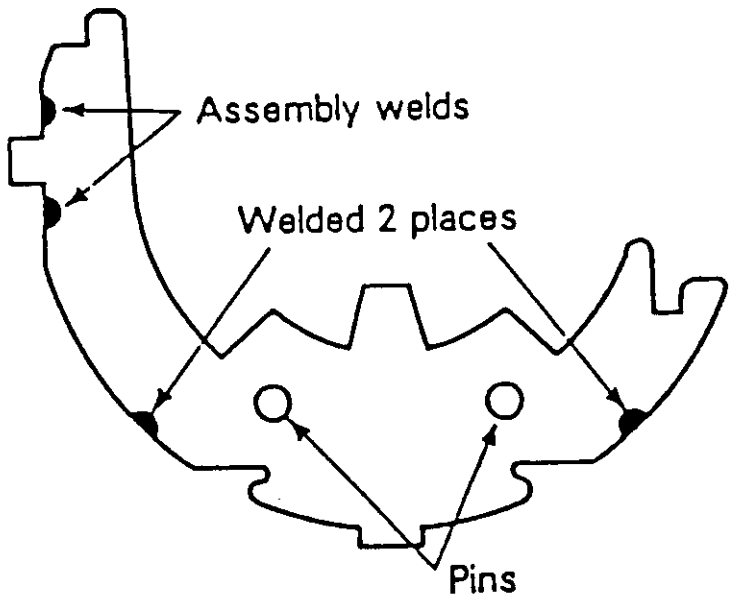

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Fig. 2. Fully-welded 15mm S.S. Collars

TABLE I

Collar Pack Test Summary Chart

ASSEMBLY	SHIMS inner mils	SHIMS outer mils	PEAK STRESS inner ksi	PEAK STRESS outer ksi	STRESS REMAINING inner ksi	STRESS REMAINING outer ksi	STRESS REMAINING AVG ksi	PRESTRESS LOSS inner ksi	PRESTRESS LOSS outer ksi	PRESTRESS LOSS AVG ksi	SPRING BACK mils rad.	VERT. DEFL. mils rad.	COIL MODULUS inner E6 psi	COIL MODULUS outer E6 psi
ASSY 2	36	46	16.9	14.0	9.4	5.5	7.5	7.5	8.5	8.0	10.5	5.0	0.71	0.81
ASSY 3	38	49	15.5	14.6	10.4	7.1	8.8	5.1	7.5	6.3	9.5	5.5	0.54	0.79
ASSY 4	36	46	16.1	9.2	9.9	2.8	6.4	6.2	6.4	6.3	11.0	6.5	0.56	0.58
ASSY 5	36	49	15.9	11.8	9.0	4.2	6.6	6.9	7.6	7.3	12.0	6.5	0.58	0.63
ASSY 6	38	49	17.5	11.5	8.6	3.5	6.1	8.9	8.0	8.5	12.5	6.5	0.71	0.64
ASSY 7	38	49	16.0	11.4	8.6	3.7	6.2	7.4	7.7	7.6	13.5	7.0	0.55	0.57
	AVERAGE:		16.3	12.1	9.3	4.5	6.9	7.0	7.6	7.3	11.5	6.2	0.61	0.67
	STD. DEV.:							1.3	0.7				0.08	0.10
SW 2	35	45	11.8	12.1	6.3	6.7	6.5	5.5	5.4	5.5	--	5.0	--	--
SW 3	35	45	11.2	9.2	6.2	5.2	5.7	5.0	4.0	4.5	6.0	5.5	0.83	0.67
SW 4	38	45	14.0	8.2	9.9	4.3	7.1	4.1	3.9	4.0	6.0	6.0	0.68	0.65
SW 5	35	43	15.0	6.2	9.2	2.4	5.8	5.8	3.8	4.8	6.0	4.5	0.97	0.63
SW 6	35	43	14.5	6.5	8.6	2.0	5.3	5.9	4.5	5.2	6.0	4.5	0.98	0.75
SW 7	36	46	14.8	8.6	9.4	3.9	6.7	5.4	4.7	5.1	6.5	5.5	0.83	0.72
	AVERAGE:		13.6	8.5	8.3	4.1	6.2	5.3	4.4	4.8	6.1	5.2	0.86	0.68
	STD. DEV.:							0.7	0.6				0.12	0.05
							AVERAGE:	9.0	11.0	10.2	LONG MAGNETS			
							STD. DEV.:	2.0	1.5		(SLN-010 to LLN-002)			

NOTES: Keys "tapped" in for all cases.
Coil ends restrained in SW 6 and SW 7
One inner gage not working in SW 2
Fast loading rate in ASSY 7
Apparent Coil Modulus = (Prestress Loss) / (Spring Back)

TABLE II

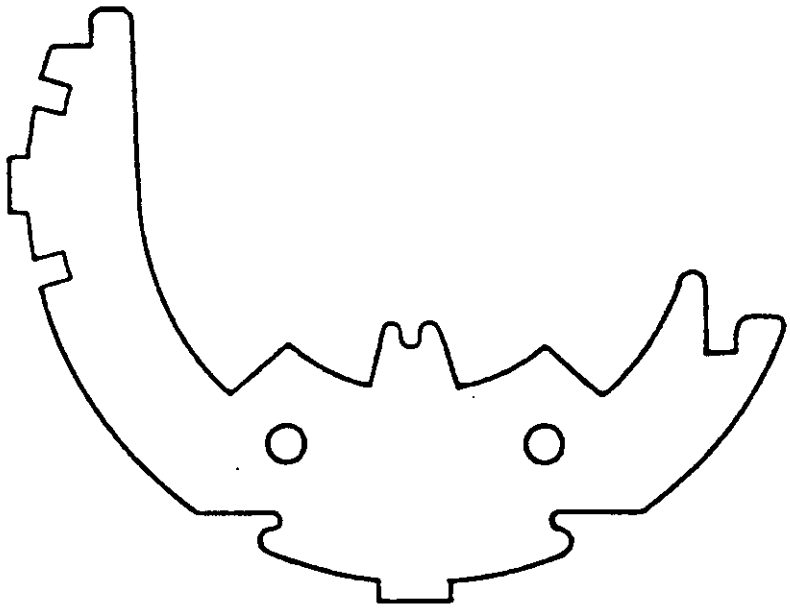
COLLAR COMPARISON TEST OF WELDED AND NON-WELDED 15mm S.S. COLLARS AT LBL

COLLAR TYPE	ASSEMBLY INNER/OUTER	RESIDUAL SPRINGBACK LOSS			BEFORE COOLDOWN	CREEP LOSS		AFTER COOLDOWN	COOLDOWN LOSS	
	(Kpsi)	(Kpsi)	(Kpsi)	(%)	(Kpsi)	(Kpsi)	(%)	(Kpsi)	(Kpsi)	(%)
TEST #1										
NON-WELD	26.2	10.5	15.7	60	9.8	0.7	7	4.2	5.6	57
(BNL type)	-	-	-	-	-	-	-	-	-	-
NON-WELD	16.4	8.3	8.1	49	7.9	0.4	5	4.3	3.6	46
(LBL type)	-	-	-	-	-	-	-	-	-	-
FULL-WELD	17.9	12.5	5.4	30	10.9	1.6	13	3.1	7.8	72
(BNL type)	-	-	-	-	-	-	-	-	-	-
TEST #2										
NON-WELD	16.7	8.0	8.7	52	7.1	0.9	11	2.6	4.5	63
(LBL type)	19.6	5.6	14.0	71	4.9	0.7	13	2.3	2.6	53
SPOT-WELD	20.2	9.8	10.4	51	9.3	0.5	5	4.4	4.9	53
(BNL type)	17.7	7.1	10.6	60	6.6	0.5	7	3.1	3.5	53

TABLE III

SUMMARY OF COIL PRESTRESS DATA (NORMALIZED TO 18Kpsi) FOR WELDED 15mm S.S. COLLAR TESTS AT LBL AND BNL

COLLAR TYPE	ASSEMBLY INNER/OUTER	RESIDUAL SPRINGBACK LOSS			BEFORE COOLDOWN	CREEP LOSS		AFTER COOLDOWN	COOLDOWN LOSS	
	(Kpsi)	(Kpsi)	(Kpsi)	(%)	(Kpsi)	(Kpsi)	(%)	(Kpsi)	(Kpsi)	(%)
LBL TEST #1										
NON-WELD	18.0	7.2	10.8	60	6.7	0.5	7	2.9	3.8	57
(BNL type)	-	-	-	-	-	-	-	-	-	-
NON-WELD	18.0	9.2	8.8	49	8.7	0.5	5	4.7	4.0	46
(LBL type)	-	-	-	-	-	-	-	-	-	-
FULL-WELD	18.0	12.6	5.4	30	11.0	1.6	13	3.1	7.9	72
(BNL type)	-	-	-	-	-	-	-	-	-	-
LBL TEST #2										
NON-WELD	18.0	8.6	9.4	52	7.7	1.0	11	2.8	4.8	63
(LBL type)	18.0	5.2	12.8	71	4.5	0.7	13	2.1	2.4	53
SPOT-WELD	18.0	8.8	9.2	51	8.4	0.4	5	3.9	4.4	53
(BNL type)	18.0	7.2	10.8	60	6.7	0.5	7	3.1	3.5	53
BNL TEST										
NON-WELD	18.0	10.3	7.7	43	-	-	-	-	-	-
	18.0	6.7	11.3	63	-	-	-	-	-	-
SPOT-WELD	18.0	11.0	7.0	39	-	-	-	-	-	-
	18.0	8.6	9.4	52	-	-	-	-	-	-
LBL 1-M MODELS										
NON-WELD	18.0	7.7	10.3	57	6.6	1.2	15	2.2	4.4	67
	18.0	7.7	10.3	57	6.4	1.3	17	4.8	1.7	26



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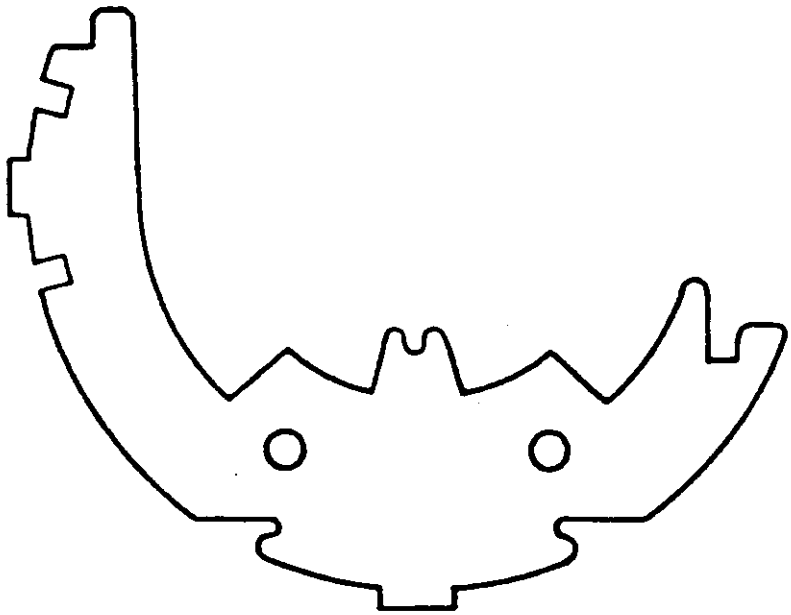

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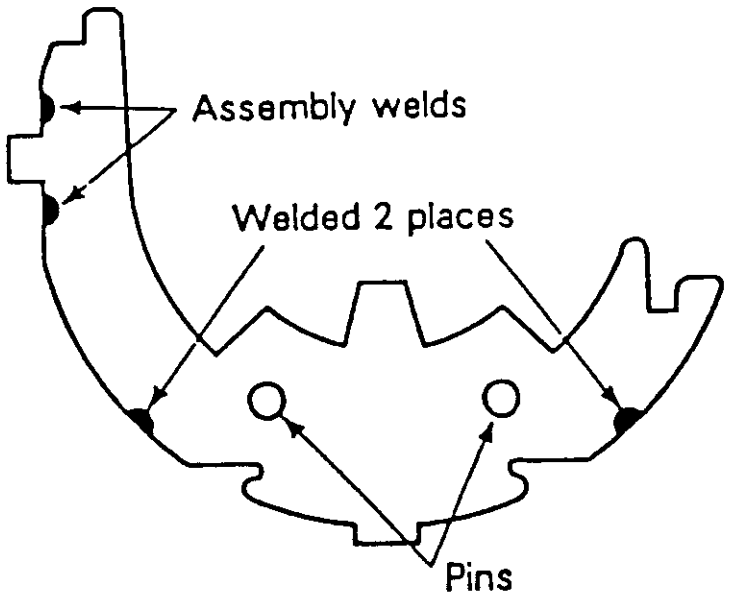

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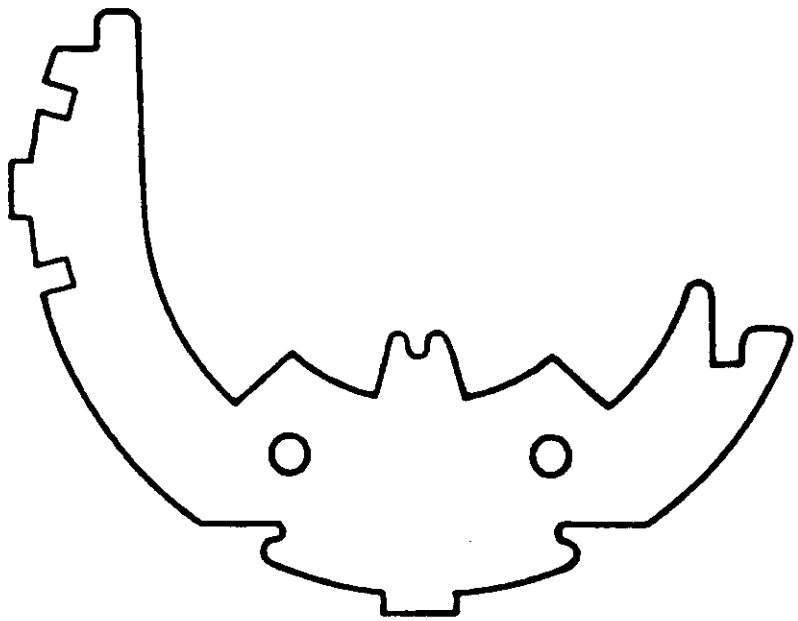

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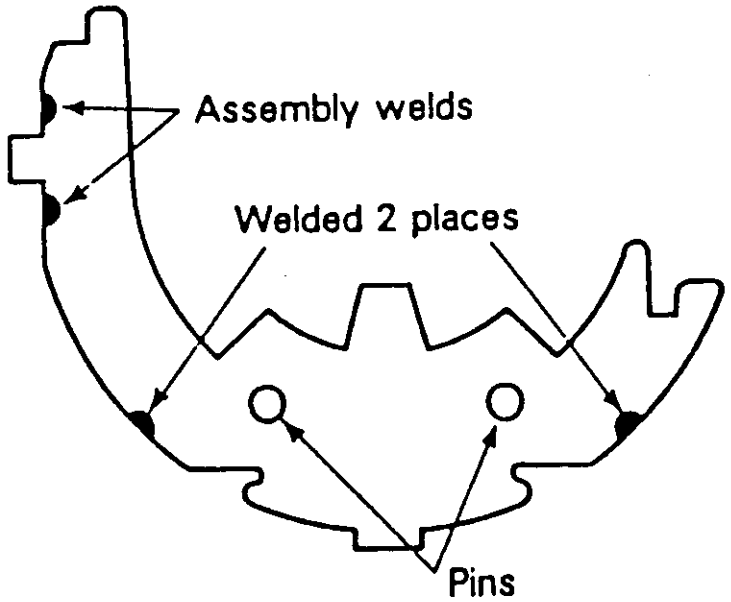

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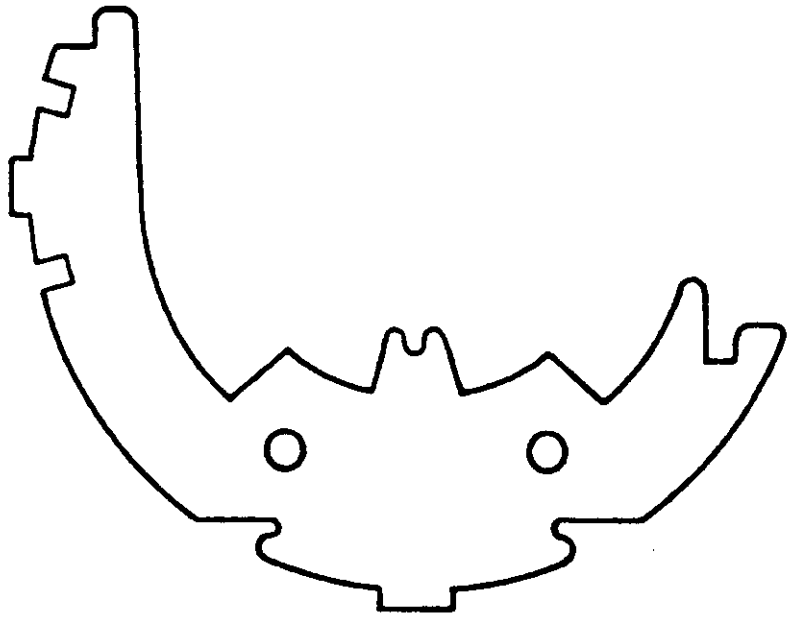

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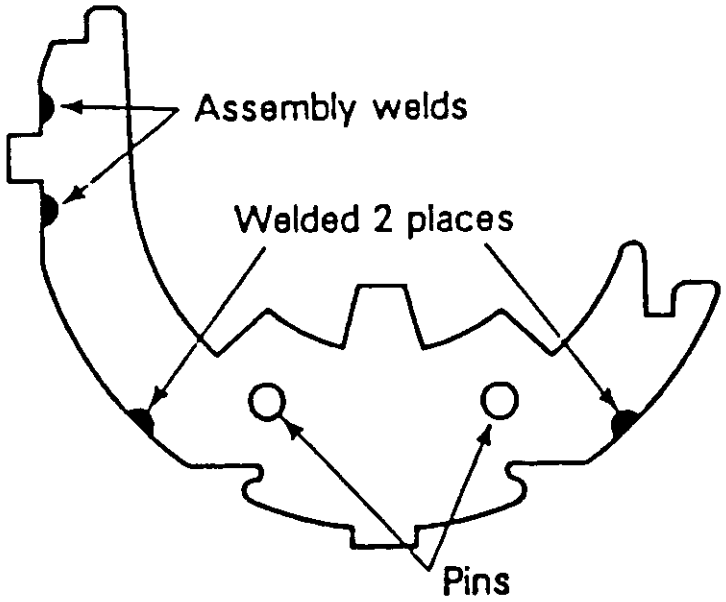

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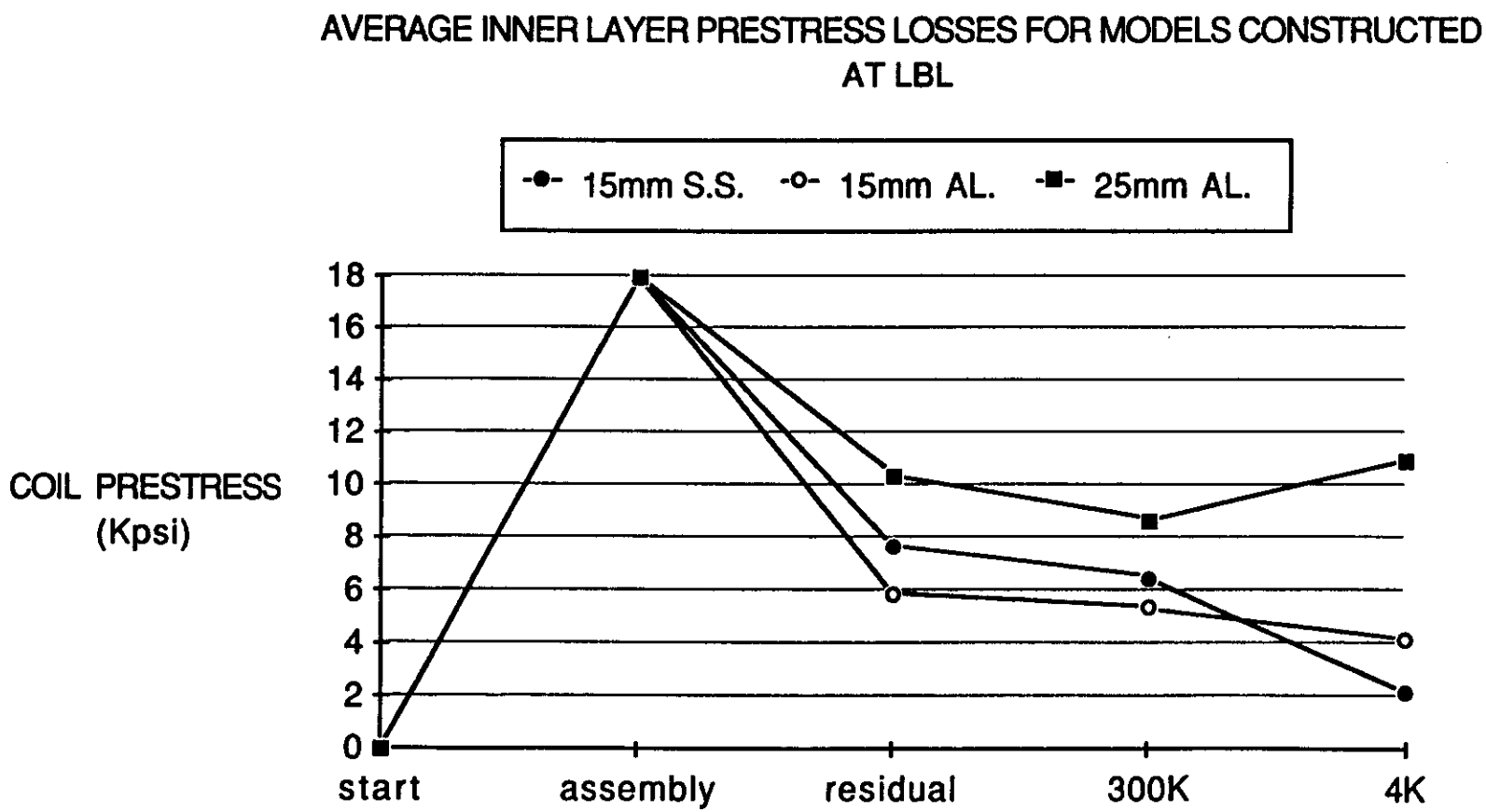
AVERAGE INNER LAYER PRESTRESS LOSSES FOR MODELS CONSTRUCTED AT LBL
15mm S.S.
15mm AL.
25mm AL.
COIL PRESTRESS (Kpsi)
18
16
14
12
10
8
6
4
2
0
start
assembly
residual
300K
4K

FIG. 1