TS-SSC 91-060

DEVELOPMENT OF COLLAR KEYING PROCEDURES

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DEVELOPMENT OF COLLAR KEYING PROCEDURES

OBJECTIVES

1) OPTIMIZE PROCEDURES TO MINIMIZE PEAK COIL STRESS IN COLLARING PRESS:
   a) "PRIMARY" METHOD: SET THE KEYS IN ("SQUARE KEY" METHOD).
   b) "BACKUP" METHOD: DRIVE THE KEYS IN ("TAPERED KEY" METHOD).

2) DETERMINE COIL SIZE + POLE SHIM COMBINATION THAT GIVES PRESTRESS IN THE TARGET WINDOW: 10 (8) ± 2 KPSI IN THE INNER (OUTER) COIL.

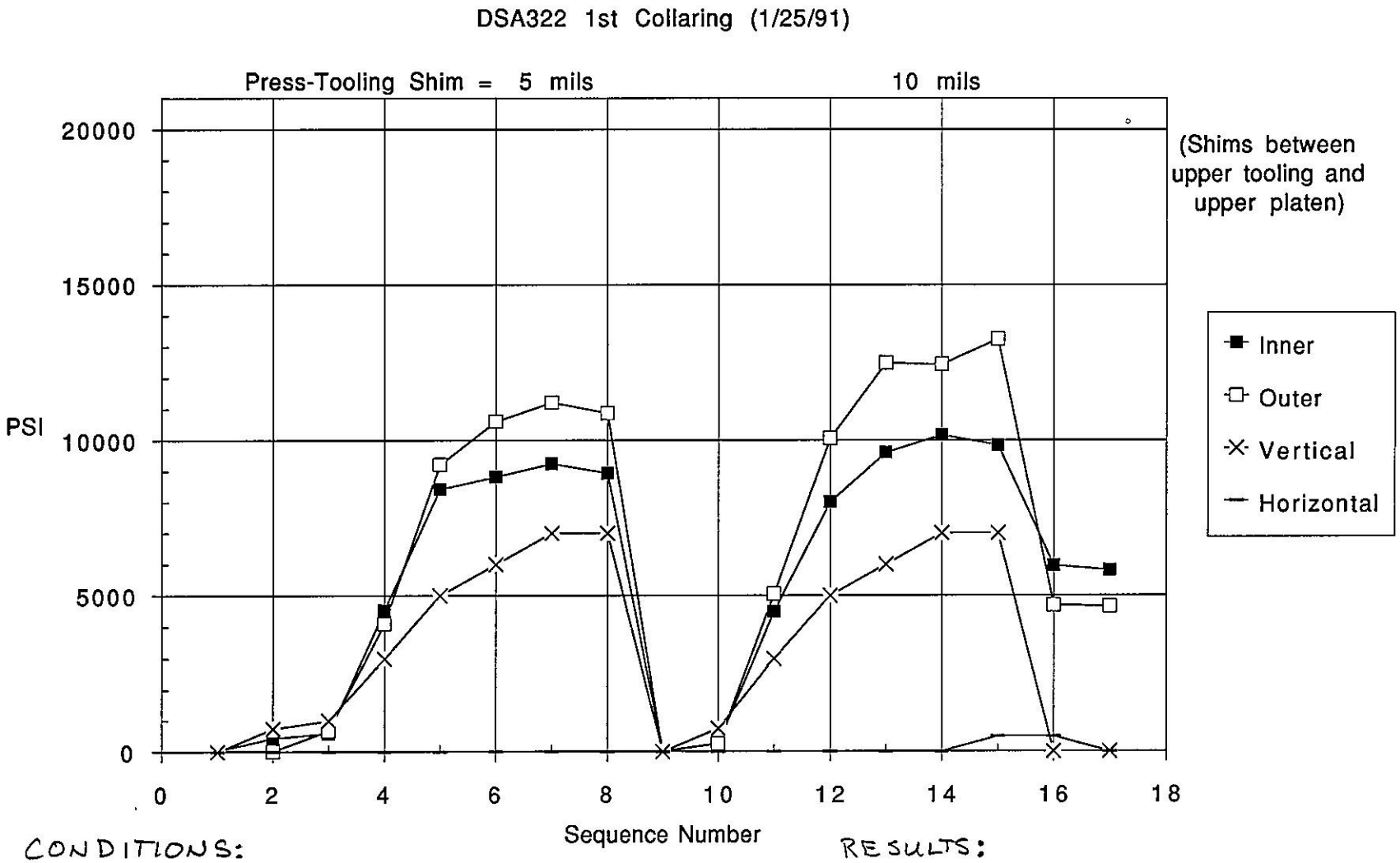
3) OPTIMIZING FIELD QUALITY IS NOT A PRIMARY OBJECTIVE BUT HARMONICS ARE MEASURED ON EACH ASSEMBLY

TOOLING IS DESIGNED TO OPERATE IN A "CLOSED CAVITY" CONDITION – COLLARS ARE CLOSED TO A FIXED DIMENSION AND THE KEYS ARE INSERTED.

OPTIMIZE

1) VERTICAL PRESS STOP TO
   a) SET KEY INTO COLLARS WITH MINIMAL OVERCOMPRESSION ("SQUARE KEY" METHOD), OR
   b) DRIVE KEYS INTO COLLARS WITH MINIMAL SIDE FORCE ("TAPERED KEY" METHOD).

2) AZIMUTHAL ALIGNMENT OF UPPER RELATIVE TO LOWER COLLARS TO ACHIEVE THE SAME OBJECTIVES.

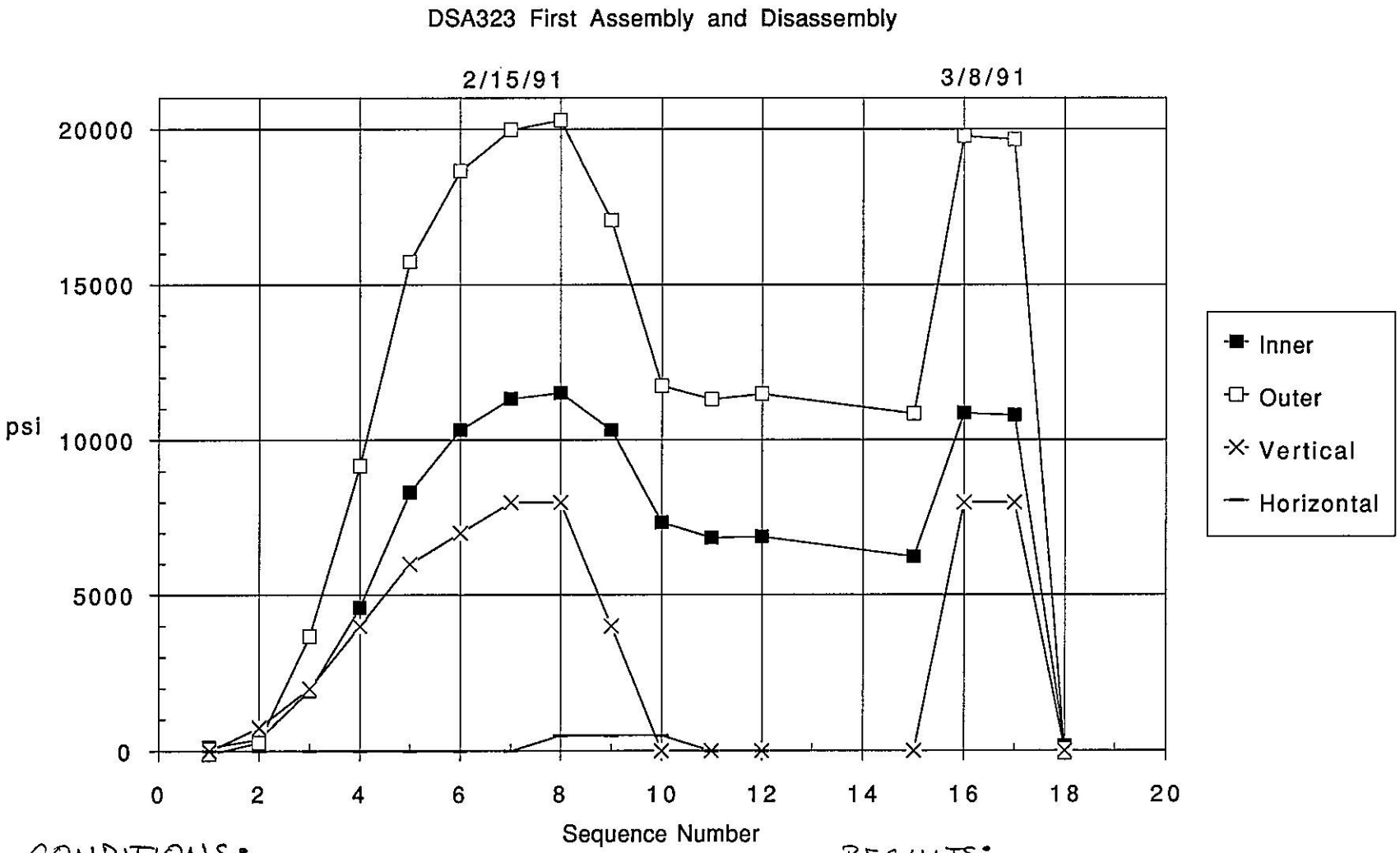


CONDITIONS:

1) NO POLE SHIMS
2) EDMed TOOLING:
   UPPER - NO AZIMUTHAL ALIGNMENT FEATURES

RESULTS:

1) SIGNIFICANT AZIMUTHAL MIS-ALIGNMENT ~ 12-15 mil LEFT-RIGHT COLLAR CLOSURE DIFFERENCE
2) SIGNIFICANT OVERCOMPRESSION REQUIRED TO OVERCOME EFFECT OF (1)

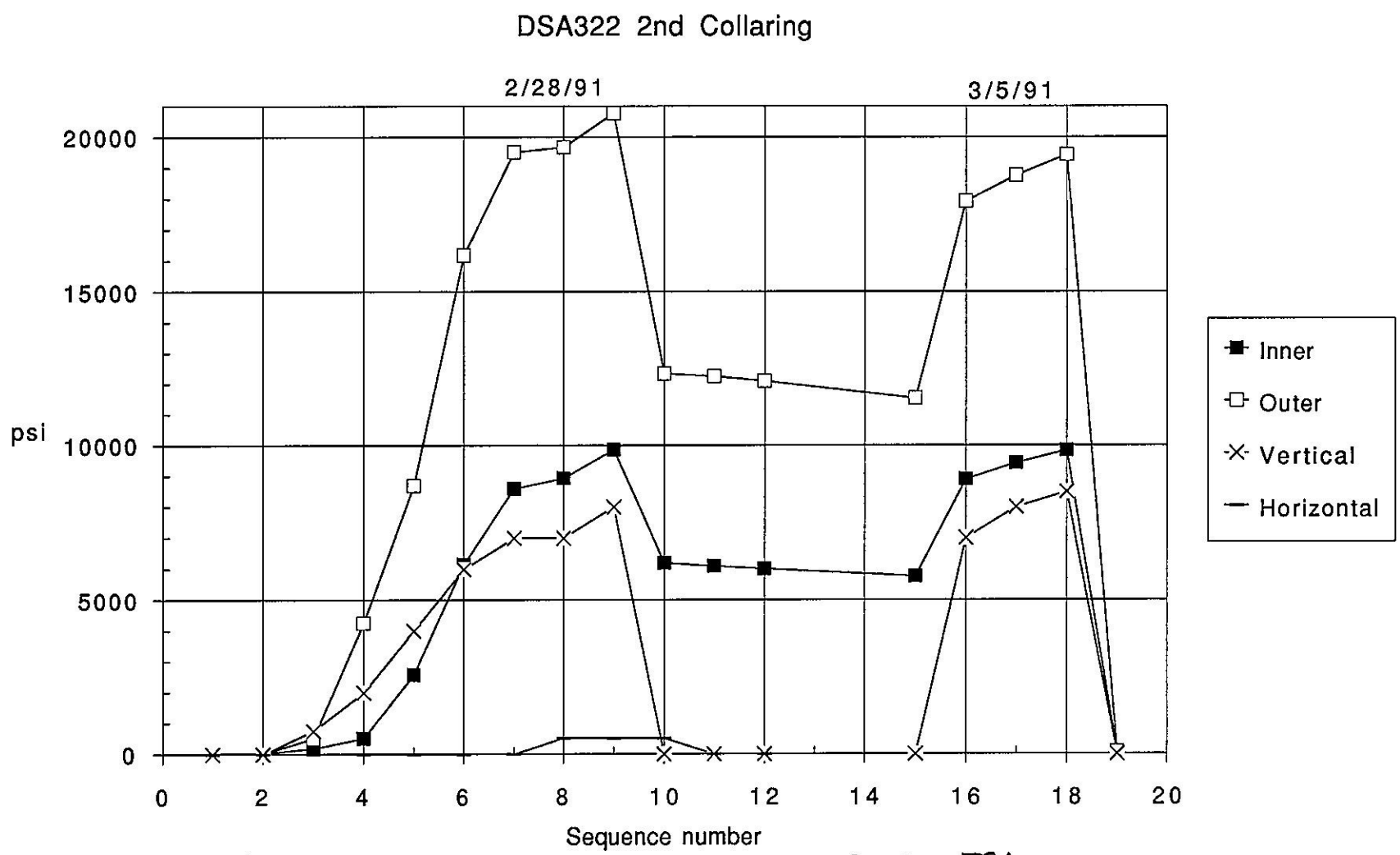


CONDITIONS:

1) NO POLE SHIMS
2) LAMINATED UPPER TOOLING HAS ALIGNMENT FEATURES
3) 5 mil PRESS STOP SHIM

RESULTS:

1) SIGNIFICANT AZIM. MIS-ALIGNMENT ~10-12 mil LEFT-RIGHT DIFFERENCE
2) KEYS NOT FULLY INSERTED (~10 mils) AT 500 LBS./IN.

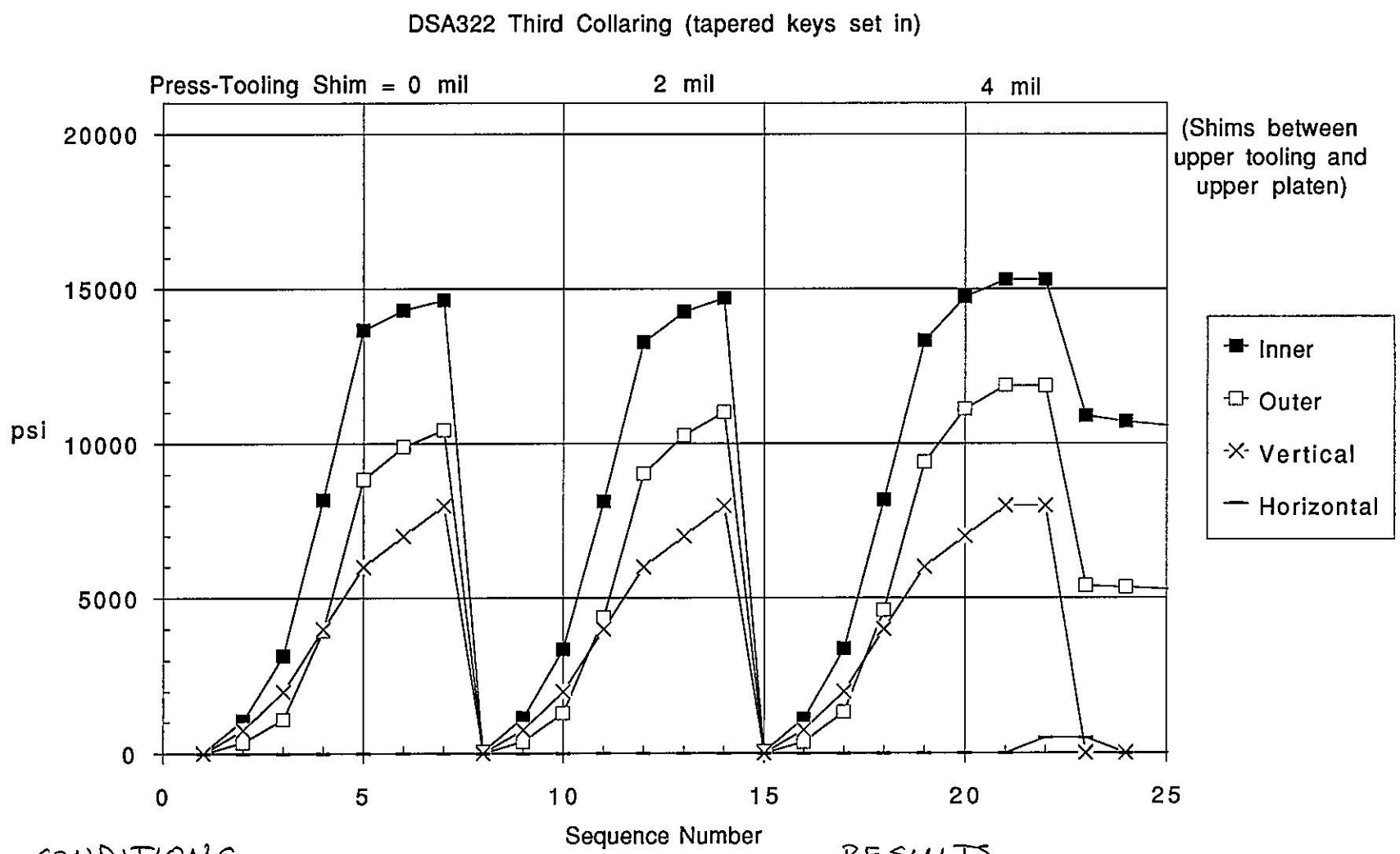


CONDITIONS:

1) NO POLE SHIMS
2) 5 MIL "AZIMUTHAL" SHIMS, 4 QUADRANTS
3) 5 MIL PRESS STOP SHIM

RESULTS:

1) NO AZIMUTHAL MIS-ALIGNMENT
2) KEYS FULLY INSERTED AT 500 LBS./IN.



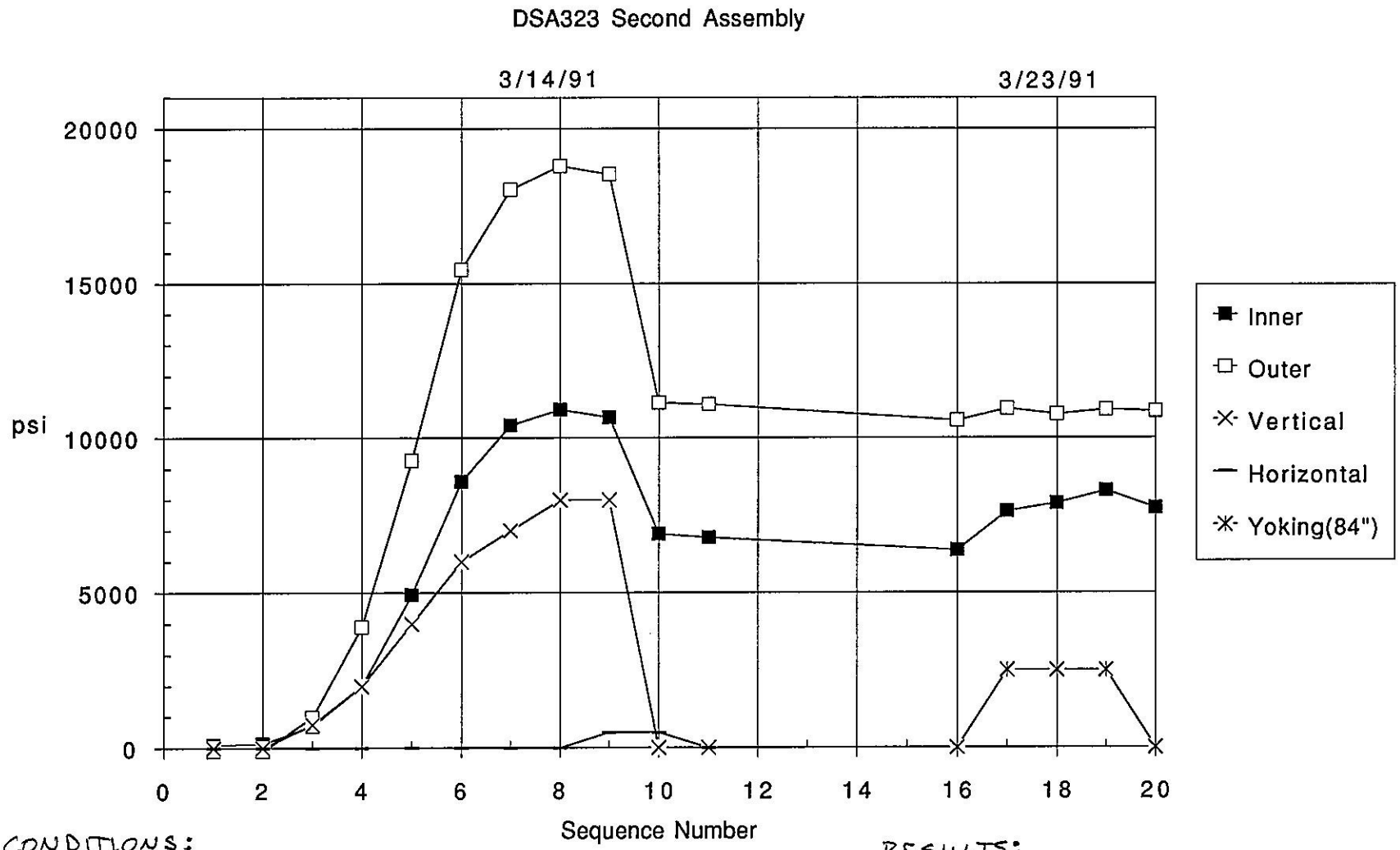
CONDITIONS

1) +5 (−5) MIL INNER (OUTER) POLE SHIM
2) 5 MIL "AZIMUTHAL" SHIMS
3) INCREASE PRESS STOP SHIM UNTIL KEYS CAN BE PLACED BY HAND

RESULTS

1) 4 MIL PRESS STOP SHIM OPTIMAL FOR "SQUARE KEY" METHOD
2) INNER COIL "SPRING-BACK" = 4.5 KPSI
3) NO MID-PLANE INSULATION DAMAGE @ 15 KPSI
4) CHOSEN POLE SHIMS GIVE "CORRECT" INNER PRESTRESS, TOO LOW OUTER PRESTR

(7)



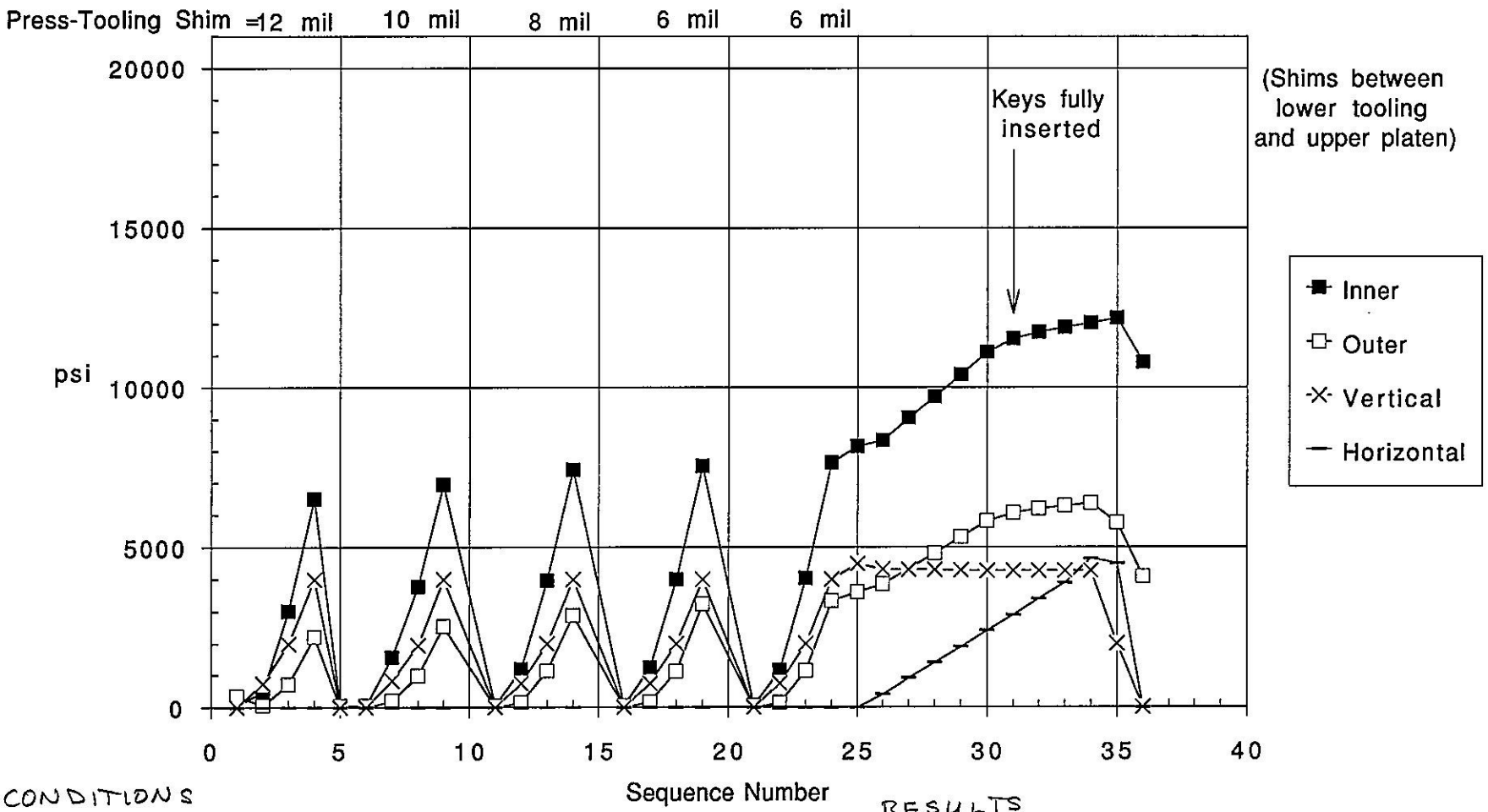
CONDITIONS:

1) NO POLE SHIMS
2) TOOLING SETUP THE SAME AS 3RD DSA322 ASSEMBLY

RESULTS:

1) SUCCESSFUL APPLICATION OF "SQUARE KEY" ASSEMBLY METHOD
2) $\gtrsim$1 KPSI LOWER PEAK STRESS THAN PREVIOUS ASSEMBLY

DSA322 4th Collaring (tapered keys driven in)

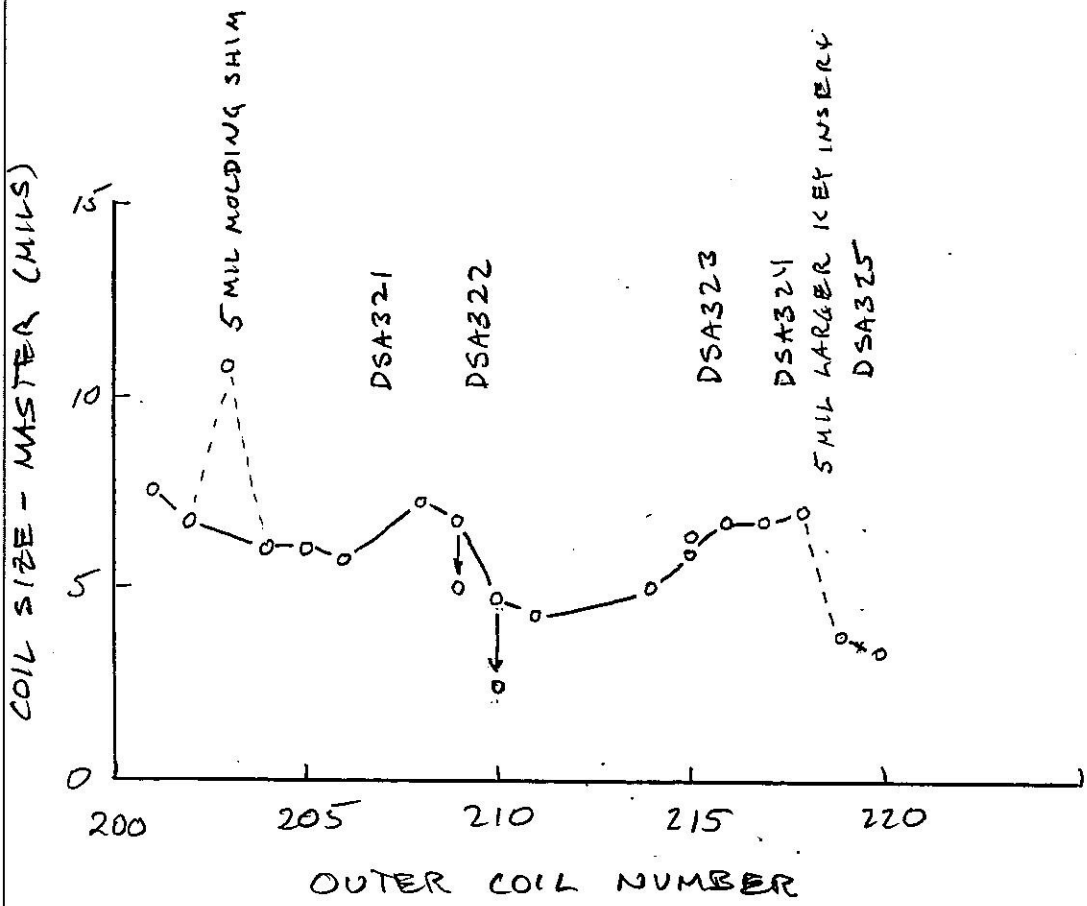


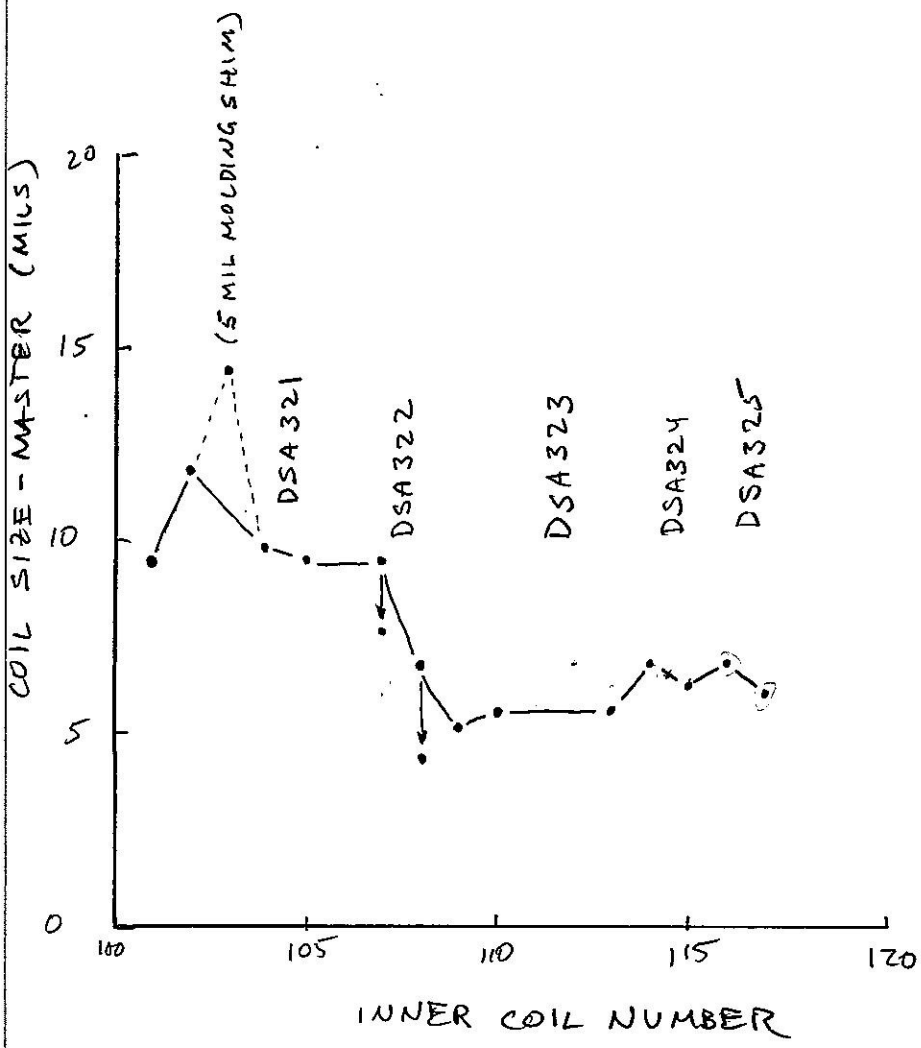
CONDITIONS

1) +5(−5) MIL INNER (OUTER) POLE SHIM
2) LAMINATED LOWER TOOLING
3) 5 MIL "AZIMUTHAL" SHIMS
4) PRESS STOP SHIMS ADJUSTED UNTIL KEYS CAN BE INSERTED 50 MILS

RESULTS

1) "SPRING BACK" ≈ 1 KPSI
2) TAPERED KEYS DID "MORE WORK" THAN NECESSARY
3) EVALUATION RELATIVE TO SQUARE KEY ASSEMBLY IS IN PROGRESS.


COIL SIZE - MASTER (MILS)
15
10
5
0
200
205
210
215
220
OUTER COIL NUMBER
5 MIL MOLDING SHIM
DSA321
DSA322
DSA323
DSA324
5 MIL LARGER KEY INSERT
DSA325


COIL SIZE - MASTER (MILS)
20
15
10
5
0
(5 MIL MOLDING SHIM)
DSA 321
DSA 322
DSA 323
DSA324
DSA325
100
105
110
115
120
INNER COIL NUMBER

1.5 m Model Dipole Harmonics

	Collared Coils	b_2	b_4
	DSA320	-2.4	0.57
	DSA322 (1st assembly)	-6.2	0.89
	DSA322 (2nd assembly)	-2.9	0.48
[1]	DSA322 (3rd assembly)	-3.5	0.59
[1,2]	DSA322 (4th assembly)	-2.4	0.43
	DSA323	-4.1	0.31
	Calculated (w/o iron)	-4.0	0.14
	Complete Magnet		
[3]	DSA321	2.6	0.35
	Calculated (with iron)	0.2	0.07

Notes

On all assemblies the keys were set into the collars with minimal force and no pole shims were used unless otherwise noted.

[1] +5(-5) mil pole shim on inner(outer) coil.

[2] Tapered keys driven in after they could be started by 50 mils.

[3] Collared in Tevatron press using upper tooling only, keys "tapped in" with hammers.

CONCLUSIONS AND PLANS

1) "SQUARE KEY" METHOD IS OPTIMIZED EXCEPT THAT PRESS STOP SHIM VALUE MUST BE CONFIRMED FOR ALL-LAMINATED TOOLING. THIS WILL BE (OR HAS BEEN) DONE TODAY WITH DSA325.

2) "TAPERED KEY" METHOD STILL NEEDS TO BE OPTIMIZED TO REDUCE REQUIRED SIDE FORCE. EVALUATION OF COIL DIMENSION CONTROL MUST BE MADE. THESE WILL BE DONE ON NEXT ASSEMBLY(S) OF DSA322.

3) OUTER COIL MOLD SIZE HAS BEEN REDUCED BY 5 MILS (~3 MIL COIL SIZE REDUCTION) STARTING WITH DSA325 COILS. INNER COIL MOLD SIZE WILL BE INCREASED BY ≳ 5 MILS STARTING WITH DSA327 COILS (WHICH PRECEDE DSA326).

4) LONG AND SHORT TOOLING ARE IDENTICAL AND LONG AND SHORT PRESSES ARE VERY SIMILAR, SO THESE RESULTS WILL BE DIRECTLY APPLICABLE TO THE LONG MAGNETS.

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