NSCX Composite Coil Tests

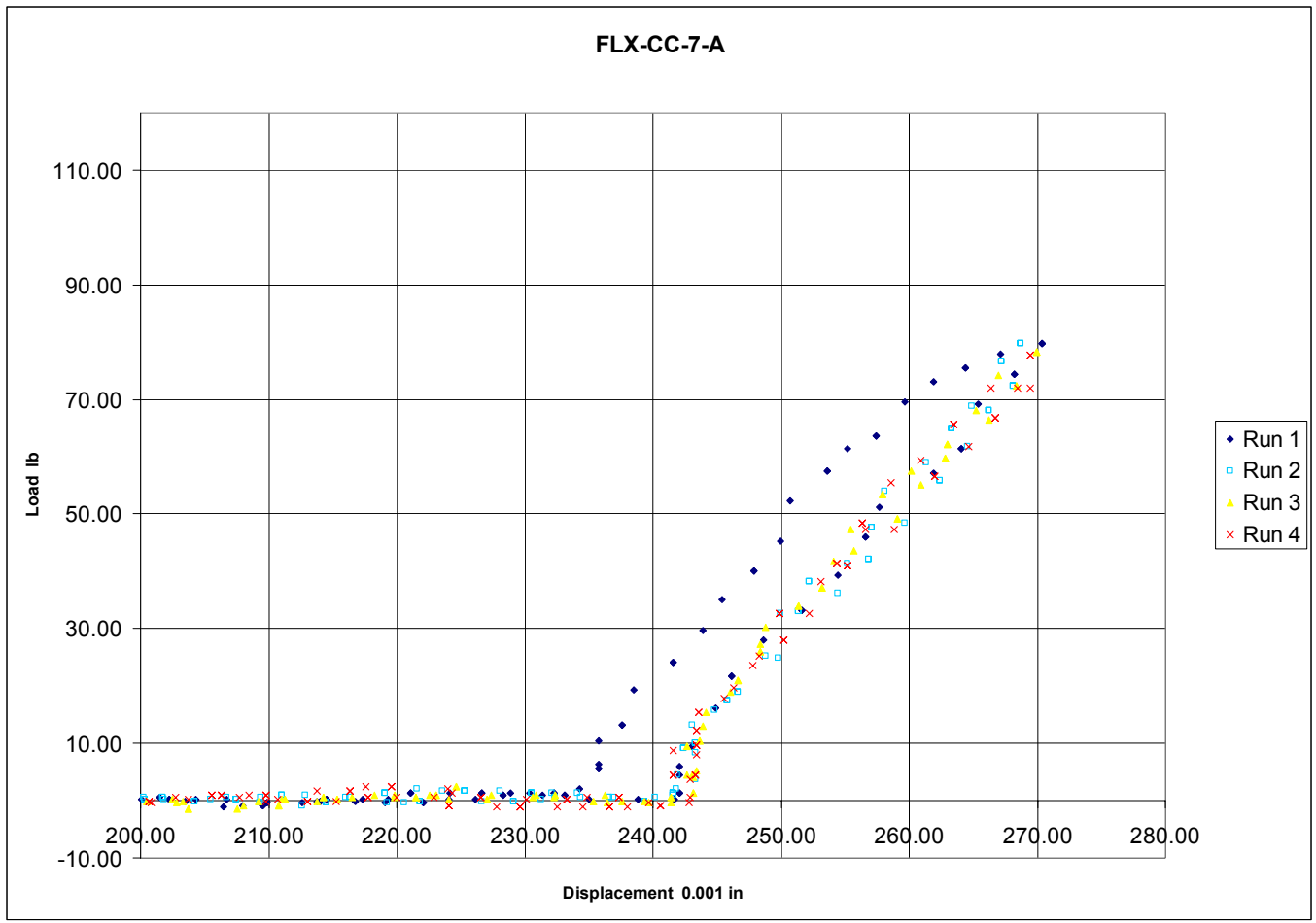
Flexural Testing of Bare Impregnated Copper Conductor

- Six new sample bars of composite conductor material were received on 11-Mar-04.
- The material consisted of bare copper strands impregnated with resin and formed to a rectangular section.
- Two 8” sample sections were cut from each bar.

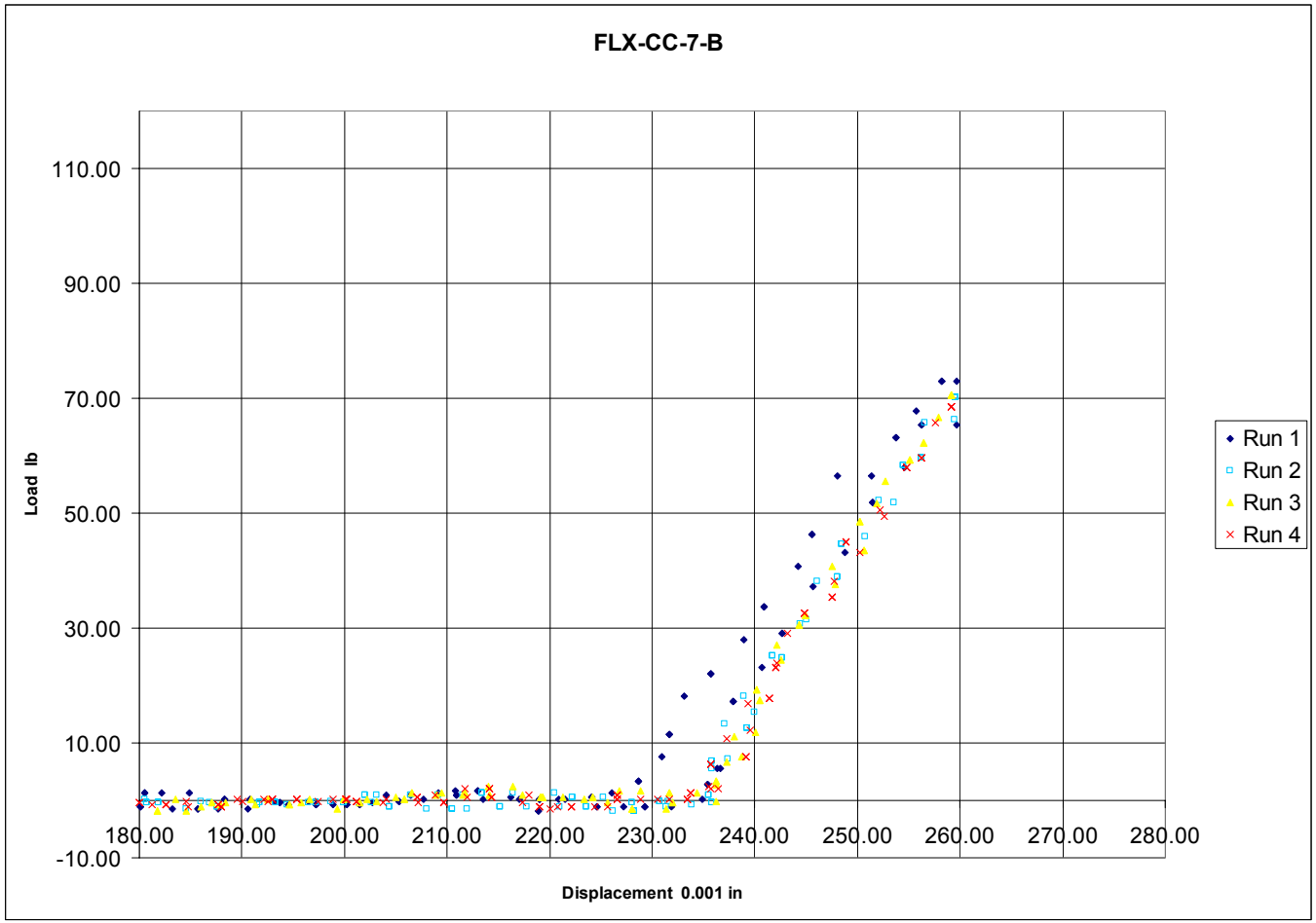
- One sample from each bar was tested at room temperature and one was tested at 77 K.
- The strain was controlled and had a maximum value of approximately 0.050”
- Four consecutive cycles were run on each sample.

Bare Resin Impregnated Conductor

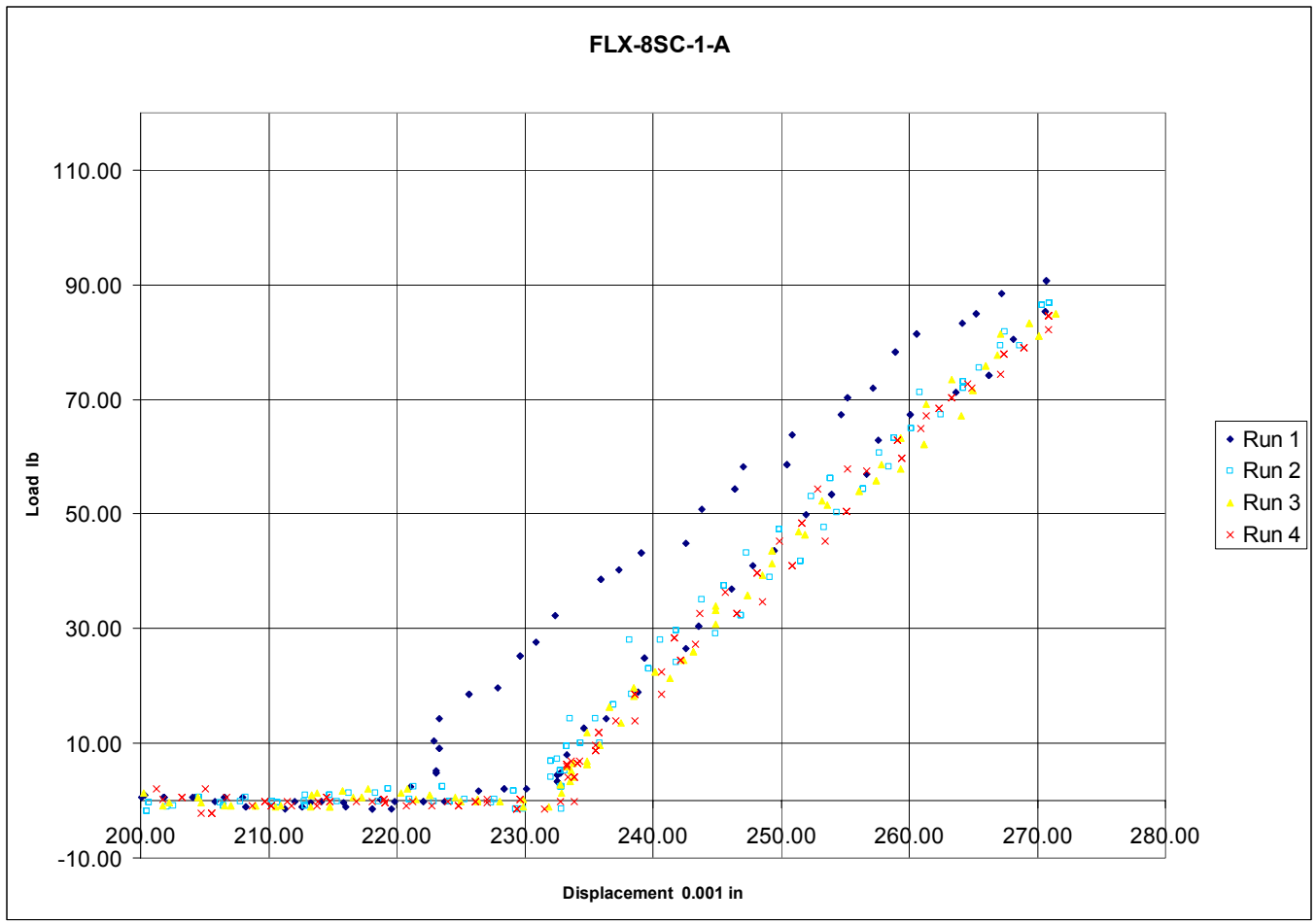
Typical Room Temp. Flexural Data



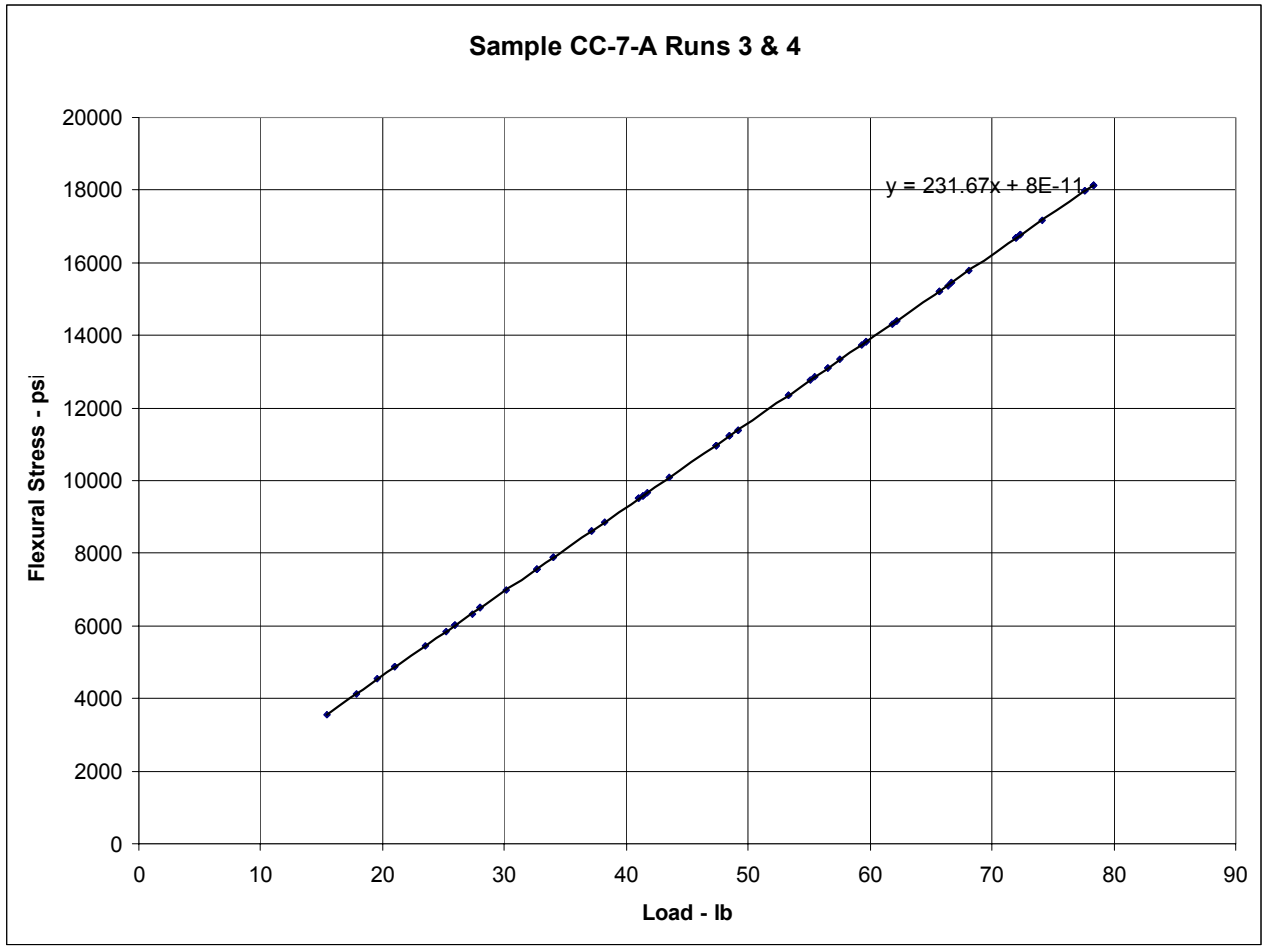
Typical LN2 Temp. Flexural Data



Flexural Data for Glass Wrapped Conductor from Previous Testing for Comparison (@ room temp)



Flexural Stress per ASTM D 790-03



Tangent Modulus of Elasticity for Bare Resin Impregnated Cu at Room Temperature

Sample	Temperature	Span	Width	Depth	Slope	Modulus	Average	Std Dev
#		L	b	d	m	Eb		
	C	in	In	in	lbf/in	10E6 psi		
CC-7-A	25.5	6	0.310	0.354	2.377	9.333		
CC-8-A	25.5	6	0.317	0.345	2.254	9.349		
CC-9-A	25.5	6	0.315	0.346	2.332	9.650		
CC-10-A	25.5	6	0.316	0.343	2.105	8.913		
CC-11-A	25.5	6	0.315	0.350	2.477	9.902		
CC-12-A	25.5	6	0.309	0.354	2.693	10.608		
	25.5						9.63	0.59

Tangent Modulus of Elasticity for Bare Resin Impregnated Cu at LN2 Temperature

Sample	Temperature	Span	Width	Depth	Slope	Modulus	Average	Std Dev
#		L	b	d	m	Eb		
	C	in	In	in	lbf/in	10E6 psi		
CC-7-B	-196	6	0.316	0.352	2.767	10.842		
CC-8-B	-196	6	0.319	0.344	2.763	11.490		
CC-9-B	-196	6	0.318	0.343	2.593	10.912		
CC-10-B	-196	6	0.314	0.347	0.000	0.000		
CC-11-B	-196	6	0.315	0.350	0.000	0.000		
CC-12-B	-196	6	0.311	0.358	0.000	0.000		
	-196						11.081	0.36

Tangent Modulus of Elasticity for Glass Wrapped Resin Impregnated Cu at Room Temperature

Sample	Temperature	Span	Width	Depth	Slope	Modulus	Average	Std Dev
#		L	b	d	m	Eb		
	C	in	In	in	lbf/in	10E6 psi		
SC-1-A	28	6	0.368	0.370	2.073	6.005		
SC-2-A	28	6	0.354	0.375	2.301	6.656		
SC-3-A	28	6	0.372	0.385	2.468	6.278		
SC-4-A	28	6	0.369	0.365	2.128	6.404		
SC-5-A	28	6	0.361	0.372	2.086	6.061		
	28						6.28	0.26

Tangent Modulus of Elasticity for Glass Wrapped Resin Impregnated Cu at Room Temperature

Sample	Temperature	Span	Width	Depth	Slope	Modulus	Average	Std Dev
#		L	b	d	m	Eb		
	C	in	In	in	lbf/in	10E6 psi		
SC-1-B	-196	6	0.362	0.367	2.321	7.004		
SC-2-B	-196	6	0.359	0.379	2.791	7.712		
SC-3-B	-196	6	0.368	0.380	2.909	7.779		
SC-4-B	-196	6	0.369	0.371	2.393	6.858		
SC-5-B	-196	6	0.361	0.377	2.684	7.493		
	-196						7.37	0.42

Tangent Modulus of Elasticity for Glass Wrapped Resin Impregnated Cu at Room Temperature Using only the Estimated Cu Cross Section

Sample	Temperature	Span	Width	Depth	Slope	Modulus	Average	Std Dev
#		L	b	d	m	Eb		
	C	in	In	in	lbf/in	10E6 psi		
SC-1-A	28	6	0.325	0.320	2.073	10.511		
SC-2-A	28	6	0.325	0.330	2.301	10.639		
	28						10.57	0.09
SC-1-B	-196	6	0.330	0.320	2.321	11.591		
SC-2-B	-196	6	0.340	0.335	2.791	11.791		
	-196						11.69	0.14

Observations

- The Cu section of the conductor provides virtually all of the tensile strength.
- Bare Cu samples are difficult to cut without fraying the strands as the resin fractures and falls out.