LARC j-pole Construction Project

- **Before I begin I would like to thank**
  - **Ren for pointers on centering stock in a lathe**
  - **Ernie for the dial indicator and caps**
  - **Rich for his support in tracking down vendors, the loan of tools, and encouragement**
  - **And many others for their suggestions**

The Design

- **Strictly the Arrow design as published**
- **No attempt to modify any of the dimensions**
- **A factory unit was available for comparison and used for thread length measurement**

Materials

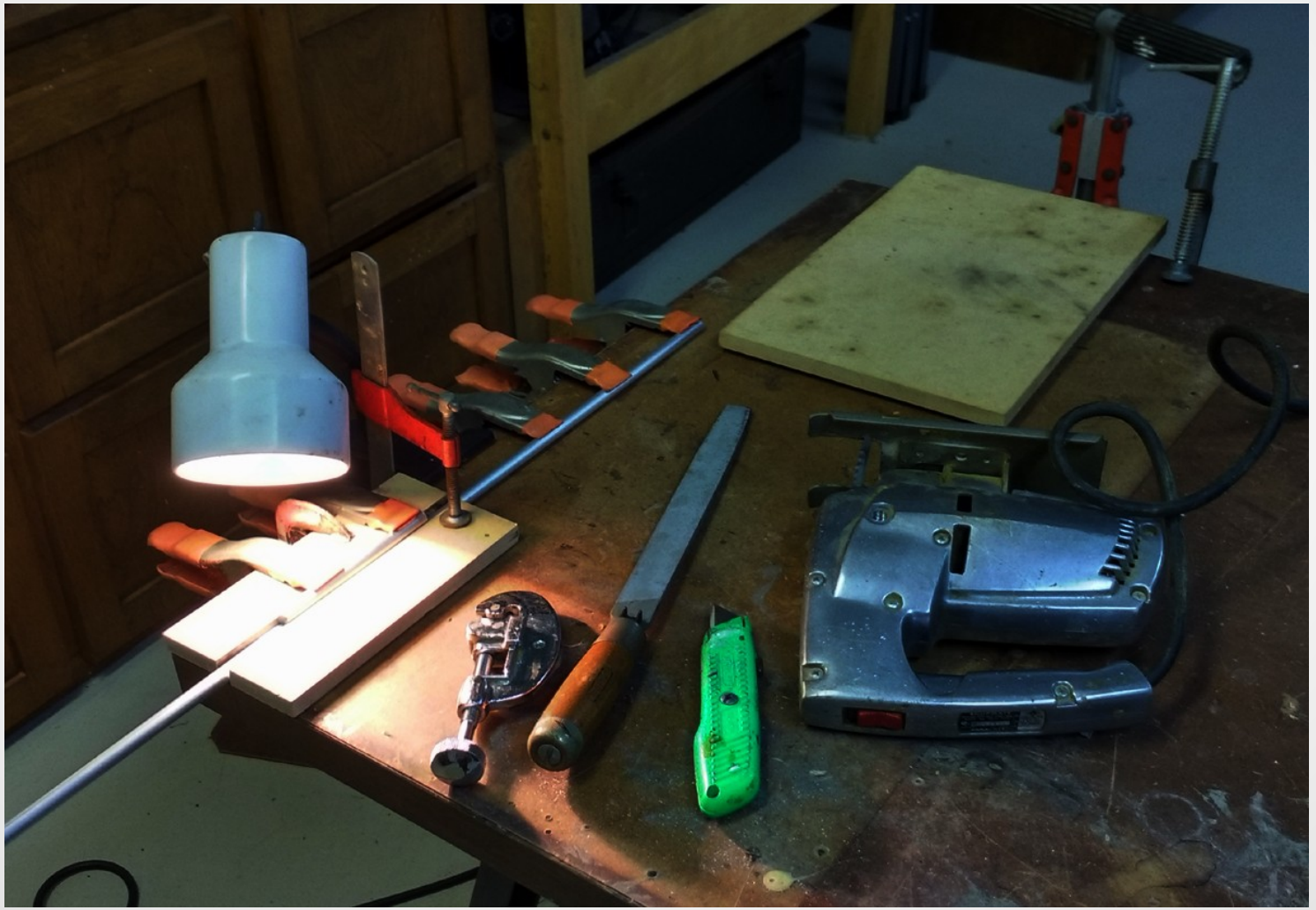
- **Rod – 3/8-aluminum rod, type 6061 aircraft grade**
- **Base plate – construction grade aluminum angle**
- **SO239 stud**
- **Stainless nuts**

Material Costs

- **All over the place**
  - **Rod from over $1.00 to $0.35 per foot**
  - **Angle aluminum from $3 to $2 per foot**
  - **Studs from over $6 to $4 each**

- **It pays to shop around, and purchase in quantity.**

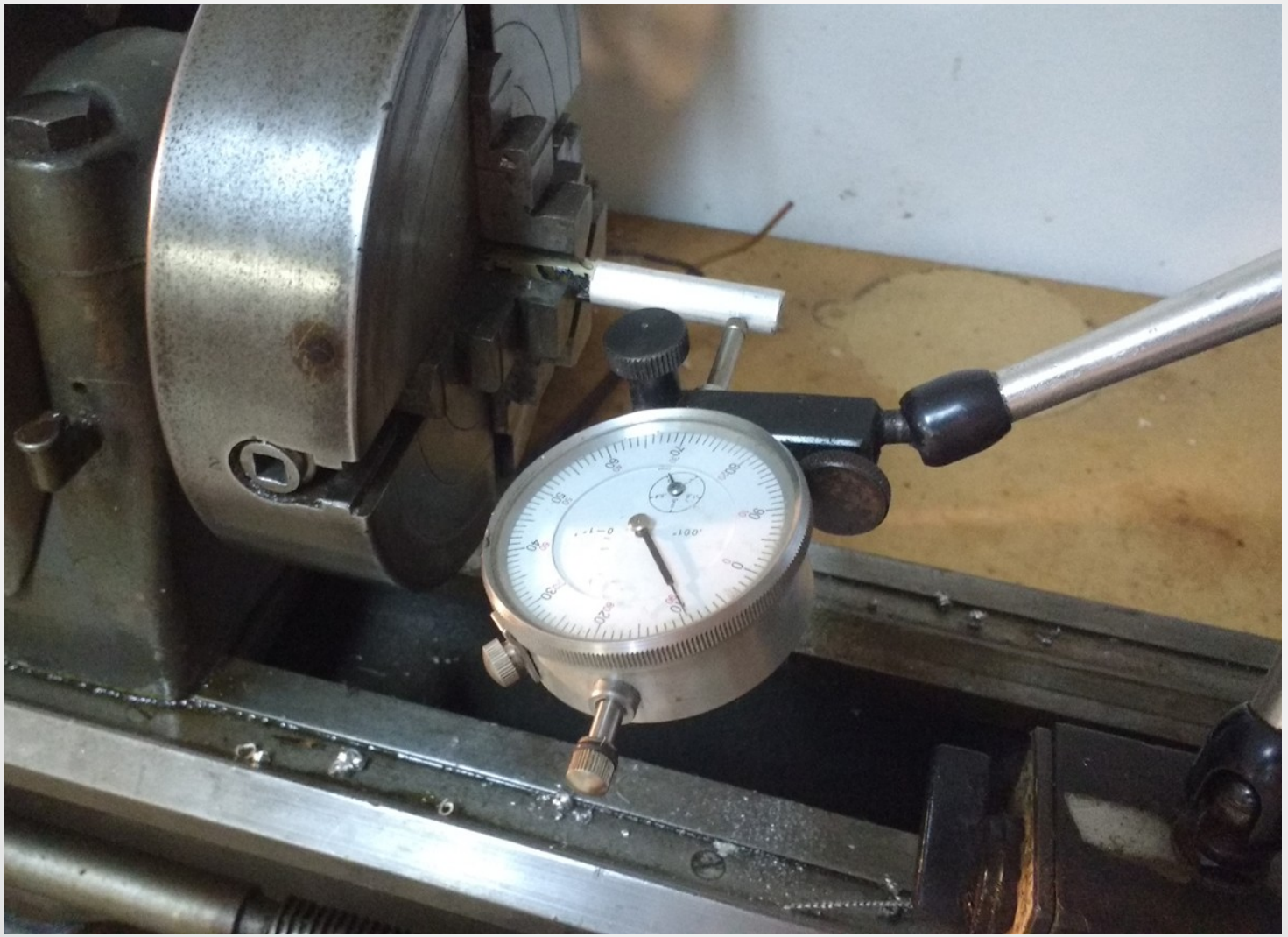
Rod Cut To Length Operation



Rod Cut To Length Operation

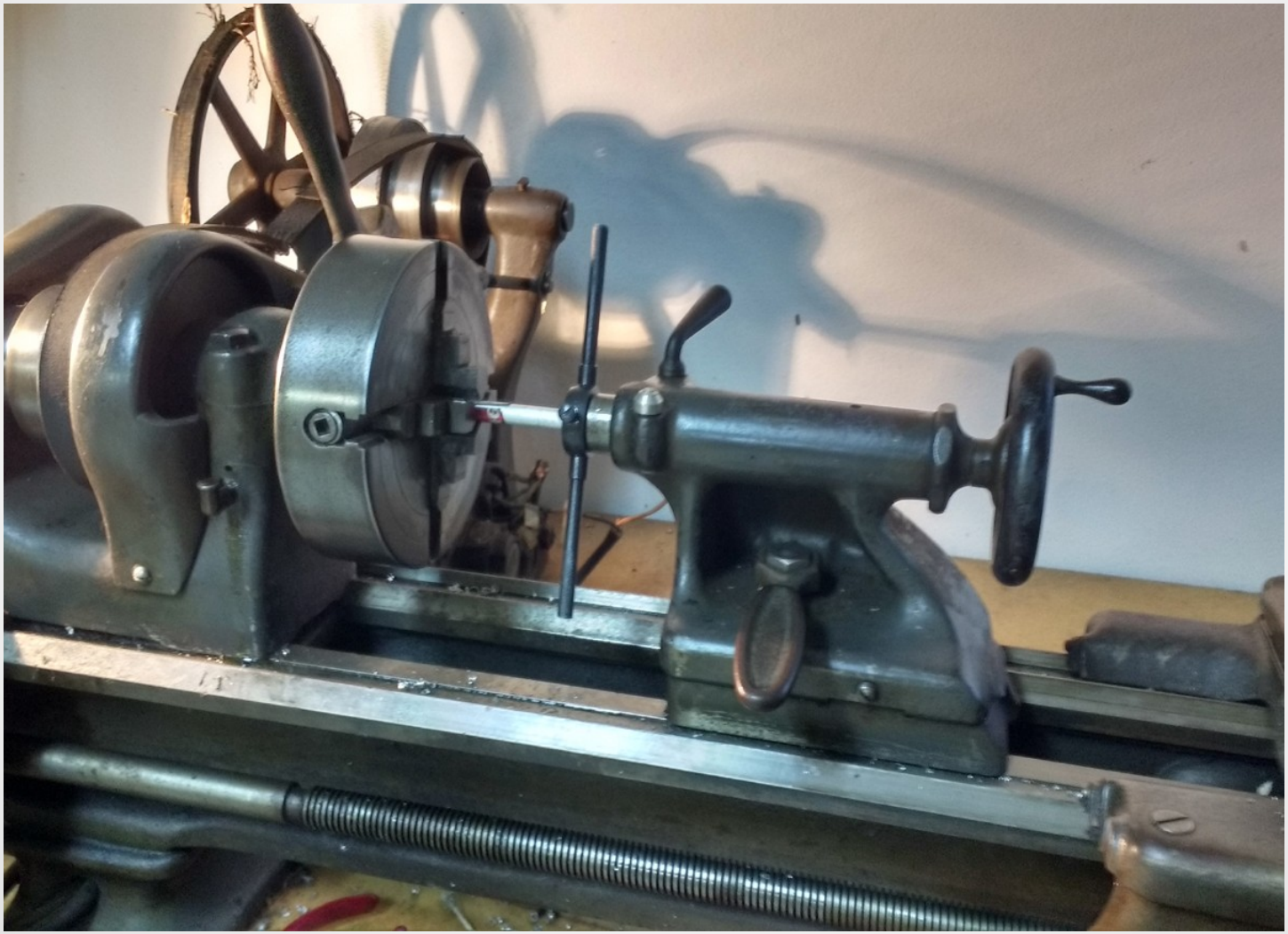
All Twenty Sets Of Rods Cut

Rod Centering Operation



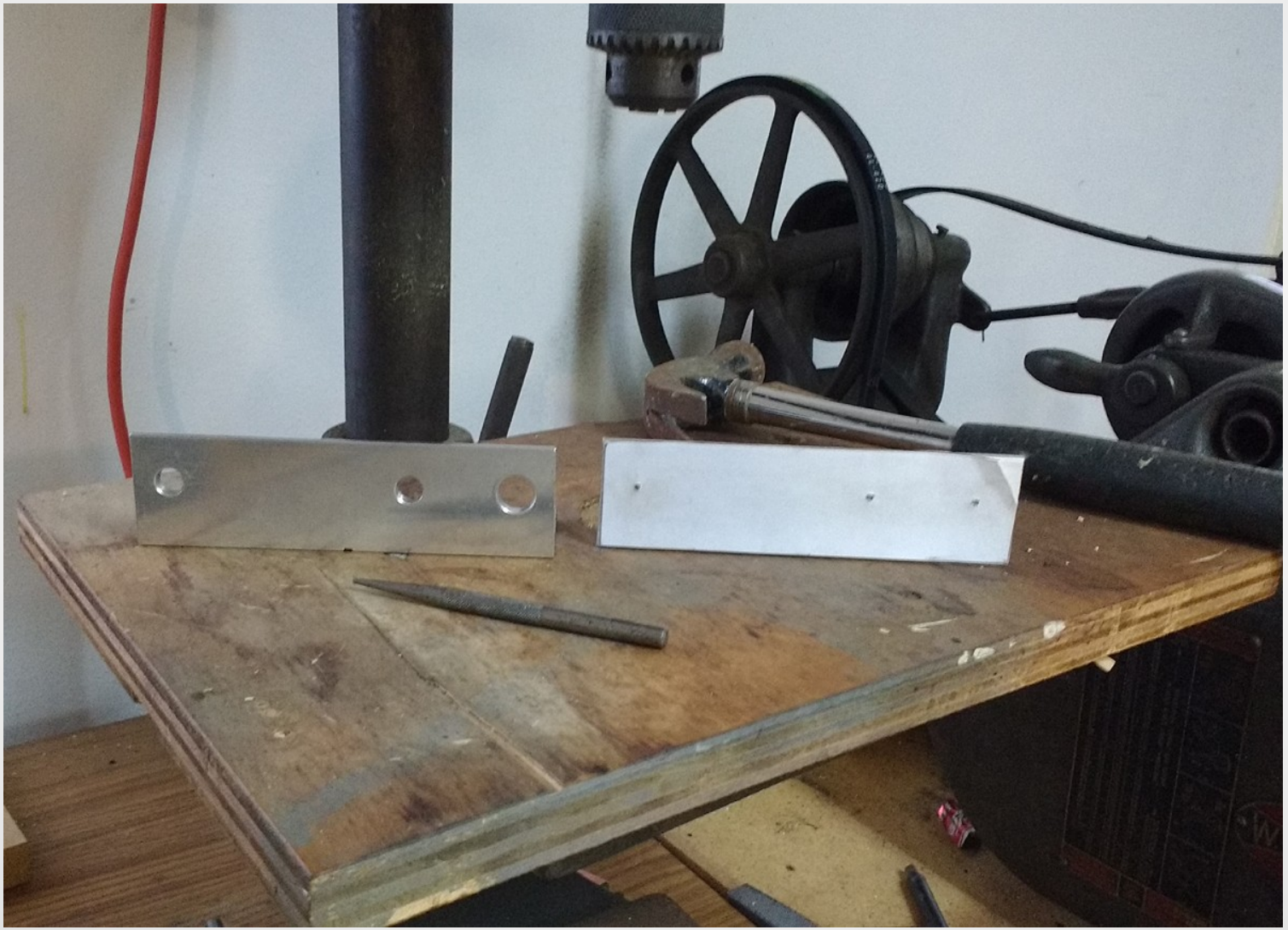
Shim Production Area

Threading Operation



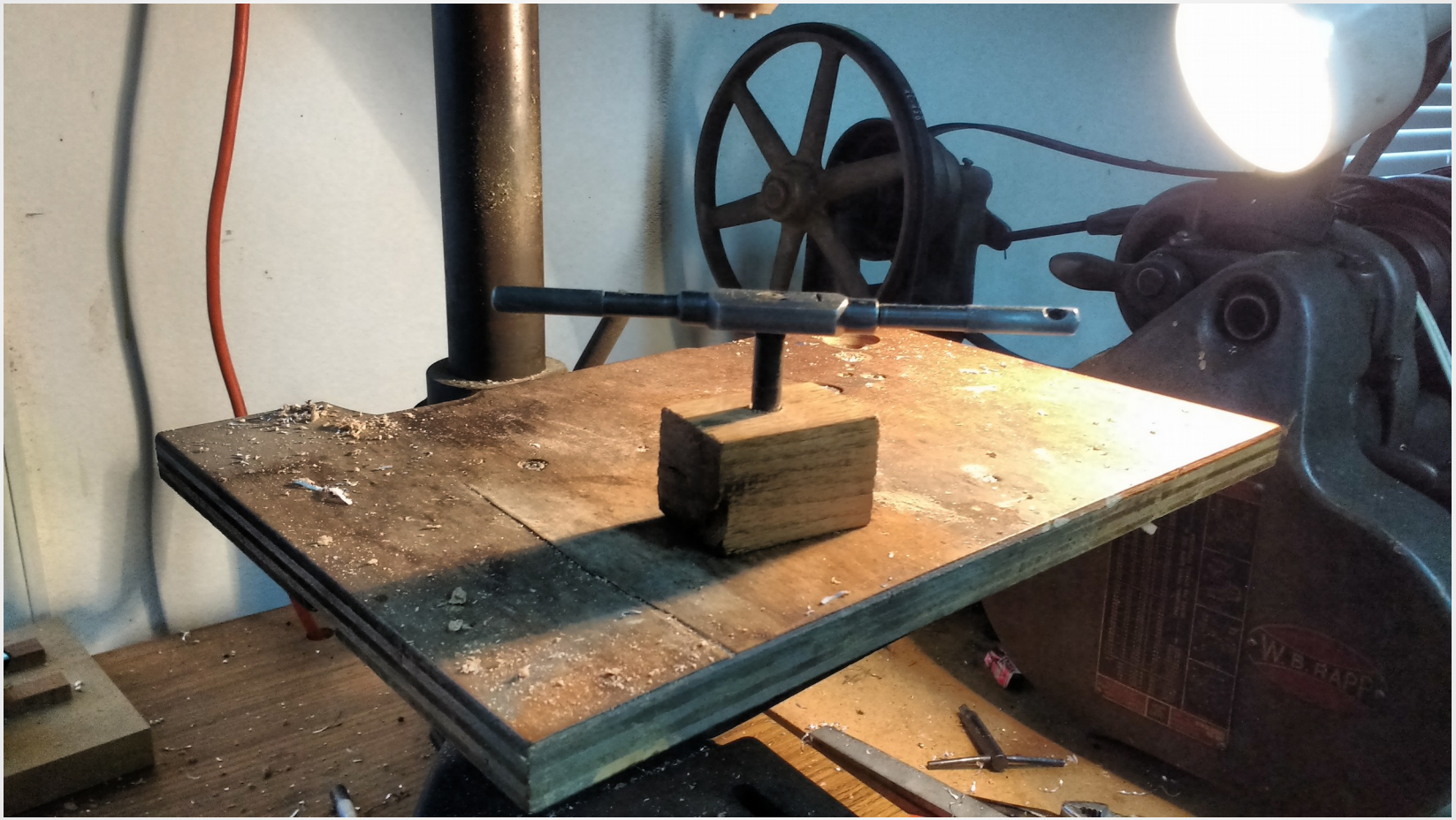
Twenty Antennas Cut And Threaded

Marking Operation



Drilling Operation

Tapping Jig (if you are Irish.:-))



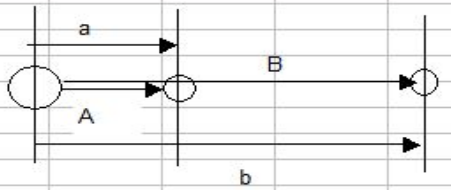
Tapping Operation

All Tapped Out

All Machining Operations Complete

Assembly

Hole Drilling Accuracy



a calculated center to center
A measured shortest path
b calculated center to center
B measured shortest path

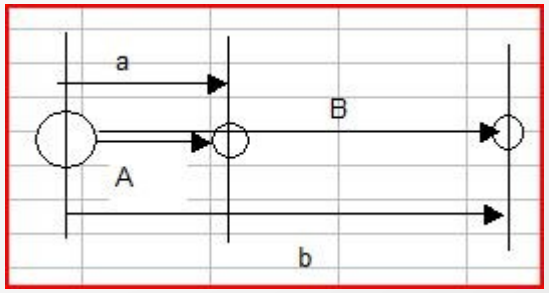
Base plate measured distances

large hole	0.5	inches		
threaded hole	0.33	inches	a	b
Nominal center to center aim a and b			1.4375	4.5

			Calculated center to center distances				
Pt. No.	A	B	a	b	b-a	a-aim	b-aim
1	0.948	4.057	1.363	4.472	3.109	-0.075	-0.028
2	0.979	4.100	1.394	4.515	3.121	-0.043	0.015
3	0.953	4.099	1.368	4.514	3.146	-0.070	0.014
4	1.019	4.129	1.434	4.544	3.110	-0.004	0.044
5	0.990	4.111	1.405	4.526	3.121	-0.033	0.026
6	0.986	4.130	1.401	4.545	3.144	-0.037	0.045
7	0.993	4.123	1.408	4.538	3.130	-0.030	0.038
8	0.984	4.130	1.399	4.545	3.146	-0.039	0.045
9	0.983	4.068	1.398	4.483	3.085	-0.039	-0.017
10	0.988	4.108	1.403	4.523	3.120	-0.035	0.023
11	0.988	4.103	1.403	4.518	3.115	-0.035	0.018
12	0.997	4.090	1.412	4.505	3.093	-0.026	0.005
13	0.984	4.112	1.399	4.527	3.128	-0.039	0.027
14	0.982	4.096	1.397	4.511	3.114	-0.041	0.011
15	0.982	4.105	1.397	4.520	3.123	-0.041	0.020
16	0.998	4.109	1.413	4.524	3.111	-0.025	0.024
17	1.003	4.120	1.418	4.535	3.117	-0.020	0.035
18	0.993	4.112	1.408	4.527	3.119	-0.030	0.027
19	0.982	4.109	1.397	4.524	3.127	-0.041	0.024
20	0.995	4.114	1.410	4.529	3.119	-0.027	0.029
21	0.989	4.112	1.404	4.527	3.123	-0.034	0.027
22	0.953	4.086	1.368	4.501	3.133	-0.070	0.001
average	0.985	4.106	1.400	4.521	3.121	-0.038	0.021
max	1.019	4.130	1.434	4.545	3.146	-0.004	0.045
min	0.948	4.057	1.363	4.472	3.085	-0.075	-0.028
st dev	0.01628168	0.018358	0.016282	0.018358	0.014879	0.016282	0.018358

Hole Drilling Accuracy Summary

- **Dimension (a) accuracy is about -1/16 of an inch from aim worse case**
- **On average about -1/32 of an inch from aim.**
- **Dimension (b) accuracy is about 1/32 inch worse case**
- **On average + 1/32 from aim**



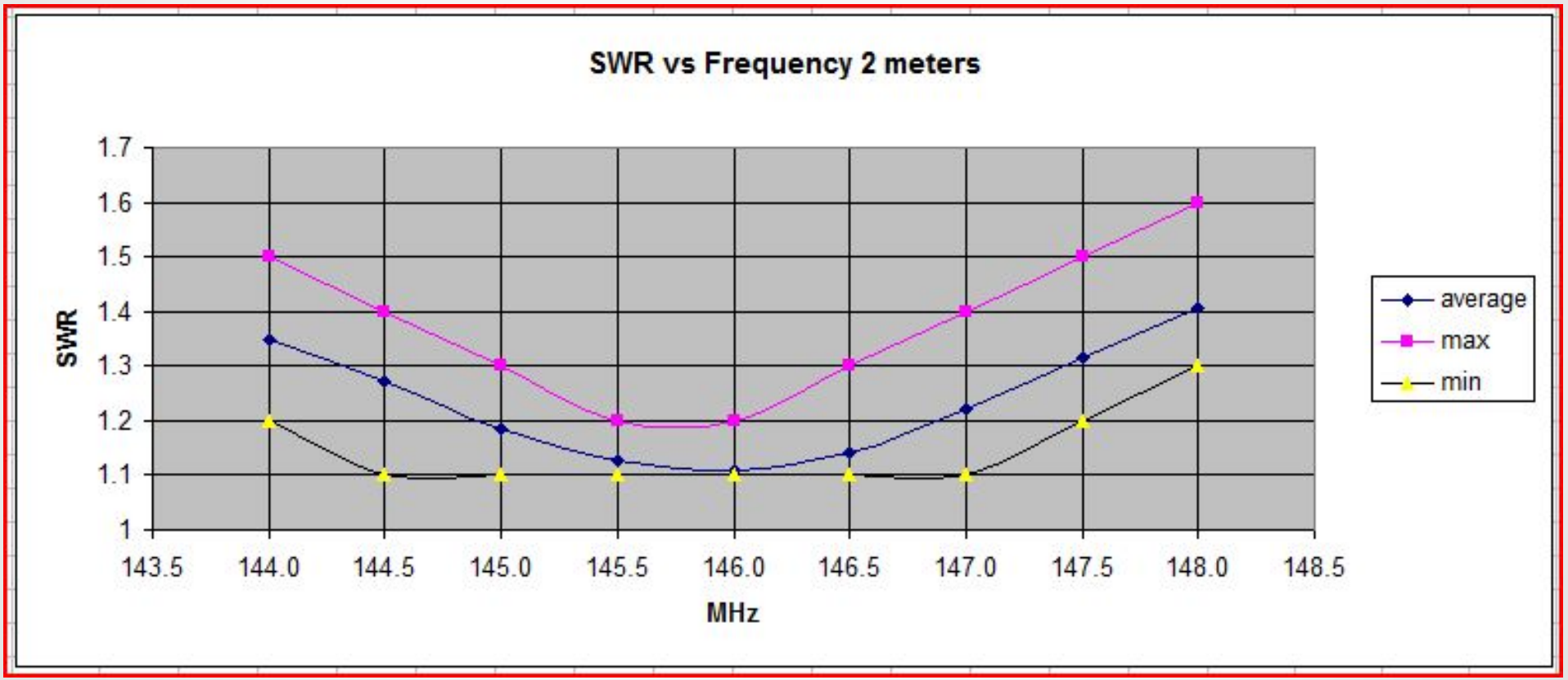
Antenna Characterization

- **Data was collected for a random sample of fifteen of the twenty antennas.**
- **Each antenna was measured with an MFJ 269 Antenna Analyzer.**
- **Each antenna was measured at an elevation of 15 feet, using a section of RG8X of approximately 17 feet in length.**
- **Data for SWR, Impedance, and Reactance follows.**

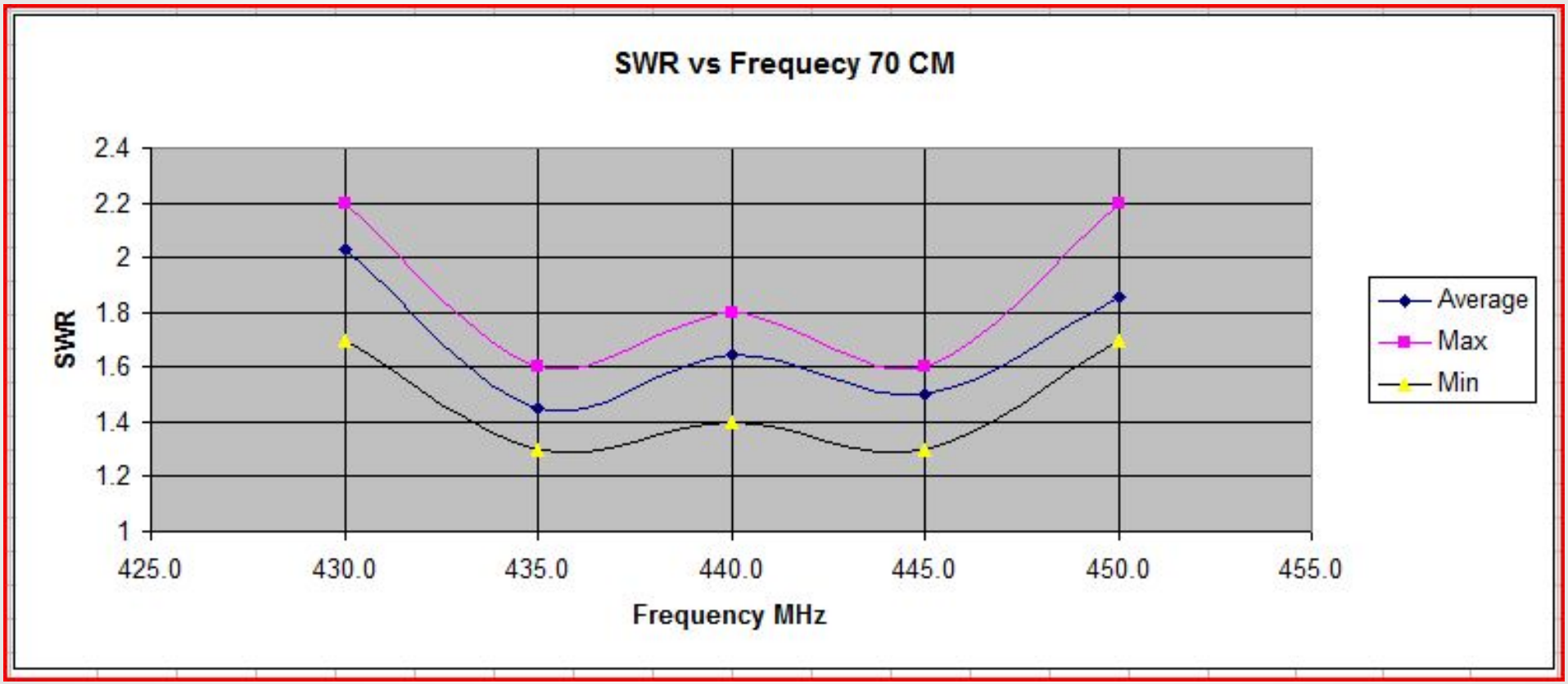
SWR vs Freq For 14 Antennas

															average	max	min	stdev
	16	2	13	15	3	14	19	18	9	7	11	4	20	21				
144.0	1.2	1.3	1.4	1.4	1.4	1.5	1.4	1.3	1.4	1.2	1.3	1.3	1.4	1.4	1.35	1.5	1.2	0.085
144.5	1.1	1.2	1.3	1.3	1.4	1.4	1.3	1.3	1.3	1.2	1.2	1.2	1.3	1.3	1.271	1.4	1.1	0.083
145.0	1.1	1.1	1.2	1.2	1.3	1.3	1.2	1.2	1.2	1.1	1.1	1.2	1.2	1.2	1.186	1.3	1.1	0.066
145.5	1.1	1.1	1.2	1.1	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.129	1.2	1.1	0.047
146.0	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.107	1.2	1.1	0.027
146.5	1.3	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.1	1.1	1.143	1.3	1.1	0.065
147.0	1.4	1.3	1.1	1.2	1.2	1.1	1.2	1.2	1.2	1.3	1.2	1.3	1.2	1.2	1.221	1.4	1.1	0.08
147.5	1.5	1.4	1.2	1.3	1.3	1.2	1.2	1.3	1.3	1.4	1.3	1.4	1.3	1.3	1.314	1.5	1.2	0.086
148.0	1.6	1.5	1.3	1.4	1.3	1.3	1.3	1.4	1.4	1.5	1.4	1.5	1.4	1.4	1.407	1.6	1.3	0.092
430.0	2	1.9	2.1	2.2	2	2.1	2.1	2.1	1.9	1.7	1.9	2.2	2	2.2	2.029	2.2	1.7	0.144
435.0	1.4	1.4	1.4	1.5	1.4	1.5	1.5	1.5	1.4	1.3	1.4	1.6	1.4	1.6	1.45	1.6	1.3	0.085
440.0	1.7	1.6	1.6	1.7	1.6	1.7	1.7	1.8	1.5	1.4	1.6	1.7	1.6	1.8	1.643	1.8	1.4	0.109
445.0	1.5	1.4	1.6	1.6	1.5	1.6	1.5	1.6	1.4	1.4	1.3	1.6	1.4	1.6	1.5	1.6	1.3	0.104
450.0	1.9	2	1.9	1.8	1.8	1.8	1.7	1.7	2	2.2	1.8	1.7	2	1.7	1.857	2.2	1.7	0.15

Graphical Presentation 2 Meters



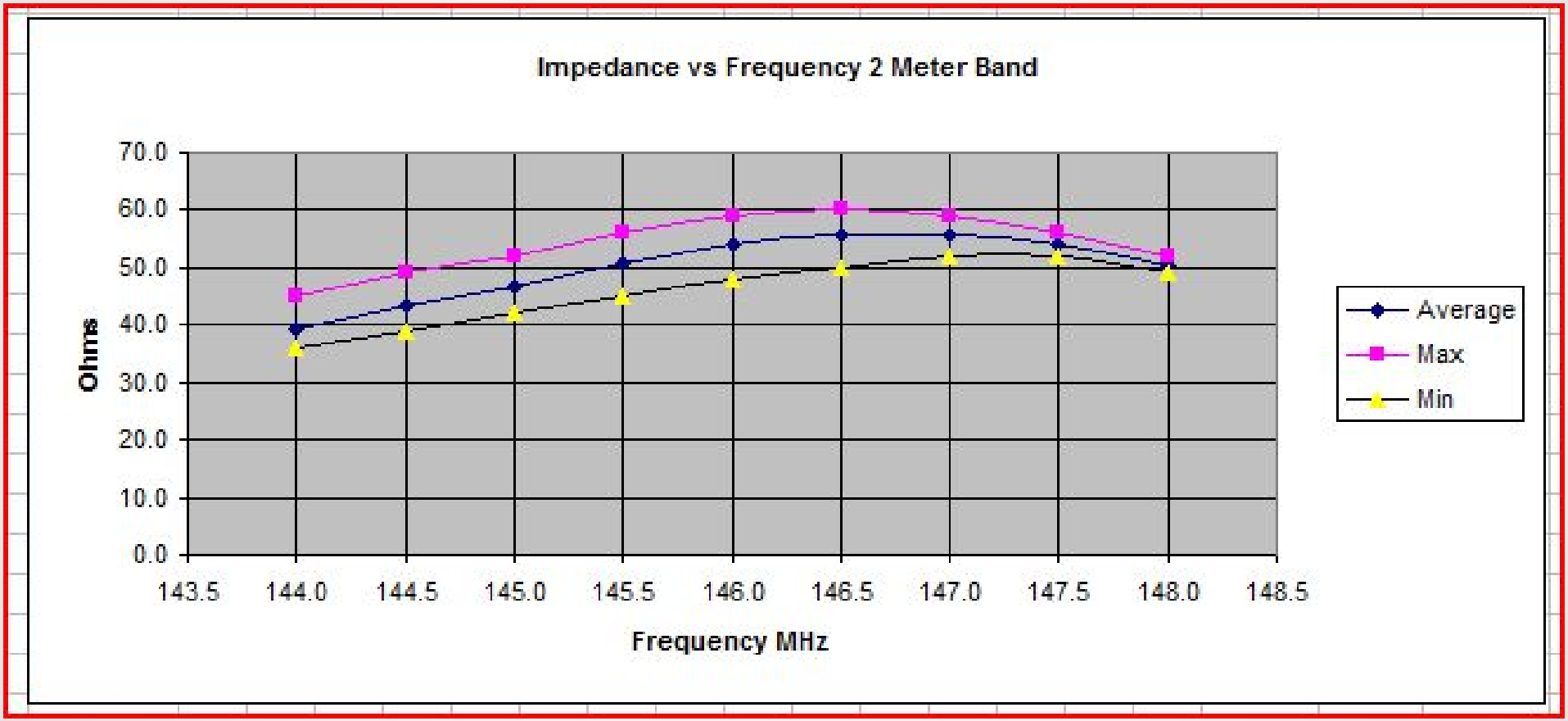
Graphical Presentation 70 CM



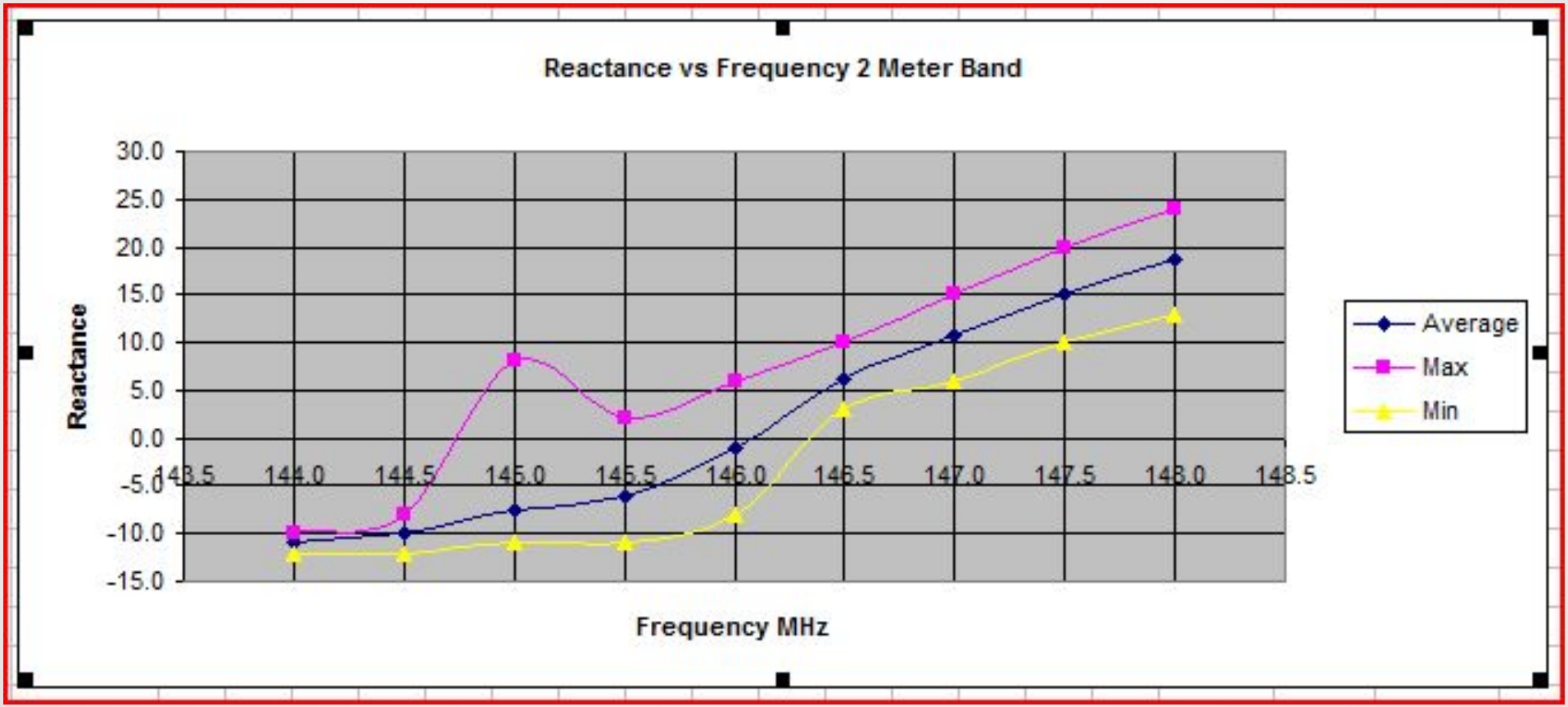
Impedance and Reactance

Freq	R															Average	Max	Min
144.0	45	42	36	38	38	37	36	36	39	38	43	42	42	38	41	39.4	45.0	36.0
144.5	49	46	40	42	42	40	39	40	42	42	47	46	48	41	46	43.3	49.0	39.0
145.0	52	51	43	46	45	44	42	44	46	46	50	49	48	46	51	46.9	52.0	42.0
145.5	56	54	46	50	49	48	45	47	50	50	54	53	54	49	54	50.6	56.0	45.0
146.0	59	57	49	54	53	52	48	51	54	53	56	56	56	52	58	53.9	59.0	48.0
146.5	60	58	52	56	55	55	50	54	56	55	57	58	58	55	59	55.9	60.0	50.0
147.0	59	57	53	55	56	55	52	55	56	55	56	58	58	55	58	55.9	59.0	52.0
147.5	56	53	53	55	54	54	52	54	54	53	53	56	55	52	55	53.9	56.0	52.0
148.0	51	49	50	50	51	51	50	51	50	50	49	52	51	49	50	50.3	52.0	49.0
	X																	
Freq																		
144.0	-10	-11	-11	-11	-11	-11	-12	-11	-10	-11	-10	-10	-11	-10	-12	-10.8	-10.0	-12.0
144.5	-8	-9	-10	-11	-11	-11	-12	-11	-10	-10	-8	-9	-9	-11	-11	-10.1	-8.0	-12.0
145.0	-6	-7	-9	-9	-9	-10	-11	-10	8	-9	-6	-7	-8	-10	-9	-7.5	8.0	-11.0
145.5	2	-4	-8	-7	-7	-9	-11	-8	-6	-7	-4	-4	-5	-7	-6	-6.1	2.0	-11.0
146.0	5	5	-5	-5	-5	-6	-8	-6	3	-4	5	-2	4	-3	6	-1.1	6.0	-8.0
146.5	10	10	4	6	5	5	5	5	5	5	9	5	6	3	10	6.2	10.0	3.0
147.0	15	15	6	10	10	9	9	8	10	10	14	10	11	9	15	10.7	15.0	6.0
147.5	20	19	11	15	14	13	10	12	15	15	18	15	17	14	20	15.2	20.0	10.0
148.0	24	22	15	17	18	16	13	15	18	18	21	20	22	17	23	18.6	24.0	13.0

Z For 2 Meters



Reactance For Two Meters

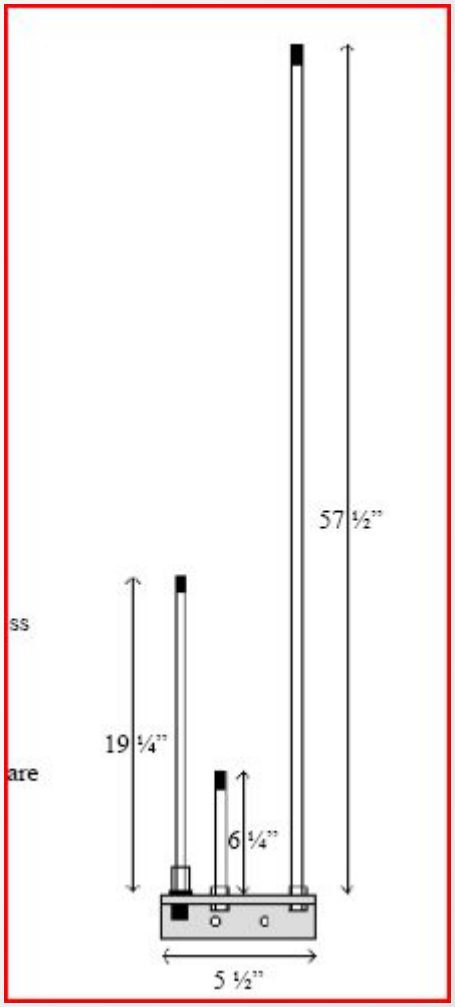


Sensitivity Study

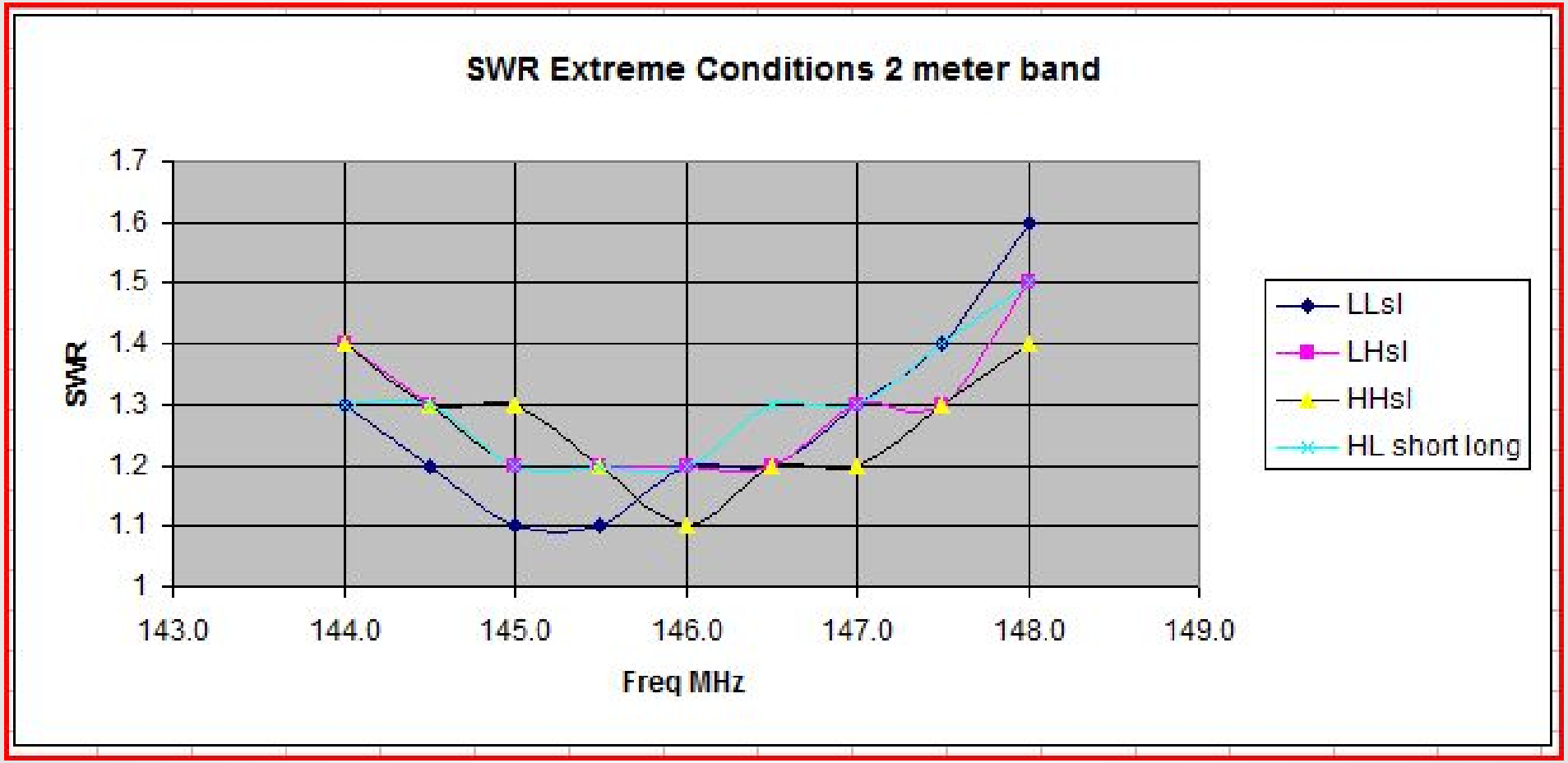
- **To assess the sensitivity of SWR to element length the following experiment was run. The short and long elements were adjusted all the way out and all the way in, as far as possible. All combinations of extremes were tested, and the results summarized.**

Study- Tabular Form

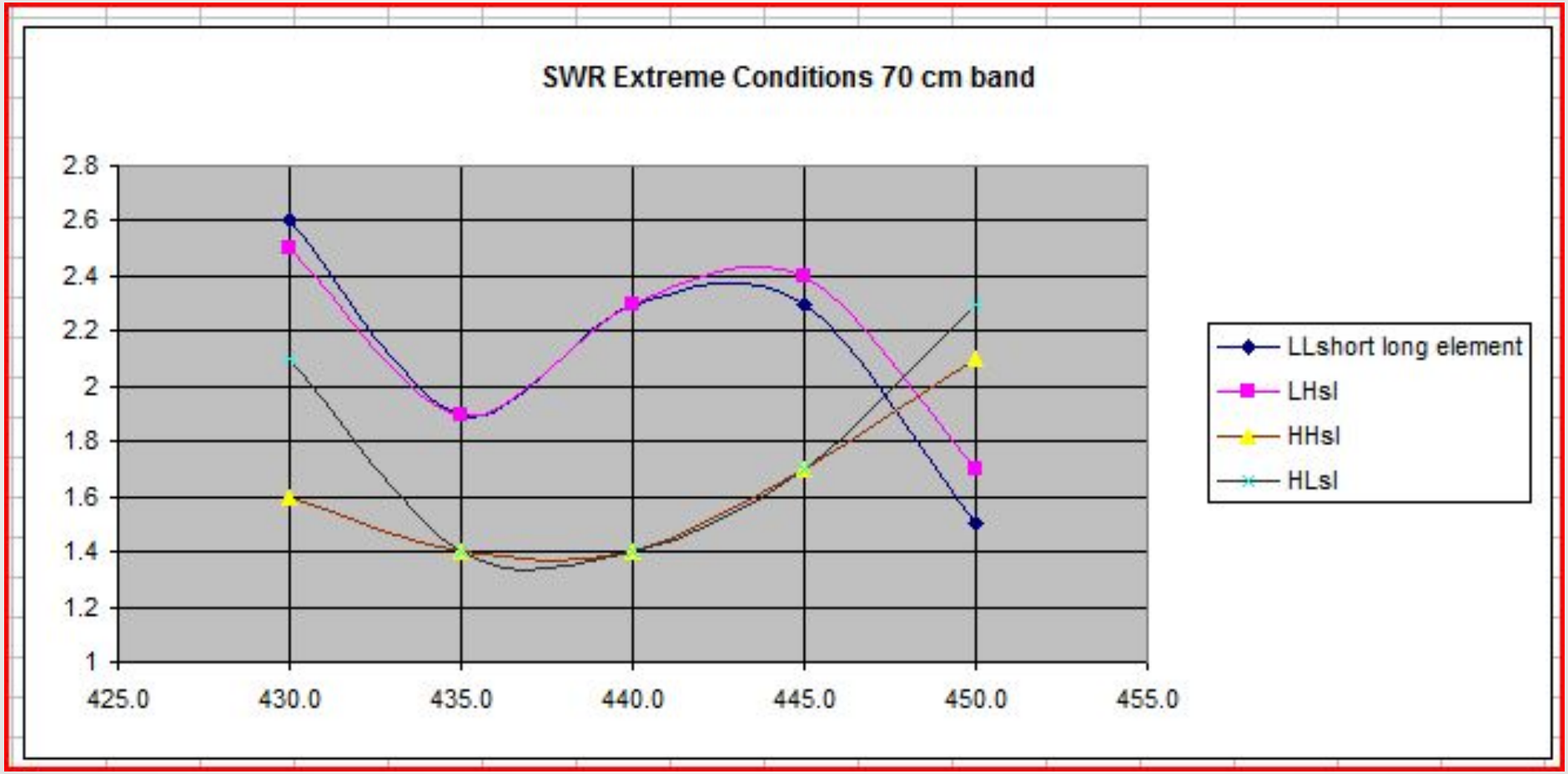
Freq	LLsl SWR	LHsl SWR	HHsl SWR	HLsl SWR
144.0	1.3	1.4	1.4	1.3
144.5	1.2	1.3	1.3	1.3
145.0	1.1	1.2	1.3	1.2
145.5	1.1	1.2	1.2	1.2
146.0	1.2	1.2	1.1	1.2
146.5	1.2	1.2	1.2	1.3
147.0	1.3	1.3	1.2	1.3
147.5	1.4	1.3	1.3	1.4
148.0	1.6	1.5	1.4	1.5
average	1.266667	1.288889	1.266667	1.3
430.0	2.6	2.5	1.6	2.1
435.0	1.9	1.9	1.4	1.4
440.0	2.3	2.3	1.4	1.4
445.0	2.3	2.4	1.7	1.7
450.0	1.5	1.7	2.1	2.3
average	2.12	2.16	1.64	1.78



High Low Study 2 Meters



High Low Study 70 CM



Dimension of the shortest element is most critical.

Sensitivity Continued

So how much of a deviation from aim length makes a difference?

			experimental			short	long	
short	long		short	long		6.25	57.5	nominal
high	high		6.4375	57.625		0.1875	0.125	
high	low		6.4375	57.25		0.1875	-0.25	
low	high		6.0625	57.625		-0.1875	0.125	
low	low		6.0625	57.25		-0.1875	-0.25	

Conclusion

- **SWR is relatively insensitve to rod length for 2-meters**
- **SWR is quite sensitive to rod length for 70-cm**
    - **Especially for the length of the shortest element**
- **Values will vary somewhat depending on the mounting conditions. YMMV**

So . . .

- **For the Arrow Design j-pole project we have covered:**
  - **Design**
  - **Materials**
  - **Rod cutting**
  - **Rod threading**
  - **Base plate cutting**
  - **Base plate drilling**
  - **Base plate tapping**
  - **Assembly**
  - **Characterization**

Thank You

Questions?