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**FM DIRECTIONAL BROADCAST ANTENNA**

**PROOF-OF-PERFORMANCE**

**MODEL JMPC-1R (DA), 88.1MHZ**

**SERIAL NUMBER 20309-A**

**WCRX-FM**

**COLUMBIA COLLEGE CHICAGO, IL**





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6340 Sky Creek Drive, Sacramento, California 95828  
P.O. Box 292880, Sacramento, California 95829-2880

(916) 383-1177 FAX (916) 383-1182

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**JAMPRO**  
ANTENNAS, INC.

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DATE: May 10, 2023

FM ANTENNA FOR: STATION: WCRX, 88.1 MHz

LOCATION: COLUMBIA COLLEGE CHICAGO

ANTENNA GAIN	H-pol	V-pol
Relative	1.286	0.890
(dBd)	(1.092)	(-0.506)

MODEL NUMBER: JMPC-1R DA

FREQUENCY & ERP: 88.1 MHz, 0.1 kW

ANTENNA INPUT POWER: 0.0778 kW

ANTENNA BORESIGHT BOOM HEADING: 100° True North

RMS OF THE NORMALIZED	Composite	H-pol	V-pol
AZIMUTH PATTERNS:	0.6740	0.6002	0.7727

Ratio of RMS of Composite pattern over RMS Limits 0.856 (85.6%)

## CERTIFICATION

This certification, along with the accompanying antenna specification sheet, antenna mounting sketches, and azimuth and elevation patterns, certifies the construction, measurement and calculations of the *JAMPRO* FM CP antenna to the station's requirements, as designed, calculated, analyzed and measured at the *JAMPRO* Antenna, Inc. factory site in Sacramento, California. The following is an outline of construction methods, patterns design and calculations, tuning as measured , installation requirements, recommended maintenance and equipment used.

## CONSTRUCTION

A standard CP FM antenna model was used and parasitic reflectors were added to create the required directional patterns. These additional reflectors elements are steel, hot dipped galvanized and either bolted or welded in place. Measurements to establish their exact location are shown on the antenna mounting sketches.

## ANTENNA PATTERNS CALCULATIONS AND ANALYSIS

The full scale antenna was numerically modelled using commercial High Frequency Simulation Solver software ANSYS®Electromagnetics Suite 18.1.0. The model includes complete antenna with reflectors on a duplicate of its mechanical support. Resulting Azimuth HRP patterns, RMS values, Elevation patterns and gain figures each in both polarizations Horizontal and Vertical, as well their Composite pattern and other details, are to be found on the accompanying pages.



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## TUNING MEASUREMENT

Once antenna was manufactured it was mounted on a duplicate of its support for purpose to verify and meet tuning VSWR requirement by actual measurement. Equipment used for this measurement was Agilent E5071C ENA Network Analyzer. The tuned measured data is included in the project manual.

## INSTALLATION

The antenna must be installed in the manner in which it was calculated and measured at the factory. This is shown in detail on the antenna mounting drawing, including the azimuth bearing of the element. This boom must be verified by a surveyor at the site when installation is being completed. Only non-metallic guy wires are permitted within the aperture of the directional antenna. Good engineering practices should be followed in any details not covered by specific instructions.

## MAINTENANCE

Annual or regular inspection should be made on the antenna system. At this time, tightness of U-bolts, or other fastenings, should be routinely checked. Any deterioration of the antenna due to lightning, or other causes should be promptly repaired.

## CONCLUSION

In the development of this pattern, JAMPRO antennas, Inc. observed known requirements of the FCC, as stated on the station construction permit. Gain figures and required input power to achieve station ERP, as well as other details, are found on the first page.

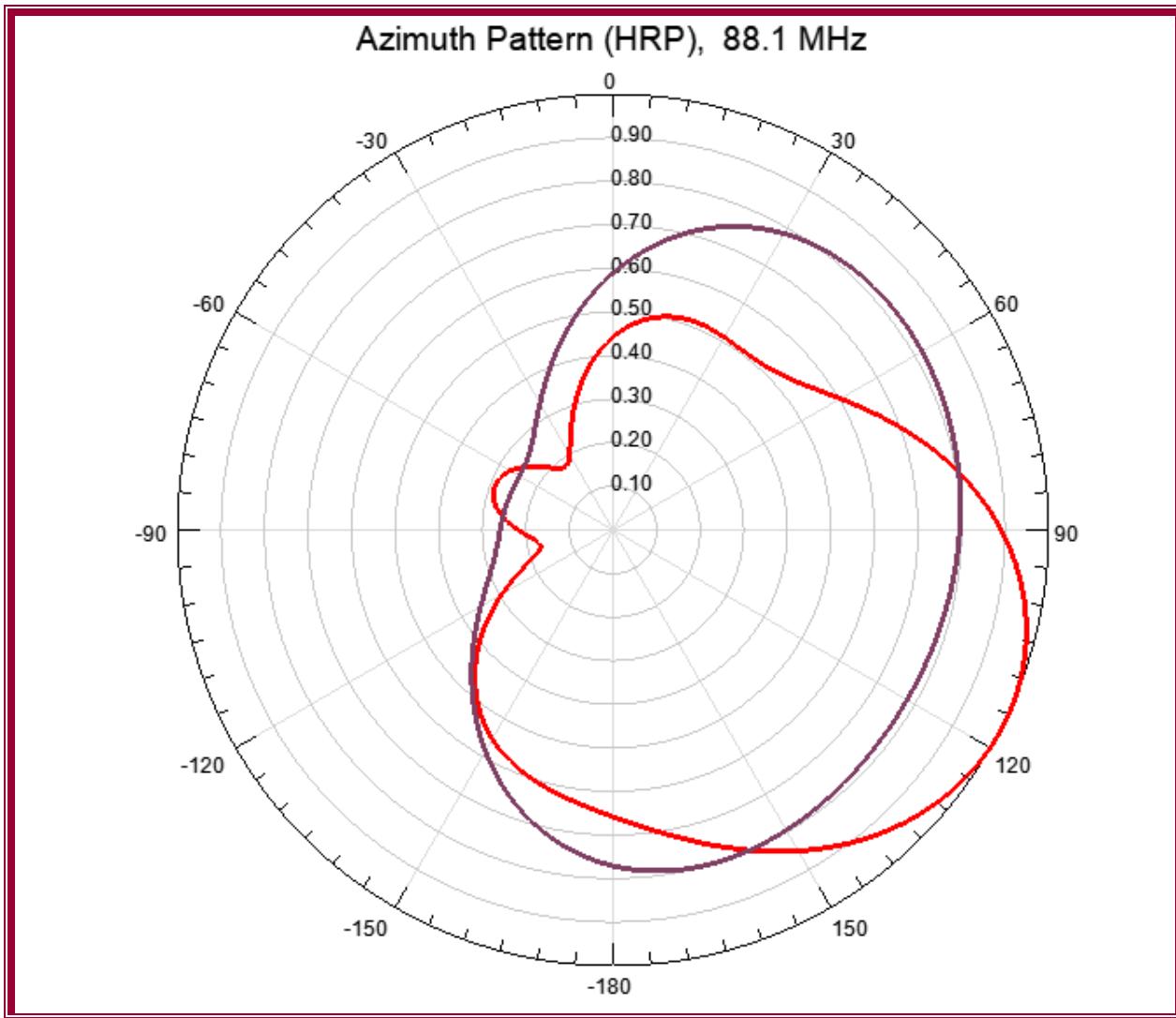
The design, configuration, calculations, measurements and certification for this antenna were performed by or under the direction of  
Vyacheslav Bulkin, Ph.D, E.E., Senior RF Engineer, JAMPRO Antennas, Inc.

EXECUTED THIS 10th DAY OF May, 2023  
BY: Vyacheslav Bulkin

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Vyacheslav Bulkin, Ph.D, E.E., Senior RF Engineer, JAMPRO Antennas, Inc.

## **ANTENNA AZIMUTH PATTERN PLOT AT 88.1 MHZ**



---- Horizontal Polarization

---- Vertical Polarization



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Station: WCRX Model JMPC-1R DA, 88.1 MHz

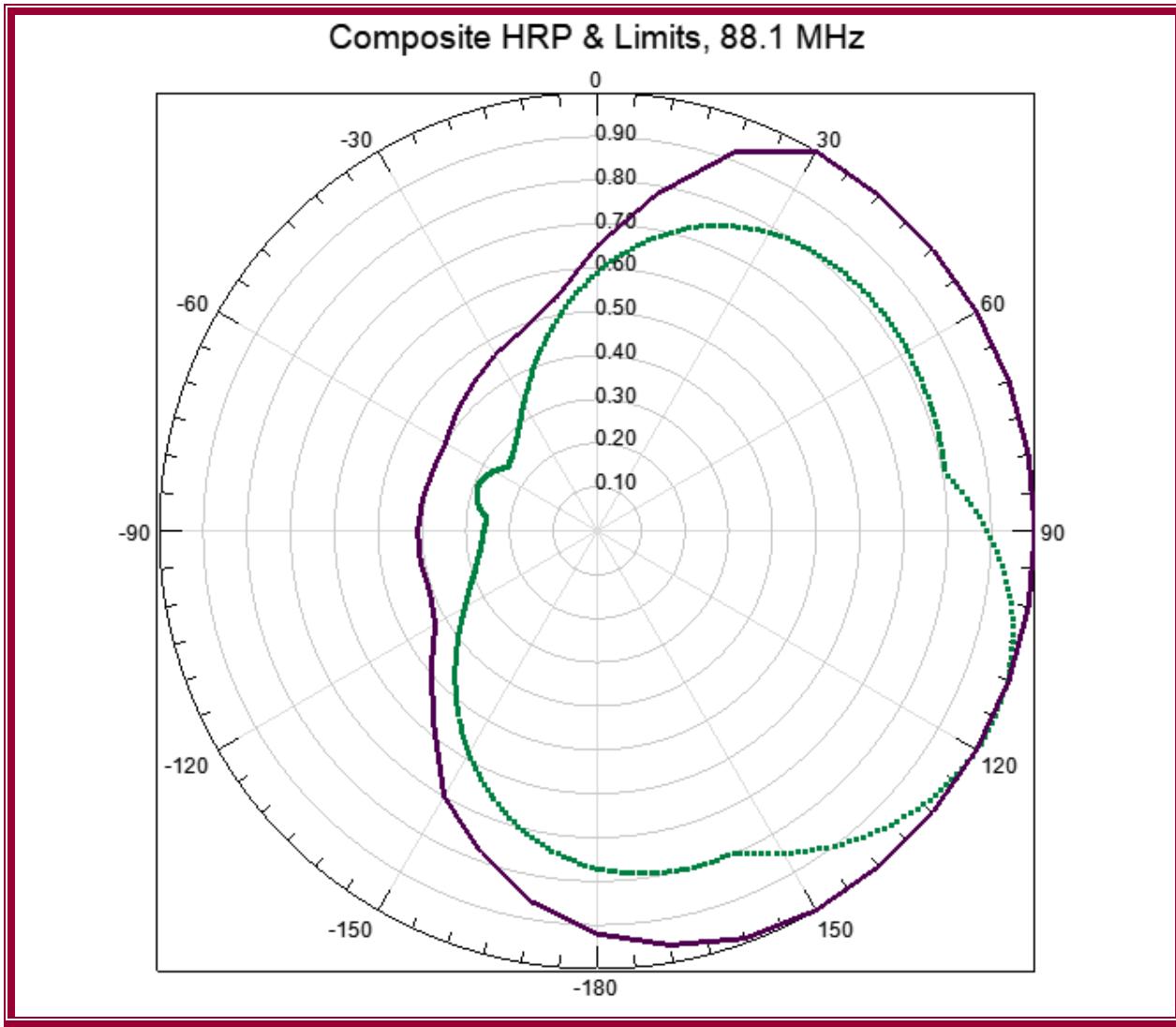
ERP=0.1 kW

Tabulation Of Radiating Fields

Bearing degrees	Horizontal Polarization			Vertical Polarization		
	Field	ERP	dBk	Field	ERP	dBk
0	0.443	0.020	-17.08	0.589	0.035	-14.59
10	0.493	0.024	-16.14	0.673	0.045	-13.44
20	0.513	0.026	-15.80	0.740	0.055	-12.61
30	0.511	0.026	-15.84	0.786	0.062	-12.10
40	0.510	0.026	-15.86	0.810	0.066	-11.83
50	0.537	0.029	-15.41	0.819	0.067	-11.73
60	0.603	0.036	-14.40	0.819	0.067	-11.74
70	0.697	0.049	-13.14	0.813	0.066	-11.80
80	0.799	0.064	-11.95	0.805	0.065	-11.88
90	0.891	0.079	-11.00	0.796	0.063	-11.98
100	0.959	0.092	-10.36	0.788	0.062	-12.07
110	0.996	0.099	-10.03	0.782	0.061	-12.14
120	1.000	0.100	-10.00	0.780	0.061	-12.16
130	0.972	0.095	-10.24	0.782	0.061	-12.14
140	0.920	0.085	-10.73	0.788	0.062	-12.07
150	0.850	0.072	-11.41	0.795	0.063	-11.99
160	0.776	0.060	-12.20	0.799	0.064	-11.95
170	0.709	0.050	-12.99	0.793	0.063	-12.01
180	0.658	0.043	-13.63	0.771	0.059	-12.26
190	0.624	0.039	-14.10	0.728	0.053	-12.76
200	0.595	0.035	-14.52	0.664	0.044	-13.55
210	0.554	0.031	-15.13	0.586	0.034	-14.64
220	0.490	0.024	-16.20	0.501	0.025	-16.00
230	0.400	0.016	-17.96	0.419	0.018	-17.55
240	0.294	0.009	-20.64	0.351	0.012	-19.11
250	0.200	0.004	-23.98	0.301	0.009	-20.42
260	0.173	0.003	-25.26	0.273	0.007	-21.29
270	0.218	0.005	-23.23	0.259	0.007	-21.74
280	0.269	0.007	-21.41	0.253	0.006	-21.94
290	0.289	0.008	-20.77	0.249	0.006	-22.07
300	0.272	0.007	-21.31	0.248	0.006	-22.12
310	0.227	0.005	-22.90	0.256	0.007	-21.83
320	0.185	0.003	-24.66	0.284	0.008	-20.95
330	0.199	0.004	-24.02	0.335	0.011	-19.49
340	0.273	0.008	-21.26	0.409	0.017	-17.76
350	0.364	0.013	-18.77	0.497	0.025	-16.07
Bearing degrees	Horizontal Polarization	ERP	dBk	Vertical Polarization	ERP	dBk
	Field			Field		
	rms=0.6002			rms=0.7727		

## **COMPOSITE AZIMUTH PATTERN & LIMITS PLOT,**

**AT 88.1 MHZ**



---- Composite Horizontal& Vertical Polarization (rms=0.6740)

---- Limits (rms=0.7876)



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Station: WCRX Model JMPC-1R DA, 88.1 MHz

ERP=0.1 kW

Tabulation Of Radiating Fields

Composite H & V Pattern			
Bearing degrees	Field	ERP	dBk
		kW	
0	0.589	0.035	-14.59
10	0.673	0.045	-13.44
20	0.740	0.055	-12.61
30	0.786	0.062	-12.10
40	0.810	0.066	-11.83
50	0.819	0.067	-11.73
60	0.819	0.067	-11.74
70	0.813	0.066	-11.80
80	0.805	0.065	-11.88
90	0.891	0.079	-11.00
100	0.959	0.092	-10.36
110	0.996	0.099	-10.03
120	1.000	0.100	-10.00
130	0.972	0.095	-10.24
140	0.920	0.085	-10.73
150	0.850	0.072	-11.41
160	0.799	0.064	-11.95
170	0.793	0.063	-12.01
180	0.771	0.059	-12.26
190	0.728	0.053	-12.76
200	0.664	0.044	-13.55
210	0.586	0.034	-14.64
220	0.501	0.025	-16.00
230	0.419	0.018	-17.55
240	0.351	0.012	-19.11
250	0.301	0.009	-20.42
260	0.273	0.007	-21.29
270	0.259	0.007	-21.74
280	0.269	0.007	-21.41
290	0.289	0.008	-20.77
300	0.272	0.007	-21.31
310	0.256	0.007	-21.83
320	0.284	0.008	-20.95
330	0.335	0.011	-19.49
340	0.409	0.017	-17.76
350	0.497	0.025	-16.07
Bearing degrees	Composite H & V Field	ERP kW	dBk
		rms=0.674	



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## ANTENNA VSWR PLOT

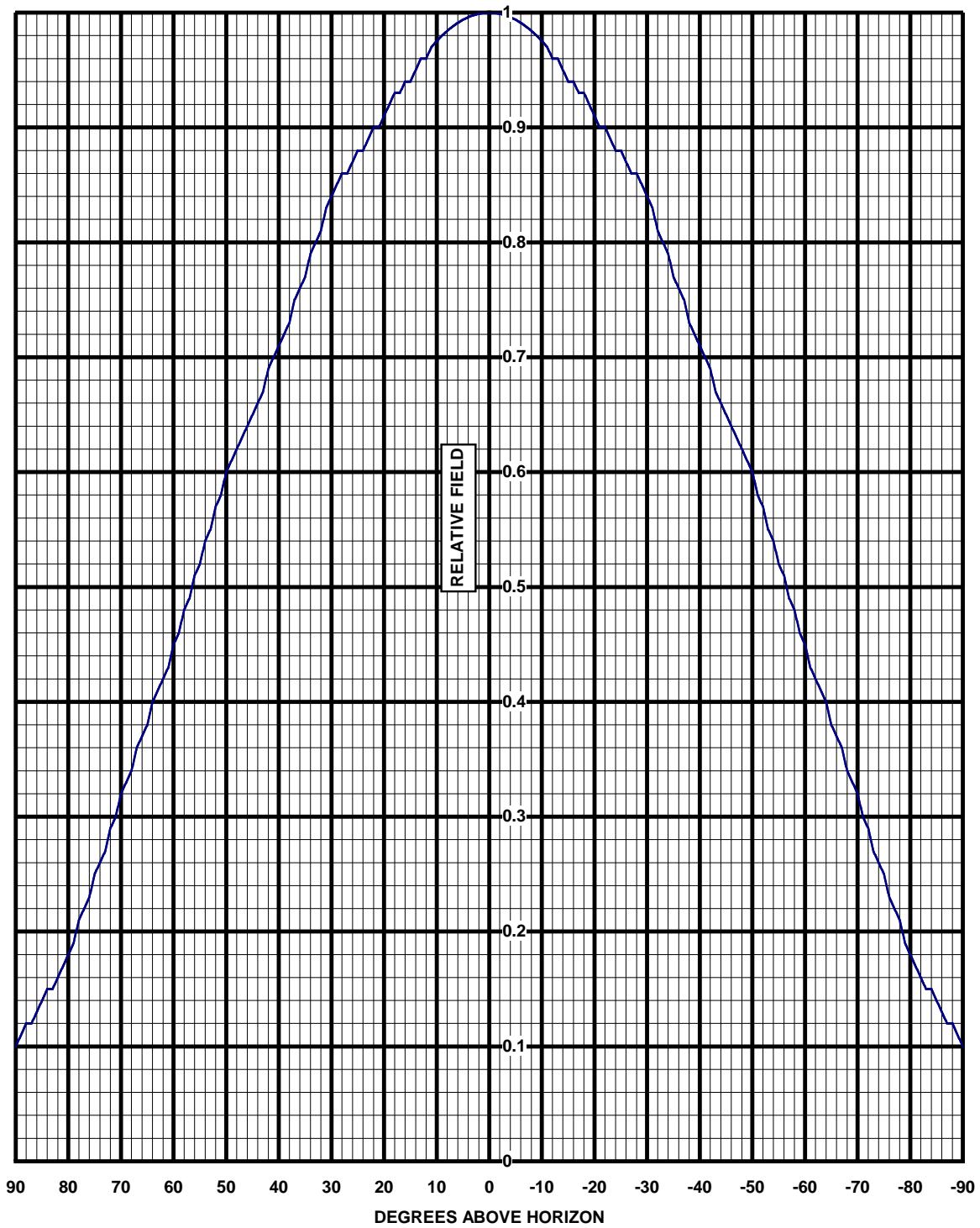




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## ELEVATION PATTERN NORMALIZED





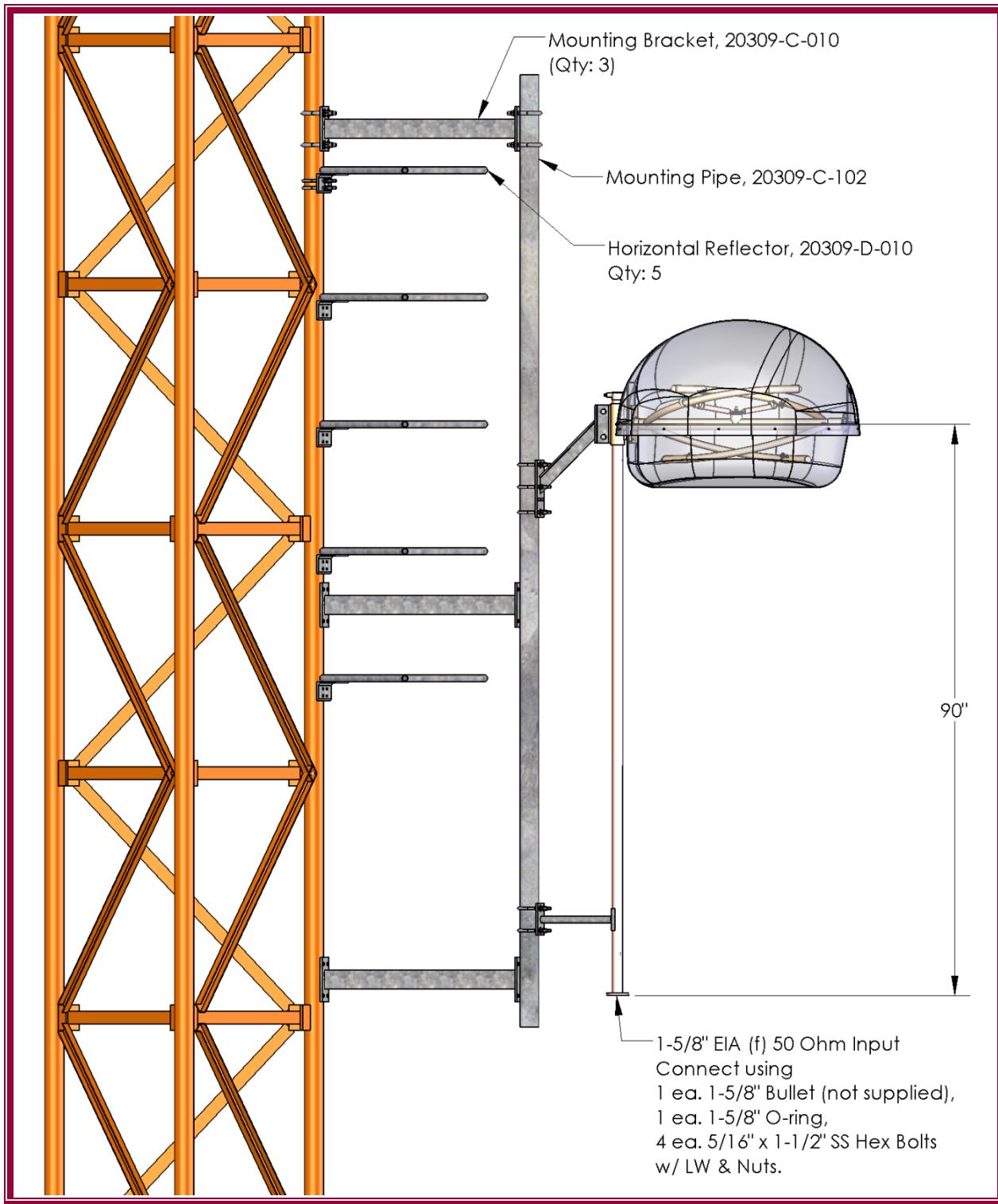
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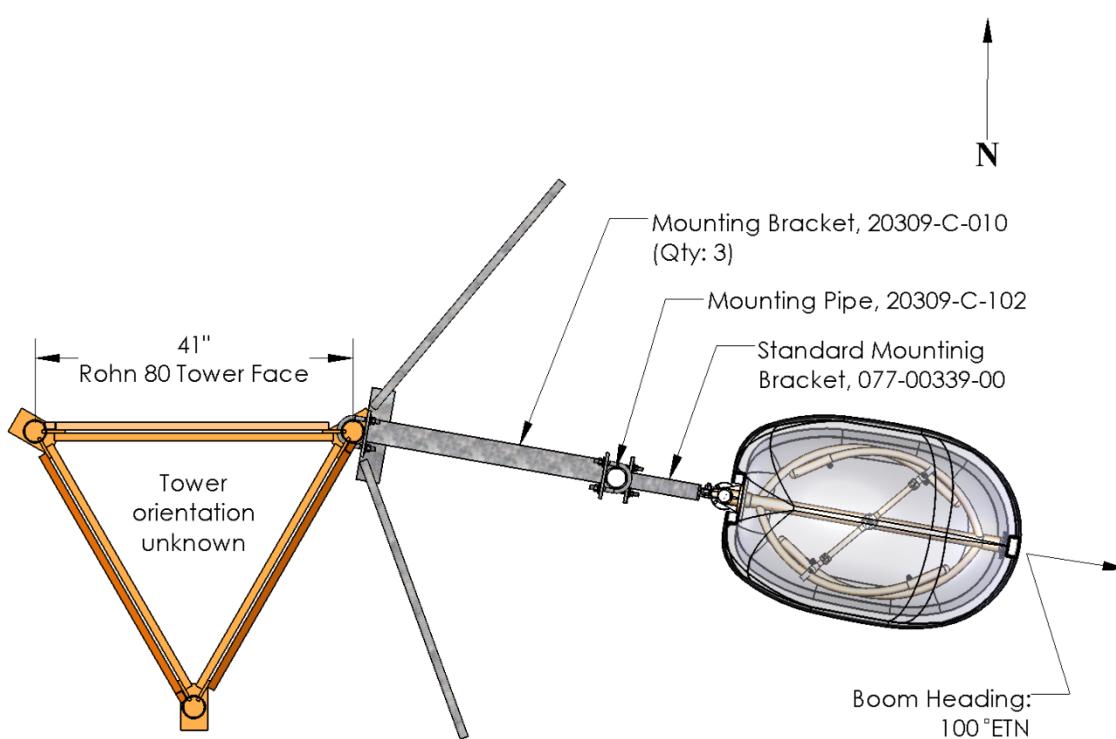
## ELEVATION PATTERN TABULATION

<u>ELEVATION ANGLE</u>	<u>RELATIVE FIELD</u>	<u>ELEVATION ANGLE</u>	<u>RELATIVE FIELD</u>	<u>ELEVATION ANGLE</u>	<u>RELATIVE FIELD</u>
10	0.975	-26	0.870	-61	0.430
9	0.980	-27	0.860	-62	0.420
8	0.984	-28	0.860	-63	0.410
7	0.988	-29	0.850	-64	0.400
6	0.991	-30	0.840	-65	0.380
5	0.994	-31	0.830	-66	0.370
4	0.996	-32	0.810	-67	0.360
3	0.998	-33	0.800	-68	0.340
2	0.999	-34	0.790	-69	0.330
1	1.000	-35	0.770	-70	0.320
0	1.000	-36	0.760	-71	0.300
-1	1.000	-37	0.750	-72	0.290
-2	0.999	-38	0.730	-73	0.270
-3	0.998	-39	0.720	-74	0.260
-4	0.996	-40	0.710	-75	0.250
-5	0.994	-41	0.700	-76	0.230
-6	0.991	-42	0.690	-77	0.220
-7	0.988	-43	0.670	-78	0.210
-8	0.984	-44	0.660	-79	0.190
-9	0.980	-45	0.650	-80	0.180
-10	0.975	-46	0.640	-81	0.170
-11	0.970	-47	0.630	-82	0.160
-12	0.960	-48	0.620	-83	0.150
-13	0.960	-49	0.610	-84	0.150
-14	0.950	-50	0.600	-85	0.140
-15	0.940	-51	0.580	-86	0.130
-16	0.940	-52	0.570	-87	0.120
-17	0.930	-53	0.550	-88	0.120
-18	0.930	-54	0.540	-89	0.110
-19	0.920	-55	0.520	-90	0.100
-20	0.910	-56	0.510		
-21	0.900	-57	0.490		
-22	0.900	-58	0.480		
-23	0.890	-59	0.460		
-24	0.880	-60	0.450		
-25	0.880				

## MECHANICAL DRAWINGS - ELEVATION VIEW



## MECHANICAL DRAWINGS - TOP VIEW



### NOTES:

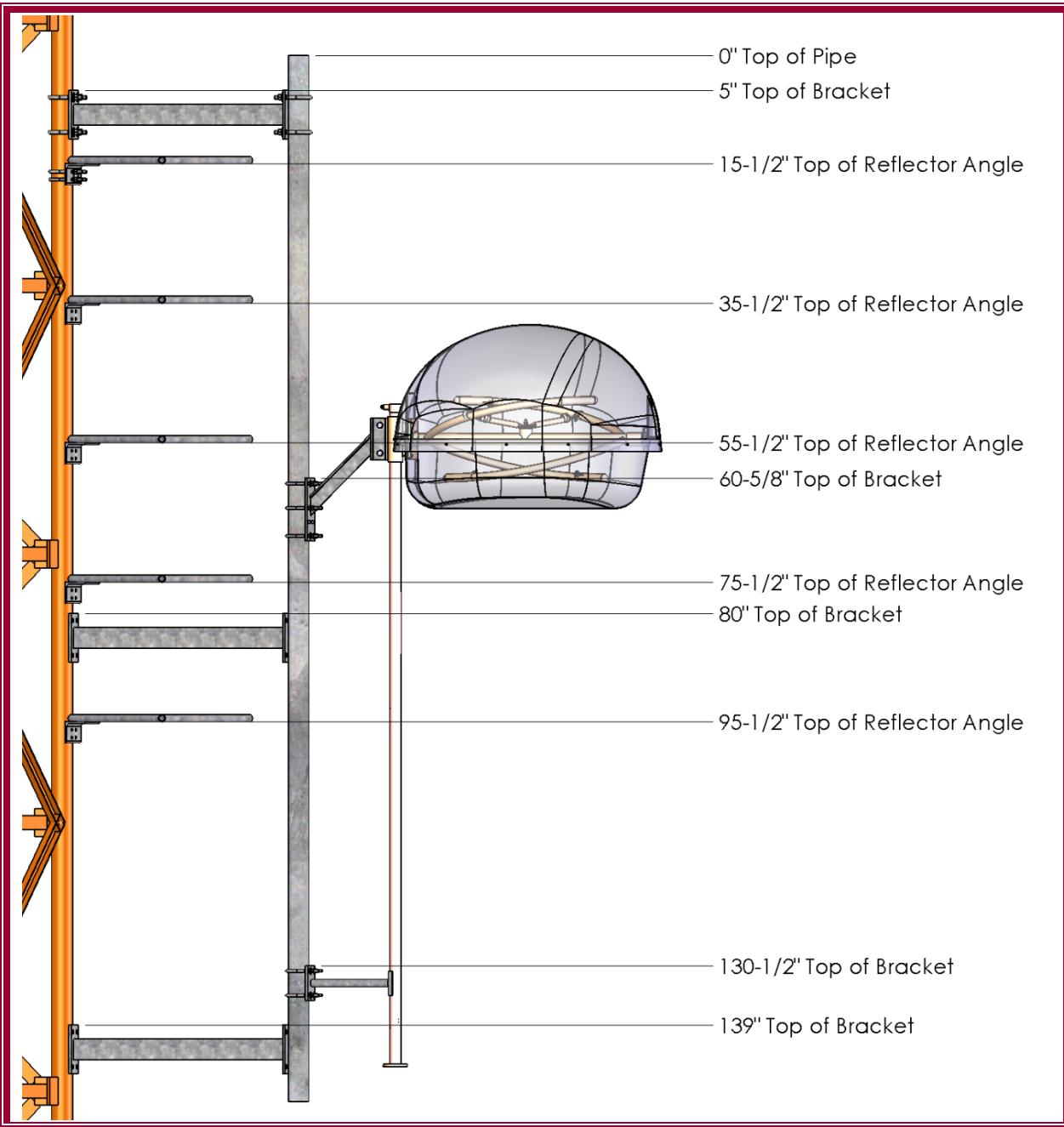
1. The leg size and/or face width are based on information provided by the customer or an authorized representative.
2. The tower orientation was unknown at the time of this publication.
3. Install the antenna as shown and position the antenna based on the dimension(s) indicated on the 'Element Position' Sheet.
4. Installing the antenna other than illustrated may affect performance.
5. If guy wires are present, use of glass rods or break-up insulators in guy wires is optional.
6. Purge moisture from antenna system and coaxial cable before applying any RF power.
7. All metal parts are at D.C. ground through element grounding.
8. Remove paint at tower leg connections to ensure proper grounding.
9. The Station Engineer is to determine onto which leg the antenna will be installed for optimal coverage.



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## MOUNT AND REFLECTOR POSITION VIEW

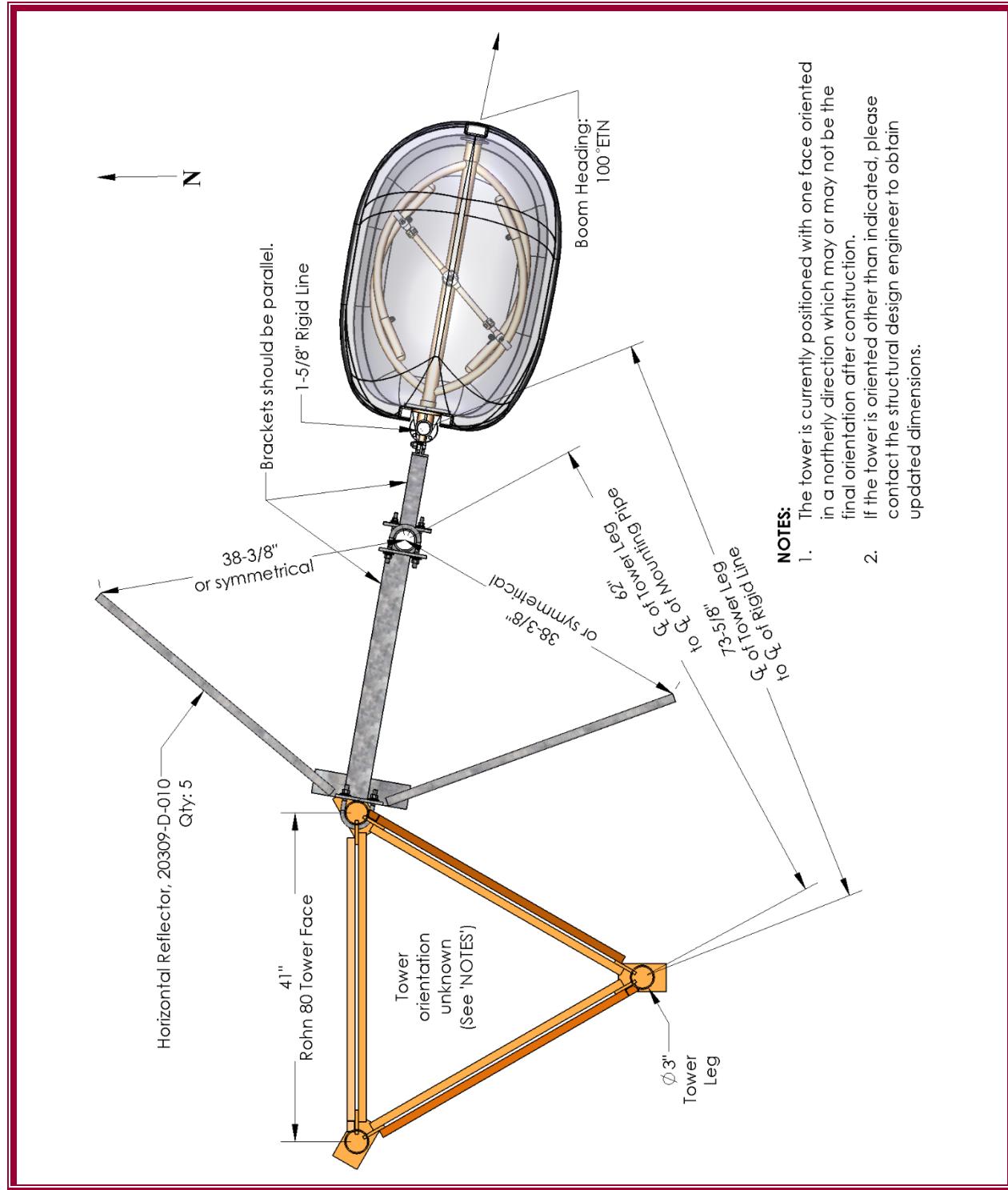




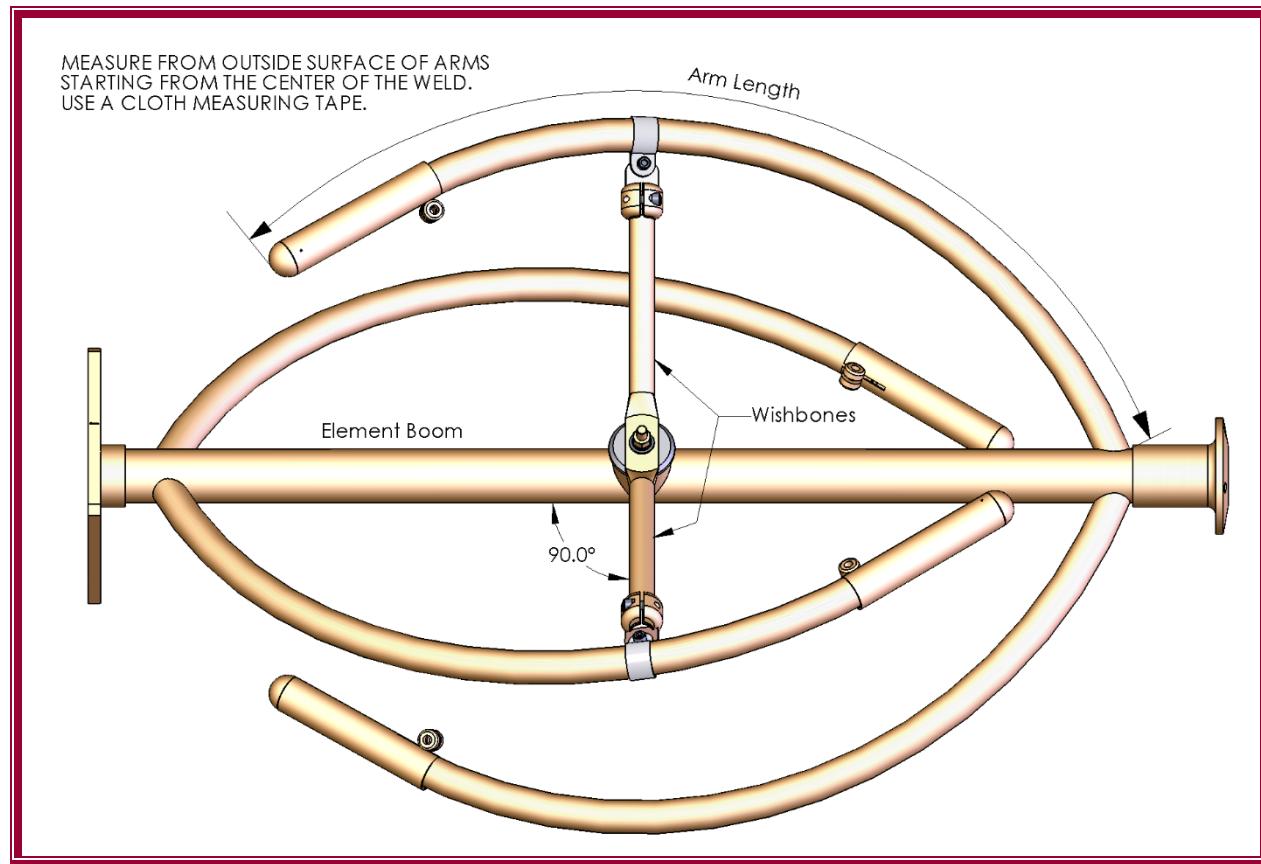
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## **MECHANICAL DRAWINGS - ELEMENT AND REFLECTOR VIEW (TOP VIEW)**



## **MECHANICAL DRAWINGS – RADIATING DIPOLES ARMS LENGTH & FEED WISHBONE SETTINGS**



Arms Length and Feed Wishbone (WB) settings for serial#20309-A are :  
Arms Length=30-1/2", WBs are Orthogonal to boom across from feed pin

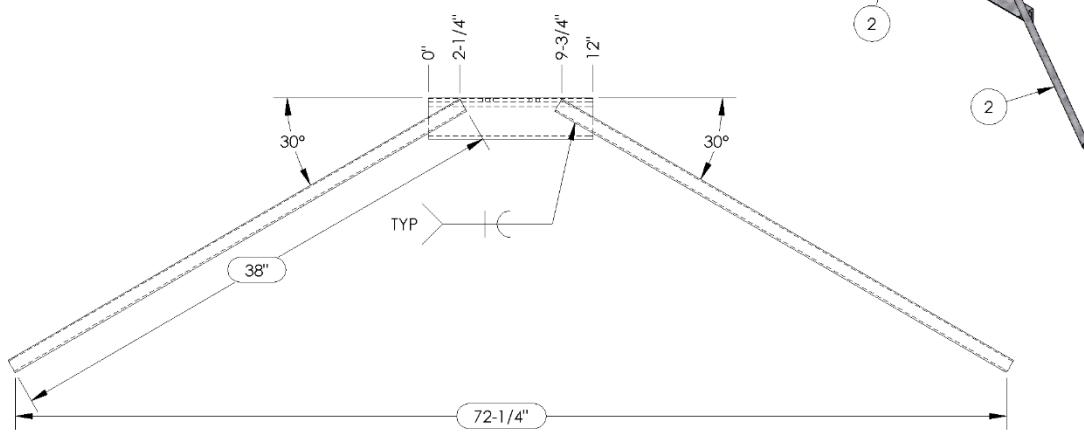


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## REFLECTORS DRAWING

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	20309-D-100	REFLECTOR BRKT	1
2	20309-D-101	Hortz Refl Rod	2



DO NOT SCALE DRAWING		QUALITY CONTROL		PRODUCTION CONTROL		NAME	DATE	JAMPRO ANTENNAS
DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED		Op	INT.	Date	Comments	Job Number:		
TOLERANCE:		1st				Date:	Priority:	
PARALLEL: .001-.002"		2nd				Issued By:	Run Size:	
ANGULAR: MACH $\pm$ .5° 88ND. $\pm$ 1°		3rd				Made By:	Qty:	
ONE PLACE DECIMAL $\pm$ .01"		4th				Made By:	Qty:	
TWO PLACE DECIMAL $\pm$ .001"		5th				Made By:	Qty:	
THREE PLACE DECIMAL $\pm$ .005"								

Horizontal Reflector

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SEE BILL OF MATERIALS

SEE DWG. NO. A 20309-D-010 SHEET 1 OF 1 REV. A