



Summary of Wind Load Calculations for Grid Reflectors

January 2006

Summary

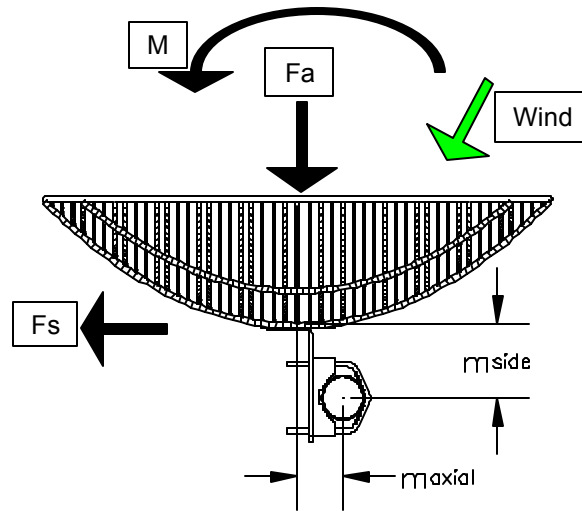
The wind load forces for a family of gridded reflectors have been calculated. The results are presented for reflector diameters of 14, 18, 24, 32, and 39 inches, at wind speeds of 70, 90, and 125 MPH. Results are provided for each condition without ice, and also with 1 inch of radial ice accumulation.

The analysis method is presented and discussed.

Analysis Method

The calculation of forces on the antenna supporting structure is performed per the guidelines of EIA/TIA-222-E, Structural Standards for Steel Antenna Towers and Antenna Supporting Structures. The wind loading values are computed for typical microwave antenna structures.

The wind forces are computed using the coordinate system shown below:



The axial force F_A acts parallel to the antenna boresight. The side force F_S acts perpendicular to F_A in the plane of F_A and the wind vector. The twisting moment M acts in the plane containing F_A and F_S . The two distances m_{side} and m_{axial} are the respective moment arm offsets from the center of the antenna mast structure to the feed origin.

These antenna loads are calculated using the following formulas:

$$F_A = C_A A K_Z G_H V^2 \text{ (lb)} \quad F_S = C_S A K_Z G_H V^2 \text{ (lb)} \quad M = C_M A D K_Z G_H V^2 \text{ (ft-lb)}$$

where

C_A , C_S , and C_M are coefficients provided in EIA/TIA-222 for generalized antenna structures (C_A , C_S , and C_M are wind angle dependent)

G_H = Gust response factor

A = Outside aperture of antenna (square ft.)

D = Outside diameter of reflector (ft.)

V = Basic wind speed (MPH)

K_Z = Exposure coefficient

For the purposes of this analysis, G_H and K_Z are considered to be 0 (zero).

The wind force coefficients for typical grid antennas (from EIA/TIA-222) were used for the “no ice” configurations. The wind force coefficients for typical paraboloids without radome were used for the “with ice” configurations. The radial ice thickness adds directly to the antenna diameter in the calculations.

For all conditions, $m_{\text{side}} = 3.35$ inches, and $m_{\text{axial}} = 2.17$ inches.

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

14 Inch Diameter Gridded Reflector, No Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole				Forces on Mount				
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0014	0.0000	0.0000	7	32	0	0	0	0	1	2	16
	70	45	0.0009	0.0007	0.0001	5	22	4	16	1	1	3	4	32
	70	56	0.0007	0.0007	0.0001	4	17	4	17	1	1	3	3	30
	70	90	-0.0001	0.0006	0.0001	-1	-3	3	14	1	1	1	2	18
	70	125	-0.0008	0.0007	0.0001	-4	-18	4	16	1	1	1	1	13
	70	180	-0.0015	0.0000	0.0000	-8	-35	0	0	0	0	-1	-2	-17
	70	30	0.0018	0.0006	0.0001	9	42							
	70	111	-0.0005	0.0007	0.0001			4	17					
	70	69	0.0004	0.0007	0.0001					1	1			
	70	31	0.0018	0.0006	0.0001							3	4	38
Comparison	90	0	0.0014	0.0000	0.0000	12	53	0	0	0	0	2	3	26
	90	45	0.0009	0.0007	0.0001	8	36	6	27	1	2	4	6	52
	90	56	0.0007	0.0007	0.0001	6	28	6	28	1	2	4	6	50
	90	90	-0.0001	0.0006	0.0001	-1	-5	5	24	1	2	2	3	29
	90	125	-0.0008	0.0007	0.0001	-7	-30	6	27	1	2	2	2	21
	90	180	-0.0015	0.0000	0.0000	-13	-59	0	0	0	0	-2	-3	-29
	90	30	0.0018	0.0006	0.0001	16	69							
	90	111	-0.0005	0.0007	0.0001			6	28					
	90	69	0.0004	0.0007	0.0001					1	2			
	90	31	0.0018	0.0006	0.0001							5	7	63
Survival	125	0	0.0014	0.0000	0.0000	23	102	0	0	0	0	4	6	50
	125	45	0.0009	0.0007	0.0001	16	69	12	51	2	3	8	11	101
	125	56	0.0007	0.0007	0.0001	12	53	12	53	3	3	8	11	97
	125	90	-0.0001	0.0006	0.0001	-2	-10	10	46	2	3	5	6	56
	125	135	-0.0010	0.0006	0.0001	-16	-71	11	47	2	3	2	3	30
	125	180	-0.0015	0.0000	0.0000	-25	-113	0	0	0	0	-5	-6	-55
	125	30	0.0018	0.0006	0.0001	30	134							
	125	111	-0.0005	0.0007	0.0001			12	54					
	125	69	0.0004	0.0007	0.0001					3	4			
	125	31	0.0018	0.0006	0.0001							10	14	121

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

18 Inch Diameter Gridded Reflector, No Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole				Forces on Mount				
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0014	0.0000	0.0000	12	53	0	0	0	0	2	3	26
	70	45	0.0009	0.0007	0.0001	8	36	6	27	2	2	5	6	56
	70	56	0.0007	0.0007	0.0001	6	28	6	28	2	2	5	6	55
	70	90	-0.0001	0.0006	0.0001	-1	-5	5	24	1	2	3	4	33
	70	125	-0.0008	0.0007	0.0001	-7	-30	6	27	2	2	2	3	26
	70	180	-0.0015	0.0000	0.0000	-13	-59	0	0	0	0	-2	-3	-29
	70	30	0.0018	0.0006	0.0001	16	69							
	70	111	-0.0005	0.0007	0.0001			6	28					
	70	69	0.0004	0.0007	0.0001					2	3			
	70	31	0.0018	0.0006	0.0001							6	7	66
Comparison	90	0	0.0014	0.0000	0.0000	20	87	0	0	0	0	4	5	43
	90	45	0.0009	0.0007	0.0001	13	59	10	44	3	4	8	11	93
	90	56	0.0007	0.0007	0.0001	10	46	10	46	3	4	8	10	91
	90	90	-0.0001	0.0006	0.0001	-2	-8	9	39	2	3	5	6	54
	90	125	-0.0008	0.0007	0.0001	-11	-49	10	44	3	4	4	5	43
	90	180	-0.0015	0.0000	0.0000	-22	-97	0	0	0	0	-4	-5	-47
	90	30	0.0018	0.0006	0.0001	26	115							
	90	111	-0.0005	0.0007	0.0001			10	46					
	90	69	0.0004	0.0007	0.0001					3	4			
	90	31	0.0018	0.0006	0.0001							9	12	110
Survival	125	0	0.0014	0.0000	0.0000	38	168	0	0	0	0	7	9	82
	125	45	0.0009	0.0007	0.0001	26	114	19	85	5	7	15	20	180
	125	56	0.0007	0.0007	0.0001	20	88	20	88	5	7	15	20	175
	125	90	-0.0001	0.0006	0.0001	-4	-16	17	76	5	6	9	12	105
	125	135	-0.0010	0.0006	0.0001	-26	-117	18	78	5	7	5	7	62
	125	180	-0.0015	0.0000	0.0000	-42	-187	0	0	0	0	-8	-10	-91
	125	30	0.0018	0.0006	0.0001	50	221							
	125	111	-0.0005	0.0007	0.0001			20	90					
	125	69	0.0004	0.0007	0.0001					6	8			
	125	31	0.0018	0.0006	0.0001							18	24	211

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

24 Inch Diameter Gridded Reflector, No Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole				Forces on Mount				
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0014	0.0000	0.0000	21	94	0	0	0	0	4	5	46
	70	45	0.0009	0.0007	0.0001	14	64	11	47	4	5	9	13	111
	70	56	0.0007	0.0007	0.0001	11	49	11	49	4	6	9	12	110
	70	90	-0.0001	0.0006	0.0001	-2	-9	10	42	3	5	6	8	69
	70	125	-0.0008	0.0007	0.0001	-12	-53	11	47	4	5	5	7	58
	70	180	-0.0015	0.0000	0.0000	-23	-104	0	0	0	0	-4	-6	-51
	70	30	0.0018	0.0006	0.0001	28	123							
	70	111	-0.0005	0.0007	0.0001			11	50					
	70	69	0.0004	0.0007	0.0001					4	6			
	70	31	0.0018	0.0006	0.0001							11	14	127
Comparison	90	0	0.0014	0.0000	0.0000	35	155	0	0	0	0	6	9	76
	90	45	0.0009	0.0007	0.0001	24	105	18	78	6	8	15	21	184
	90	56	0.0007	0.0007	0.0001	18	81	18	81	7	9	15	20	181
	90	90	-0.0001	0.0006	0.0001	-3	-15	16	70	6	8	9	13	113
	90	125	-0.0008	0.0007	0.0001	-20	-87	18	78	7	9	8	11	96
	90	180	-0.0015	0.0000	0.0000	-39	-172	0	0	0	0	-7	-9	-84
	90	30	0.0018	0.0006	0.0001	46	204							
	90	111	-0.0005	0.0007	0.0001			19	83					
	90	69	0.0004	0.0007	0.0001					7	10			
	90	31	0.0018	0.0006	0.0001							18	24	210
Survival	125	0	0.0014	0.0000	0.0000	67	299	0	0	0	0	12	16	146
	125	45	0.0009	0.0007	0.0001	46	203	34	150	12	16	30	40	356
	125	56	0.0007	0.0007	0.0001	35	157	35	156	13	18	29	39	350
	125	90	-0.0001	0.0006	0.0001	-6	-28	30	135	11	15	18	25	219
	125	135	-0.0010	0.0006	0.0001	-47	-207	31	139	12	16	12	17	147
	125	180	-0.0015	0.0000	0.0000	-75	-332	0	0	0	0	-13	-18	-162
	125	30	0.0018	0.0006	0.0001	88	393							
	125	111	-0.0005	0.0007	0.0001			36	159					
	125	69	0.0004	0.0007	0.0001					14	19			
	125	31	0.0018	0.0006	0.0001							34	46	405

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

32 Inch Diameter Gridded Reflector, No Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole				Forces on Mount				
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0014	0.0000	0.0000	37	167	0	0	0	0	7	9	81
	70	45	0.0009	0.0007	0.0001	25	113	19	84	9	12	19	25	225
	70	56	0.0007	0.0007	0.0001	20	87	20	87	10	13	19	25	224
	70	90	-0.0001	0.0006	0.0001	-4	-16	17	75	8	11	12	17	146
	70	125	-0.0008	0.0007	0.0001	-21	-94	19	84	9	13	11	15	132
	70	180	-0.0015	0.0000	0.0000	-42	-185	0	0	0	0	-8	-10	-90
	70	30	0.0018	0.0006	0.0001	49	219							
	70	111	-0.0005	0.0007	0.0001			20	89					
	70	69	0.0004	0.0007	0.0001					10	14			
	70	31	0.0018	0.0006	0.0001							21	28	248
Comparison	90	0	0.0014	0.0000	0.0000	62	276	0	0	0	0	11	15	134
	90	45	0.0009	0.0007	0.0001	42	187	31	139	15	20	31	42	372
	90	56	0.0007	0.0007	0.0001	32	144	32	144	16	22	31	42	370
	90	90	-0.0001	0.0006	0.0001	-6	-26	28	125	13	18	20	27	242
	90	125	-0.0008	0.0007	0.0001	-35	-155	31	139	16	21	18	25	217
	90	180	-0.0015	0.0000	0.0000	-69	-306	0	0	0	0	-12	-17	-149
	90	30	0.0018	0.0006	0.0001	81	362							
	90	111	-0.0005	0.0007	0.0001			33	147					
	90	69	0.0004	0.0007	0.0001					17	23			
	90	31	0.0018	0.0006	0.0001							34	46	410
Survival	125	0	0.0014	0.0000	0.0000	120	532	0	0	0	0	22	29	259
	125	45	0.0009	0.0007	0.0001	81	361	60	267	28	38	60	81	717
	125	56	0.0007	0.0007	0.0001	63	278	62	278	31	42	59	81	714
	125	90	-0.0001	0.0006	0.0001	-11	-50	54	241	26	35	39	53	467
	125	135	-0.0010	0.0006	0.0001	-83	-369	56	247	28	38	29	39	346
	125	180	-0.0015	0.0000	0.0000	-133	-590	0	0	0	0	-24	-33	-288
	125	30	0.0018	0.0006	0.0001	157	699							
	125	111	-0.0005	0.0007	0.0001			64	283					
	125	69	0.0004	0.0007	0.0001					33	45			
	125	31	0.0018	0.0006	0.0001							66	89	790

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

39 Inch Diameter Gridded Reflector, No Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole				Forces on Mount				
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0014	0.0000	0.0000	56	248	0	0	0	0	10	14	121
	70	45	0.0009	0.0007	0.0001	38	168	28	125	16	22	31	42	369
	70	56	0.0007	0.0007	0.0001	29	130	29	129	17	24	31	42	370
	70	90	-0.0001	0.0006	0.0001	-5	-24	25	112	15	20	21	28	249
	70	125	-0.0008	0.0007	0.0001	-31	-139	28	125	17	23	19	26	232
	70	180	-0.0015	0.0000	0.0000	-62	-275	0	0	0	0	-11	-15	-134
	70	30	0.0018	0.0006	0.0001	73	325							
	70	111	-0.0005	0.0007	0.0001			30	132					
	70	69	0.0004	0.0007	0.0001					19	25			
	70	31	0.0018	0.0006	0.0001							33	45	397
Comparison	90	0	0.0014	0.0000	0.0000	92	409	0	0	0	0	17	23	200
	90	45	0.0009	0.0007	0.0001	62	278	46	206	27	36	51	69	609
	90	56	0.0007	0.0007	0.0001	48	214	48	214	29	39	51	69	612
	90	90	-0.0001	0.0006	0.0001	-9	-39	42	185	24	33	34	46	411
	90	125	-0.0008	0.0007	0.0001	-52	-231	47	207	28	38	32	43	384
	90	180	-0.0015	0.0000	0.0000	-102	-454	0	0	0	0	-18	-25	-222
	90	30	0.0018	0.0006	0.0001	121	538							
	90	111	-0.0005	0.0007	0.0001			49	218					
	90	69	0.0004	0.0007	0.0001					31	42			
	90	31	0.0018	0.0006	0.0001							55	74	656
Survival	125	0	0.0014	0.0000	0.0000	178	790	0	0	0	0	32	44	385
	125	45	0.0009	0.0007	0.0001	121	536	89	397	51	69	98	133	1175
	125	56	0.0007	0.0007	0.0001	93	413	93	412	56	75	98	133	1180
	125	90	-0.0001	0.0006	0.0001	-17	-75	80	357	47	63	66	90	794
	125	135	-0.0010	0.0006	0.0001	-123	-548	83	368	51	69	52	70	624
	125	180	-0.0015	0.0000	0.0000	-197	-876	0	0	0	0	-36	-48	-428
	125	30	0.0018	0.0006	0.0001	233	1038							
	125	111	-0.0005	0.0007	0.0001			95	421					
	125	69	0.0004	0.0007	0.0001					60	81			
	125	31	0.0018	0.0006	0.0001							105	143	1265

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

14 Inch Diameter Gridded Reflector, 1 Inch Radial Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole				Forces on Mount				
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0040	0.0000	0.0000	27	121	0	0	0	0	5	7	59
	70	45	0.0042	0.0001	-0.0002	29	127	1	3	-1	-2	4	5	48
	70	56	0.0043	0.0004	-0.0002	29	131	3	13	-2	-3	4	6	49
	70	90	0.0000	0.0009	0.0003	0	-1	6	27	3	4	5	6	57
	70	125	-0.0012	0.0012	0.0004	-8	-36	8	36	3	5	4	6	51
	70	180	-0.0027	0.0000	0.0000	-18	-82	0	0	0	0	-3	-5	-40
	70	55	0.0043	0.0004	-0.0002	29	131							
	70	128	-0.0012	0.0012	0.0004			8	37					
	70	127	-0.0012	0.0012	0.0004					3	5			
	70	76	0.0027	0.0011	0.0002							7	9	82
Comparison	90	0	0.0040	0.0000	0.0000	45	200	0	0	0	0	8	11	97
	90	45	0.0042	0.0001	-0.0002	47	210	1	6	-2	-3	7	9	79
	90	56	0.0043	0.0004	-0.0002	49	216	5	21	-3	-5	7	9	81
	90	90	0.0000	0.0009	0.0003	0	-2	10	44	5	7	8	11	93
	90	125	-0.0012	0.0012	0.0004	-13	-59	14	60	6	8	7	10	84
	90	180	-0.0027	0.0000	0.0000	-31	-136	0	0	0	0	-6	-7	-66
	90	55	0.0043	0.0004	-0.0002	49	216							
	90	128	-0.0012	0.0012	0.0004			14	60					
	90	127	-0.0012	0.0012	0.0004					6	8			
	90	76	0.0027	0.0011	0.0002							11	15	136
Survival	125	0	0.0040	0.0000	0.0000	87	385	0	0	0	0	16	21	188
	125	45	0.0042	0.0001	-0.0002	91	405	2	11	-4	-6	13	17	153
	125	56	0.0043	0.0004	-0.0002	94	417	9	41	-6	-9	13	18	156
	125	90	0.0000	0.0009	0.0003	-1	-3	19	85	10	13	15	20	180
	125	135	-0.0013	0.0012	0.0004	-28	-125	26	115	10	14	13	17	151
	125	180	-0.0027	0.0000	0.0000	-59	-262	0	0	0	0	-11	-14	-128
	125	55	0.0043	0.0004	-0.0002	94	417							
	125	128	-0.0012	0.0012	0.0004			26	117					
	125	127	-0.0012	0.0012	0.0004					11	15			
	125	76	0.0027	0.0011	0.0002							22	30	262

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

18 Inch Diameter Gridded Reflector, 1 Inch Radial Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole				Forces on Mount				
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0040	0.0000	0.0000	42	189	0	0	0	0	8	10	92
	70	45	0.0042	0.0001	-0.0002	45	198	1	5	-3	-4	6	8	68
	70	56	0.0043	0.0004	-0.0002	46	204	5	20	-4	-5	6	8	67
	70	90	0.0000	0.0009	0.0003	0	-1	9	42	6	8	9	12	103
	70	125	-0.0012	0.0012	0.0004	-12	-56	13	57	7	9	8	11	96
	70	180	-0.0027	0.0000	0.0000	-29	-128	0	0	0	0	-5	-7	-63
	70	55	0.0043	0.0004	-0.0002	46	204							
	70	128	-0.0012	0.0012	0.0004			13	57					
	70	127	-0.0012	0.0012	0.0004					7	9			
	70	78	0.0023	0.0010	0.0002							11	15	136
Comparison	90	0	0.0040	0.0000	0.0000	70	312	0	0	0	0	13	17	152
	90	45	0.0042	0.0001	-0.0002	74	328	2	9	-4	-6	9	13	113
	90	56	0.0043	0.0004	-0.0002	76	338	7	33	-7	-9	9	13	111
	90	90	0.0000	0.0009	0.0003	-1	-2	16	69	10	13	14	19	170
	90	125	-0.0012	0.0012	0.0004	-21	-92	21	94	11	15	13	18	158
	90	180	-0.0027	0.0000	0.0000	-48	-212	0	0	0	0	-9	-12	-104
	90	55	0.0043	0.0004	-0.0002	76	338							
	90	128	-0.0012	0.0012	0.0004			21	94					
	90	127	-0.0012	0.0012	0.0004					11	15			
	90	78	0.0023	0.0010	0.0002							19	25	225
Survival	125	0	0.0040	0.0000	0.0000	135	602	0	0	0	0	24	33	294
	125	45	0.0042	0.0001	-0.0002	142	633	4	17	-9	-12	18	25	218
	125	56	0.0043	0.0004	-0.0002	146	651	14	64	-13	-17	18	24	214
	125	90	0.0000	0.0009	0.0003	-1	-5	30	133	19	26	27	37	327
	125	135	-0.0013	0.0012	0.0004	-44	-196	40	179	21	28	24	32	285
	125	180	-0.0027	0.0000	0.0000	-92	-409	0	0	0	0	-17	-23	-200
	125	55	0.0043	0.0004	-0.0002	147	652							
	125	128	-0.0012	0.0012	0.0004			41	182					
	125	127	-0.0012	0.0012	0.0004					21	29			
	125	78	0.0023	0.0010	0.0002							36	49	435

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

24 Inch Diameter Gridded Reflector, 1 Inch Radial Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole						Forces on Mount		
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0040	0.0000	0.0000	72	319	0	0	0	0	13	18	156
	70	45	0.0042	0.0001	-0.0002	75	335	2	9	-6	-8	8	11	99
	70	56	0.0043	0.0004	-0.0002	78	345	8	34	-9	-12	7	10	89
	70	90	0.0000	0.0009	0.0003	-1	-2	16	71	13	18	17	24	210
	70	125	-0.0012	0.0012	0.0004	-21	-94	22	96	15	20	17	23	203
	70	180	-0.0027	0.0000	0.0000	-49	-217	0	0	0	0	-9	-12	-106
	70	55	0.0043	0.0004	-0.0002	78	345							
	70	128	-0.0012	0.0012	0.0004			22	97					
	70	127	-0.0012	0.0012	0.0004					15	20			
	70	80	0.0020	0.0010	0.0003							21	29	255
Comparison	90	0	0.0040	0.0000	0.0000	119	527	0	0	0	0	21	29	257
	90	45	0.0042	0.0001	-0.0002	125	554	3	15	-10	-13	14	19	164
	90	56	0.0043	0.0004	-0.0002	128	571	13	56	-14	-20	12	17	148
	90	90	0.0000	0.0009	0.0003	-1	-4	26	117	22	29	29	39	347
	90	125	-0.0012	0.0012	0.0004	-35	-155	36	159	24	33	28	38	335
	90	180	-0.0027	0.0000	0.0000	-81	-359	0	0	0	0	-15	-20	-175
	90	55	0.0043	0.0004	-0.0002	128	571							
	90	128	-0.0012	0.0012	0.0004			36	160					
	90	127	-0.0012	0.0012	0.0004					24	33			
	90	80	0.0020	0.0010	0.0003							35	48	422
Survival	125	0	0.0040	0.0000	0.0000	229	1017	0	0	0	0	41	56	496
	125	45	0.0042	0.0001	-0.0002	240	1069	6	28	-19	-26	26	36	316
	125	56	0.0043	0.0004	-0.0002	247	1101	24	108	-28	-38	24	32	285
	125	90	0.0000	0.0009	0.0003	-2	-8	51	226	42	57	56	76	669
	125	135	-0.0013	0.0012	0.0004	-74	-331	68	302	45	61	51	69	607
	125	180	-0.0027	0.0000	0.0000	-156	-692	0	0	0	0	-28	-38	-338
	125	55	0.0043	0.0004	-0.0002	248	1102							
	125	128	-0.0012	0.0012	0.0004			69	308					
	125	127	-0.0012	0.0012	0.0004					47	64			
	125	80	0.0020	0.0010	0.0003							68	92	814

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

32 Inch Diameter Gridded Reflector, 1 Inch Radial Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole						Forces on Mount		
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0040	0.0000	0.0000	123	546	0	0	0	0	22	30	266
	70	45	0.0042	0.0001	-0.0002	129	573	3	15	-13	-18	11	15	132
	70	56	0.0043	0.0004	-0.0002	133	590	13	58	-19	-26	8	11	98
	70	90	0.0000	0.0009	0.0003	-1	-4	27	121	29	40	37	50	442
	70	125	-0.0012	0.0012	0.0004	-36	-161	37	165	33	44	37	50	439
	70	180	-0.0027	0.0000	0.0000	-83	-371	0	0	0	0	-15	-20	-181
	70	55	0.0043	0.0004	-0.0002	133	591							
	70	128	-0.0012	0.0012	0.0004			37	165					
	70	127	-0.0012	0.0012	0.0004					33	45			
	70	81	0.0018	0.0009	0.0003							42	57	502
Comparison	90	0	0.0040	0.0000	0.0000	203	902	0	0	0	0	37	50	440
	90	45	0.0042	0.0001	-0.0002	213	948	6	25	-22	-30	18	25	218
	90	56	0.0043	0.0004	-0.0002	219	976	22	96	-32	-44	13	18	162
	90	90	0.0000	0.0009	0.0003	-2	-7	45	200	49	66	61	83	731
	90	125	-0.0012	0.0012	0.0004	-60	-266	61	272	54	73	60	82	726
	90	180	-0.0027	0.0000	0.0000	-138	-613	0	0	0	0	-25	-34	-299
	90	55	0.0043	0.0004	-0.0002	220	977							
	90	128	-0.0012	0.0012	0.0004			61	273					
	90	127	-0.0012	0.0012	0.0004					54	74			
	90	81	0.0018	0.0009	0.0003							69	94	830
Survival	125	0	0.0040	0.0000	0.0000	391	1740	0	0	0	0	71	96	849
	125	45	0.0042	0.0001	-0.0002	411	1828	11	48	-42	-57	35	48	421
	125	56	0.0043	0.0004	-0.0002	423	1882	42	185	-62	-84	26	35	312
	125	90	0.0000	0.0009	0.0003	-3	-13	87	386	94	127	117	159	1409
	125	135	-0.0013	0.0012	0.0004	-127	-566	116	517	101	137	110	149	1322
	125	180	-0.0027	0.0000	0.0000	-266	-1183	0	0	0	0	-48	-65	-577
	125	55	0.0043	0.0004	-0.0002	423	1884							
	125	128	-0.0012	0.0012	0.0004			118	527					
	125	127	-0.0012	0.0012	0.0004					105	142			
	125	81	0.0018	0.0009	0.0003							133	181	1602

Summary of Wind Load Forces for Gridded Reflectors

* These drag coefficients were taken from EIA-222-E

Note 1: Numbers in **bold** indicate individual maximums; they do not occur at the same time.

Note 2: To calculate load on pole maximums should be used multiplied by the number of antenna units.

39 Inch Diameter Gridded Reflector, 1 Inch Radial Ice

	Wind Speed (MPH)	Wind Angle (degrees)	Drag Coefficients *			Forces and moment								
						Forces on Pole				Forces on Mount				
						Faxial (lbf)	Faxial (N)	Fside (lbf)	Fside (N)	M (ft-lbf)	M (N-m)	Mt (ft-lbf)	Mt (N-m)	Mt (lbf-in)
Operating	70	0	0.0040	0.0000	0.0000	178	793	0	0	0	0	32	44	387
	70	45	0.0042	0.0001	-0.0002	187	834	5	22	-23	-32	12	16	144
	70	56	0.0043	0.0004	-0.0002	193	858	19	84	-34	-46	6	8	72
	70	90	0.0000	0.0009	0.0003	-1	-6	40	176	52	70	62	85	748
	70	125	-0.0012	0.0012	0.0004	-53	-234	54	239	57	78	63	85	756
	70	180	-0.0027	0.0000	0.0000	-121	-540	0	0	0	0	-22	-30	-263
	70	55	0.0043	0.0004	-0.0002	193	859							
	70	128	-0.0012	0.0012	0.0004			54	240					
	70	127	-0.0012	0.0012	0.0004					58	78			
	70	82	0.0015	0.0009	0.0003							68	93	820
Comparison	90	0	0.0040	0.0000	0.0000	295	1311	0	0	0	0	53	72	640
	90	45	0.0042	0.0001	-0.0002	310	1378	8	37	-38	-52	20	27	239
	90	56	0.0043	0.0004	-0.0002	319	1419	31	140	-57	-77	10	13	119
	90	90	0.0000	0.0009	0.0003	-2	-10	65	291	85	116	103	140	1237
	90	125	-0.0012	0.0012	0.0004	-87	-386	89	396	95	129	104	141	1250
	90	180	-0.0027	0.0000	0.0000	-201	-892	0	0	0	0	-36	-49	-435
	90	55	0.0043	0.0004	-0.0002	319	1420							
	90	128	-0.0012	0.0012	0.0004			89	397					
	90	127	-0.0012	0.0012	0.0004					95	129			
	90	82	0.0015	0.0009	0.0003							113	153	1356
Survival	125	0	0.0040	0.0000	0.0000	569	2530	0	0	0	0	103	139	1234
	125	45	0.0042	0.0001	-0.0002	598	2659	16	70	-74	-101	38	52	460
	125	56	0.0043	0.0004	-0.0002	615	2737	61	269	-109	-148	19	26	230
	125	90	0.0000	0.0009	0.0003	-4	-19	126	561	164	223	199	270	2387
	125	135	-0.0013	0.0012	0.0004	-185	-824	169	752	177	240	190	258	2284
	125	180	-0.0027	0.0000	0.0000	-387	-1721	0	0	0	0	-70	-95	-839
	125	55	0.0043	0.0004	-0.0002	616	2739							
	125	128	-0.0012	0.0012	0.0004			172	766					
	125	127	-0.0012	0.0012	0.0004					184	249			
	125	82	0.0015	0.0009	0.0003							218	296	2616