Mobile Crane Load Moment Testing

Change 1 of the 2009 edition of the NAVFAC P-307, issued in March of 2011, included significant changes to the Appendix E load test procedures for mobile cranes. One significant change was the development of the load moment test. As activities began implementing the new procedures questions concerning determining the boom length and radius for the load moment test have arisen.

The configuration for the load moment test requires that the boom length be the "shortest length where all sections are partially extended, but not less than 50 percent of the total powered boom length (or latching boom length)". In other words:

- the main boom length must be at least 50 percent of the maximum main boom length from the crane's load chart or working range diagram, with all boom sections at least partially extended;
- this does not to include power pin flys or jibs;
- the boom length selected for the test wil be the shortest boom length that meets these conditions.

Cranes equipped with multiple boom modes must have multiple load charts checked to ensure the maximum load moment is selected. Though this may sound cumbersome, many of the boom modes or charts will be able to be eliminated simply due to the fact that all sections are not at least partially extended.

The radius for the load moment test is determined by calculating the maximum load moment at the determined boom length. Starting at the first radius that will clear the outriggers and crane carrier, calculate the load moment by multiplying the rated load times the radius. Perform the calculations at increasing radii until the resulting load moment decreases. Use the radius that results in the maximum load moment. Also, when determining the load moment test configuration the load test director will have to consider the wire rope as reeved, wire rope line pull, and winch performance as necessary.

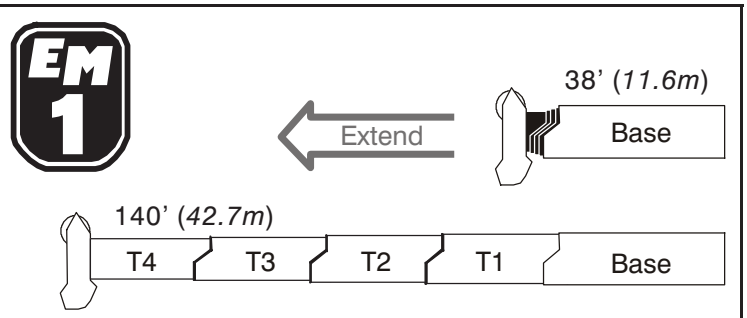
Example 1 demonstrates boom length and radius selection for a LinkBelt RTC 8090 II. The RTC 8090 II has a latching boom with three modes of operation; therefore, the first step will be to select the correct boom mode. Example 2 demonstrates boom length and radius selection for a Grove RT 865. The RT 865 has a single mode synchronous boom with all sections extending simultaneously only requiring the review of a single load chart.

The load moment test shall be started over the side of the crane prior to rotating over each outrigger. Be aware, especially on truck cranes, that as the load is rotated over the front or rear of the crane the flex in the crane will relax (deflection in the carrier will decrease) bringing the load closer to the crane. No booming functions should be performed during crane rotation, therefore, if it is anticipated that the load will come too close to the crane, select the next longer radius on the load chart for the test, even though the resulting load moment might be less than the maximum. Depending on the specific crane configuration, this radius may be in either the “structural” or “stability” range of the load chart, either of which is acceptable. Example 3 demonstrates the radius selection for a Terex HC 110 lattice boom crawler crane and the importance of being aware of the crane dimensions and deflection characteristics when selecting the correct load moment radius.

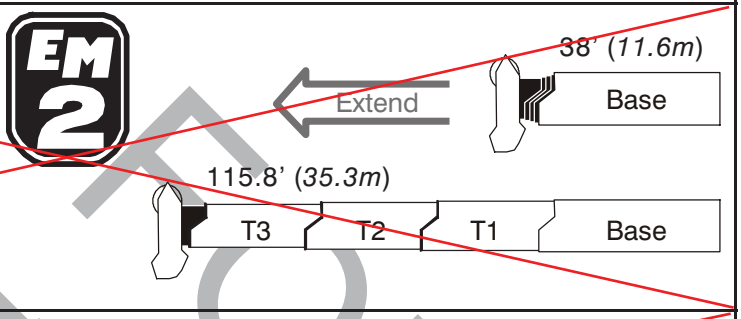
It is recognized that there will be some cranes and configurations that will provide difficulty in determining the load moment configuration. If there are questions concerning the proper load test configuration, contact NAVCRANECEN In-Service Engineering for assistance. This article is also available for download at https://portal.navfac.navy.mil/ncc.

Boom Extend Modes

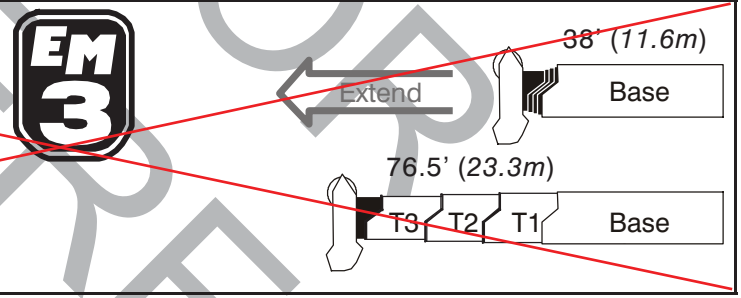
Boom Length (ft)	Boom Telescope Length (ft)							
	T4	%	T3	%	T2	%	T1	%
50	12.0	50						
60	22.0	91						
70	24.2	100	7.8	31				
80	24.2	100	17.8	71				
90	24.2	100	25.1	100	2.7	10		
100	24.2	100	25.1	100	12.7	49		
110	24.2	100	25.1	100	22.7	88		
120	24.2	100	25.1	100	25.9	100	6.8	25
130	24.2	100	25.1	100	25.9	100	16.8	63
140	24.2	100	25.1	100	25.9	100	26.8	100



Boom Length (ft)	Boom Telescope Length (ft)							
	T4	%	T3	%	T2	%	T1	%
50			12.0	48				
60			22.0	88				
70			25.1	100	6.9	27		
80			25.1	100	16.9	65		
90			25.1	100	25.9	100	1.0	4
100			25.1	100	25.9	100	11.0	41
115.8			25.1	100	25.9	100	26.8	100



Boom Length (ft)	Boom Fixed Length (ft)							
	T4	%	T3	%	T2	%	T1	%
50.7			12.7	51				
63.7			12.7	51	13.0	50		
76.5			12.7	51	13.0	50	12.8	48

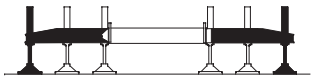


In this boom extend mode chart for a LinkBelt RTC 8090 II, boom modes EM2 and EM3 can be eliminated since section T4 is at not partially extended for all boom lengths. In boom mode EM1 the first length where all sections are partially extended is at 120 feet and would be the selected boom length for the load moment test.

RTC-8090 II Mode EM1

EXAMPLE 1 Cont.

Rated Lifting Capacities In Pounds



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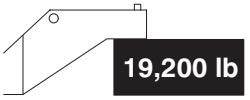

EM 1

Load Radius (ft)	100.0 ft			110.0 ft			120.0 ft		
	∠°	360°	Over Front	∠°	360°	Over Front	∠°	360°	Over Front
20	77.5	32,100	32,100	79.0	27,200	27,200			
25	75.0	32,100	32,100	76.5	27,200	27,200	78.0	28,000	28,000
30	72.0	32,100	32,100	74.0	27,200	27,200	76.0	28,000	28,000
35	69.0	29,700	29,700	71.5	27,200	27,200	73.5	28,000	28,000
40	66.0	27,100	27,100	69.0	27,200	27,200	71.5	28,000	28,000
45	62.5	24,900	24,900	66.0	25,800	25,800	69.0	26,100	26,100
50	59.5	23,000	23,000	63.0	23,800	23,800	66.5	24,100	24,100
55	56.0	21,300	21,300	60.0	21,700	21,900	63.5	21,300	21,700
60	52.0	18,800	19,200	56.5	18,700	19,100	60.5	18,300	18,700
65	48.0	16,400	16,800	53.0	16,300	16,600	57.5	15,900	16,300
70									14,300
75									12,700
80									11,200
85									10,000
90									8,900
95									8,000
100									7,100
105									6,300
110									5,700
Min.Bm. Ang./Cap.	0.0	6,600					0.0	4,300	4,300
Radius (ft)		93.0						113.0	

BOOM LENGTH/RADIUS

From the Boom Mode Chart for the RTC 8090 II, the selected boom length is 120 feet in boom mode EM1. At 120 foot boom length the rated load from 25 to 40 feet radius is 28,000 lbs. Starting the load moment calculations at 40 ft, which gives adequate clearance for the outriggers/carrier, and continuing down the load chart every 5 ft until the load moment decrease, shows that the max load moment occurs at 50 ft radius.

LOAD MOMENT

40 ft X 28,000 lbs = 1,120,000 ft-lbs
45 ft X 26,100 lbs = 1,174,500 ft-lbs
50 ft X 24,100 lbs = 1,205,000 ft-lbs
55 ft X 21,300 lbs = 1,171,500 ft-lbs

Load Radius (ft)	13				140.0 ft	
	∠°	3			360°	Over Front
25	79.5	26,900	26,900			
30	77.5	26,500	26,500	78.5	24,400	24,400
35	75.5	26,300	26,300	77.0	24,100	24,100
40	73.5	26,100	26,100	75.0	24,000	24,000
45	71.5	25,900	25,900	73.5	23,800	23,800
50	69.0	24,600	25,100	71.5	23,700	23,700
55	66.5	20,900	21,300	69.0	20,500	20,900
60	63.5	17,900	18,300	66.5	17,600	18,000
65	61.0	15,500	15,900	64.0	15,100	15,500
70	58.0	13,500	13,900	61.5	13,200	13,500
75	55.0	12,000	12,300	58.5	11,600	12,000
80	52.0	10,500	10,900	56.0	10,200	10,600
85	49.0	9,300	9,600	53.0	9,000	9,300
90	45.5	8,200	8,500	50.5	7,900	8,200
95	42.0	7,300	7,600	47.5	7,000	7,300
100	38.5	6,500	6,700	44.0	6,200	6,400
105	34.0	5,700	6,000	41.0	5,400	5,700
110	29.5	5,100	5,300	37.0	4,700	5,000
115	23.5	4,500	4,700	33.0	4,200	4,400
120	16.0	3,900	4,100	28.5	3,600	3,900
125				23.0	3,100	3,300
130				15.5	2,700	2,900
Min.Bm. Ang./Cap.	0.0	3,300	3,300	0.0	2,300	2,300
Radius (ft)		123.0			133.0	

Grove RT 865

EXAMPLE 2

Rated Lifting Capacities in Pounds
40 FT. – 125FT. Boom
ON OUTRIGGERS FULLY EXTENDED -360 °
For Training Only

Radius *in* Feet	#0001 *Main Boom* Length *in Feet*									
	40	*45*	*55*	*65*	*75*	*85*	*95*	*105*	115	125
10	130,000 (70)	105,000 *(72.5)*								
12	111,000 *(67)*	105,000 *(70)*	*94,600* (74)							
15	91,450 (61.5)	91,000 *(65.5)*	*88,250 (70.5)*	*71,050* (74)						
20	*69,550 (52.5)*	*69,050 (58)*	68,400 *(65)*	60,400 *(69)*	*55,250 (72.5)*	48,150 *(75)*				
25	*55,050* (41.5)	*54,600 (49.5)*	*53,950 (58.5)*	*53,450* (64.5)	*47,950 (68.5)*	41,700 (71.5)	*38,000 (73.5)*	*33,350 (75.5)*		
30	42,950 *(26)*	*42,450 (39.5)*	41,700 *(52)*	41,200 *(59)*	*41,950* (64)	*36,700 (67.5)*	*33,300 (70.5)*	*30,750 (72.5)*	*24,550 (75)*	*•23,700 (76.5)*
35		*33,700 (26)*	*33,300* (44.5)	*32,500 (53.5)*	*33,250 (59.5)*	*32,600 (64)*	*29,550 (67)*	*27,300 (69.5)*	*21,700 (72)*	*21,900 (74)*
40	*See Note 16*		*26,650 (35.5)*	*26,150 (47.5)*	26,900 *(54.5)*	*27,850 (60)*	*26,450 (63.5)*	*24,450 (66.5)*	*19,350 (69.5)*	*20,300 (71.5)*
45			*21,750 (23)*	21,300 *(40.5)*	*22,050 (49.5)*	23,000 *(55.5)*	*23,700 (60)*	*22,000 (63.5)*	*17,450 (66.5)*	18,800 *(69)*
50				17,500 *(32.5)*	*18,250* (44)	19,150 *(51.5)*	19,900 *(56.5)*	19,850 *(60.5)*	*15,800 (64)*	*17,050 (66.5)*
60					12,400 *(30)*	13,250 *(41.5)*	14,100 *(48.5)*	*14,650 (53.5)*	*13,250 (58)*	14,150 (61.5)
70						*9,190 (28.5)*	9,910 *(39)*	*10,400* (46)	10,850 (51.5)	11,350 *(55.5)*
80							*6,930 (27)*	*6,740 (37)*	*7,850* (44.5)	*8,290 (49.5)*
90								*5,170 (25.5)*	*5,600 (36)*	6,010 *(42.5)*
100										*4,250 (34.5)*
110										2,840 (24)
Minimum boom angle *(deg.) for* indicated *length (no* load)										0
Maximum *boom* length (ft.) *at* 0 *degree boom angle (no* load)										*125*

BOOM LENGTH

From this load chart for a Grove RT 865, 50 % of the maximum boom length on this load chart is 62.5 feet, therefore, assuming that all sections are partially extended, the selected boom length should be 65 feet.

RADIUS

On the Grove RT 865, determined from the crane specifications, the radius required to clear the outriggers/carrier is approximately 18 feet, therefore load moment calculations should begin at least at 25 feet, which happens to result in the maximum load moment. If the test load will not safely clear the crane at 25 feet due to the size of the load, the test can be performed at 30 feet.

LOAD MOMENT

25 ft X 53,450 lbs = 1,336,250 ft-lbs
30 ft X 41,200 lbs = 1,236,000 ftl-bs
MAX load moment is at 25 ft radius.

NOTE: () *Boom angles are in degrees.*
***** *Based on* maximum obtainable *boom angle.*
# LMI operating code. *Refer to LMI* manual *for* operating *instructions.*

TEREX HC 110

CRAWLER CRANE
HC 110
EXAMPLE 3

WITH 59HI OFFSET TIP BOOM – 4 SHEAVE TIP

52,900 lb + 23,000 lb SC | 360° | ANSI B 30.5

50' (15.2 m) Boom length

Radius (Feet)	Boom Angle (Degrees)	Side Frames Extended (Pounds)	From Boom Pt. to Ground (Feet)
13	79.9	220,000*	56
15	77.6	190,080*	55
20	71.6	123,290	54
25	65.4	87,670	52
30	58.9	67,640	49
35	51.9	54,900	46
40	44.1	46,010	41
50	22.7	34,480	26

60' (18.3 m) Boom length

14	80.7	203,570*	66
15	79.7	189,950*	65
20	74.8	123,100	64
25	69.7	87,490	63
30	64.5	67,430	61
35	59.1	54,700	58
40	53.3	45,790	54
50	40.0	34,250	45
60	20.6	27,130	27

70' (21.3 m) Boom length

16	80.3	177,910*	75
20	77.0	122,950	75
25	72.8	87,320	73
30	68.4	67,250	71
35	63.9	54,530	69
40	59.2	45,620	67
50	49.0	34,050	59
60	36.9	26,960	48
70	19.0	22,070	29

80' (24.4 m) Boom length

17	80.8	161,850	85
20	78.7	122,740	85
25	75.0	87,130	84
30			
35			
40			
50			
60			
70			
80			

90' (27.4 m) Boom length

Radius (Feet)	Boom Angle (Degrees)	Side Frames Extended (Pounds)	From Boom Pt. to Ground (Feet)
19	80.6	133,440	95
20	79.9	122,580	95
25	76.7	86,970	94
30	73.4	66,860	93
35	70.0	54,150	91
40	66.6	45,210	89
50	59.4	33,630	84
60	51.6	26,570	77
70	42.9	21,670	68
80	32.3	18,120	55
90	16.7	15,440	32

100' (30.5 m) Boom length

20	80.9	122,380	105
25	78.0	86,760	104
30	75.1	66,630	103
35	72.1	53,930	102
40	69.0	44,980	100
50	62.7	33,380	95
60	56.0	26,340	89
70	48.8	21,430	82
80	40.6	17,880	71
90	30.6	15,190	57
100	15.8	13,090	34

110' (33.5 m) Boom length

22	80.7	105,050	115
25	79.1	86,580	114
30	76.5	66,410	113
35	73.8	53,720	112
40	71.0	44,760	110
50	65.4	33,160	106
60	59.5	26,130	101
70	53.2	21,220	94
80	46.4	17,650	86

On the Terex HC 110 quick calculations show that the maximum load moment is at minimum radius for all boom lengths shown above. The load moment radius for this crane will be dependant on providing adequate clearance around the crawler tracks. From the crane specifications the radius to the corner of the crawler track is approximately 14 feet. Depending on the size of the load a radius of 25 ft may be required to safely clear the crawlers and account for loss of deflection over the front and rear of the crane. If 20 feet is adequate then for some boom lengths the max capacity test and the load moment test may be able to be combined.

KEY

	Counterweight
SC	Sideframe Counterweight