

# Hydraulic Mobile Cranes

## Product knowledge guidebook



# 1 CAPACITIES OF CRANES

## [1] Three factors that determine rated lifting capacity of mobile crane

### (1) Applicable standards

In principle, TADANO currently exports products conforming to SAE/ANSI for cranes destined for North America, EN for those destined for Europe, and ISO for those destined for other regions and countries. Such standards specify the safety factors for mobile crane stability and various mechanisms, which must be achieved according to the operating conditions.

- North America: SAE J 765, J 1289, and ANSI B 30.5 individually specify the safety factor for stability, which must be achieved, and crane test methods.

- Europe: EN 13000 is standards specifying the safety of mobile cranes.

These standards are applied to the EU countries as mandatory standards.

- Other: ISO 4305 specifies the safety factor for stability, which must be achieved.

ISO standards are used as applicable standards in many countries and operated in a similar way.

### (2) Factor 1 Crane stability

Crane stability indicates how much the crane is stable without overturning.

A crane which is lifting a load can be compared to a balance assuming that outriggers are a fulcrum against overturning.

- Stability moment:  $G$  (crane mass)  $\times$   $l$  (distance from fulcrum against overturning to center of crane gravity)

- Overturning moment:  $W$  (load mass)  $\times$   $l_1$  (distance from fulcrum against overturning to load)

When the stability moment is larger than the overturning moment, the crane is stable, but when smaller, the crane will overturn.

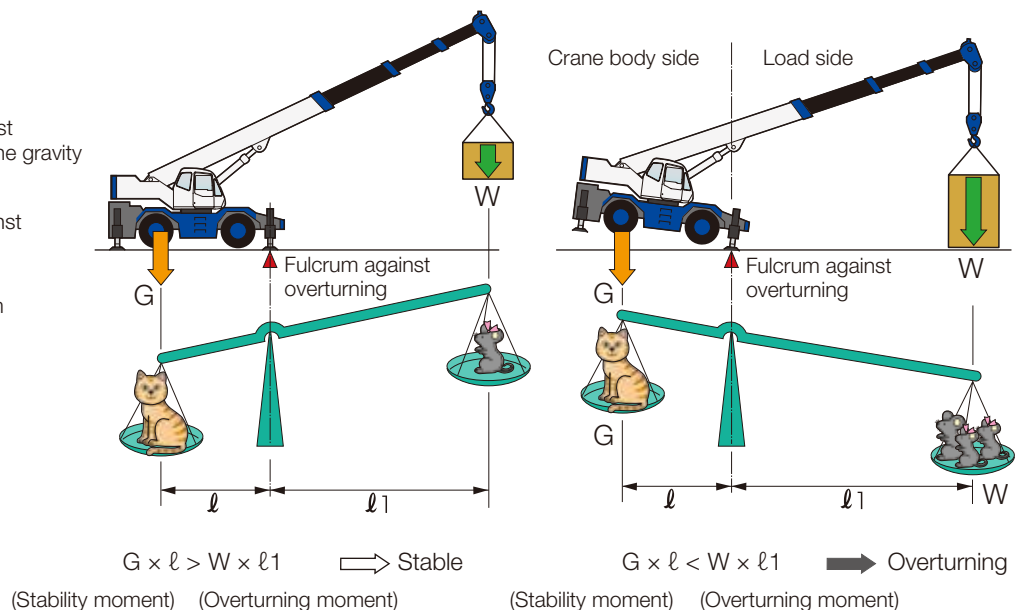
$G$ : Crane mass

$l$  : Distance from fulcrum against overturning to center of crane gravity

$W$ : Load mass

$l_1$ : Distance from fulcrum against overturning to load

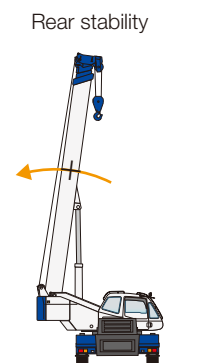
Fulcrum against overturning:  
Jacks correspond to the fulcrum of the balance.



### Rear stability

If the outrigger extension widths are too small, or the boom is excessively raised in the on-rubber status, the center of crane gravity moves rearward, which may cause overturning.

To prevent overturning to the rear, a crane has a function to stop a boom raising operation if a specific boom angle is exceeded.

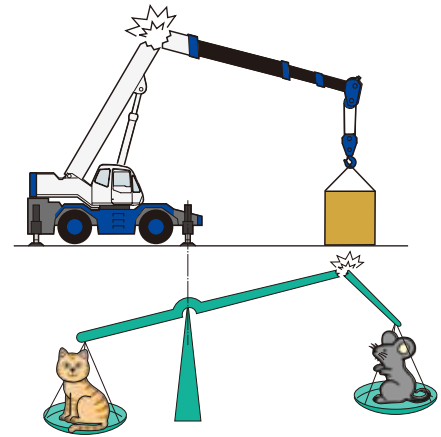


# 1 CAPACITIES OF CRANES

## (3) Factor 2 Crane strength

Crane strength indicates how much the crane is strong. Crane strength is limited by the materials and structures of components such as the boom and slewing table. Even with the same crane and load, if the boom length is made longer or the boom angle smaller, a component may be broken because of insufficient strength.

To calculate crane strength under official regulations, such things are taken into consideration as: -not only the total rated load but crane's weight, inertia force and centrifugal force due to crane's slewing and boom elevation, and wind force.

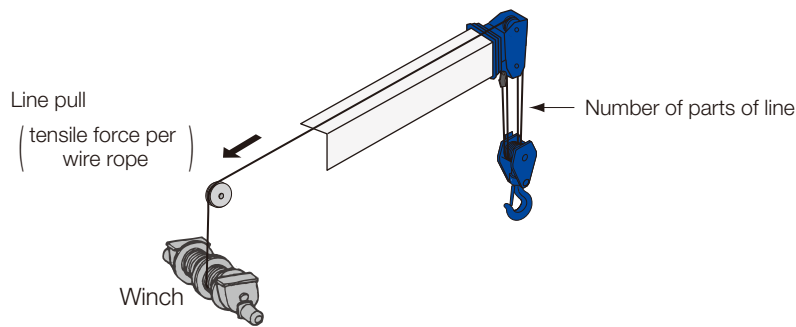


## (4) Factor 3 Capacity of hoisting device

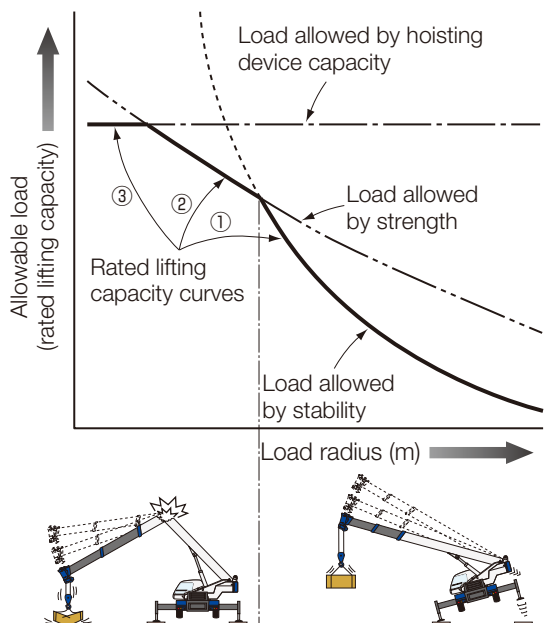
The hoisting-up capacity of the hoisting device of a crane is limited.

The strength of the wire rope is also limited.

Hoisting-up capacity limit:  $\text{Line pull (tensile force per wire rope) of hoisting device} \times \text{number of parts of line}$



## [2] Curves of three factors that determine rated lifting capacity of mobile crane



The rated lifting capacity is determined not to exceed the loads allowed by three factors.

The rated lifting capacity of a crane is determined by

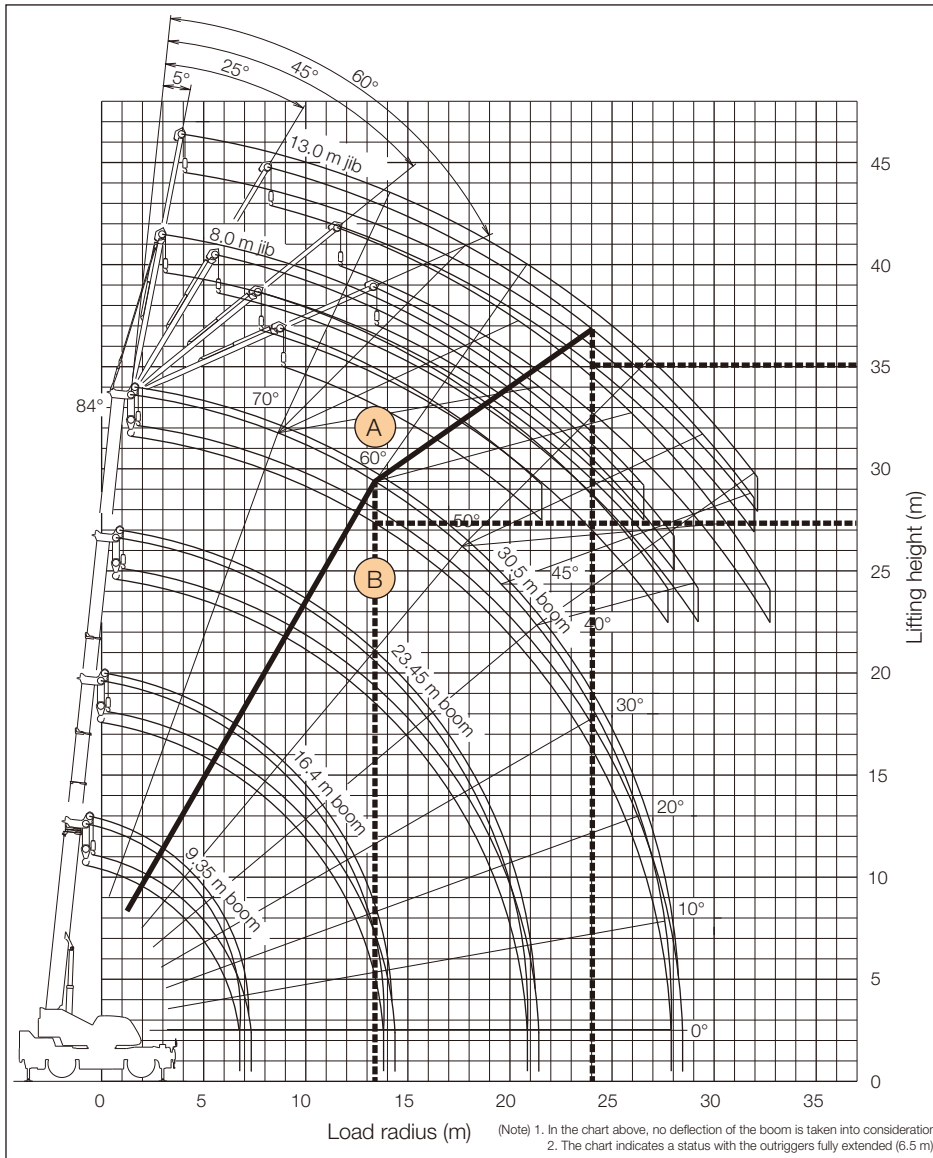
- ① the crane stability in the area with large load radius,
- ② the crane strength in the area with small load radius, and
- ③ the hoisting device capacity, telescoping device strength, or other in the area with further smaller load radius shown in the figure on the left.

## 2 HOW TO READ WORKING RANGE CHART

### Working range chart

The working range chart is included in the specifications and provided in the crane cab together with the rated lifting capacity tables, and used during crane operations and also to make a work plan.

This chart indicates the relationship between the load radius and lifting height varying with the boom and jib lengths and angles. Note that this chart indicates the relationship when the outriggers are fully extended, and no deflection of the boom, jib, etc. is taken into consideration.



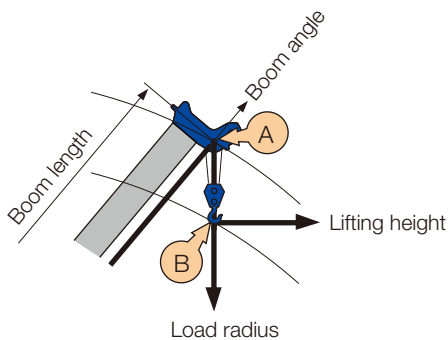
### Exercises

- ① How much are the maximum lifting height and load radius in a boom operation under the following operating conditions?  
 Outriggers: Fully extended (6.5 m)  
 Boom length: 30.5 m  
 Boom angle: 60°
- ② How much are the maximum lifting height and load radius in a jib operation with a 13.0 m jib mounted to the boom ① at an offset angle of 25°?

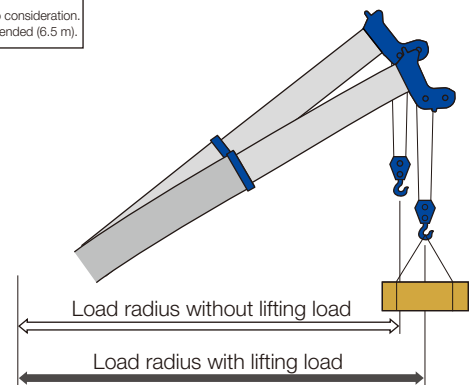
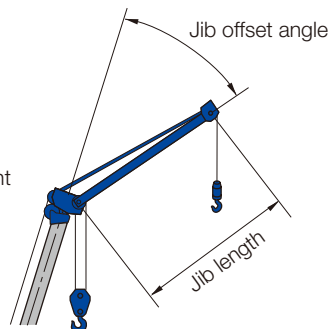
### Answers

- ① Maximum lifting height (approx. 27 m)  
 Load radius (approx. 13.5 m)
- ② Maximum lifting height (approx. 35 m)  
 Load radius (approx. 24 m)

No deflection of the boom and jib is taken into consideration.  
 The actual maximum lifting height will be smaller and actual load radius will be larger.



At the points A and B, the load radius will be the same, but the point A indicates the boom angle, and point B indicates the lifting height.



In the working range chart, no deflection of the boom is taken into consideration.  
 Note that, as the lifted load mass increases, the boom will be deflected more and the load radius will be wider.

# 3 HOW TO READ RATED LIFTING CAPACITY TABLES

## [1] Rated lifting capacity tables for wire rope telescoping boom and multi-cylinder telescoping boom

The rated lifting capacity can be read from the operating conditions such as the outrigger extension width, working area, boom length, jib length, jib offset angle, and load radius.

- The rated lifting capacity is the total mass of the lifting device including the load, rigging wire rope, and hook block.
- The load radius indicates a value in which deflection of the boom and outriggers (tires) caused by lifting a load is taken into consideration. Perform a work in reference to the load radius for an actual work in which deflection is taken into consideration.
- To perform a crane operation with a boom length not specified in the rated lifting capacity table, refer to the rated lifting capacity indication on the Load Moment Indicator. If the boom length exceeds the length specified in the rated lifting capacity table, compare the rated lifting capacity for the indicated length with that for the next larger boom length, and use the smaller rated lifting capacity as a guide.
- Create a work plan to be on the safe side with values not more than the load value.

### ■ Boom rated lifting capacity table

COUNTERWEIGHT 11.2 t  
ON OUTRIGGERS FULLY EXTENDED 7.3 m SPREAD  
360° ROTATION  
SMART CW2

B	A		D			
	12.8	17.6	22.4	22.4	31.9	
2.5	45.10					
3.0	84.10★	45.10	33.90	15.30		
3.5	75.40	45.10	33.90	15.30		
4.0	68.20	45.10	33.90	15.30		
4.5	62.00	45.10	33.90	15.30		
5.0	56.70	45.10	33.90	15.30		
5.5	52.10	45.10	33.90	15.30	15.30	12.50
6.0	48.00	45.10	33.90	15.30	15.30	12.50
6.5	43.90	43.50	32.00	15.30	15.30	12.50
7.0	40.10	39.80	30.20	15.30	15.30	12.50
7.5	37.00	36.70	28.60	15.30	15.30	12.50
8.0	34.30	33.30	27.10	15.30	15.30	12.50
9.0	29.20	27.70	24.50	15.30	15.30	12.50
10.0	23.80	23.30	21.30	15.30	15.30	12.50
11.0		19.30	18.30	15.30	15.30	12.50
12.0		16.30	15.90	15.30	14.30	12.50
14.0			11.60	14.40	12.20	11.70
16.0			8.70	11.40	10.10	
18.0			6.60	9.20	8.00	
20.0			5.10	7.50	6.40	
22.0					5.10	6.80
24.0					4.10	5.70
26.0					3.30	4.90
28.0					2.60	4.20
30.0						
32.0						
34.0						
36.0						
38.0						
40.0						
42.0						
D			0°	12°	0°	

TELESCOPING CONDITIONS (%)

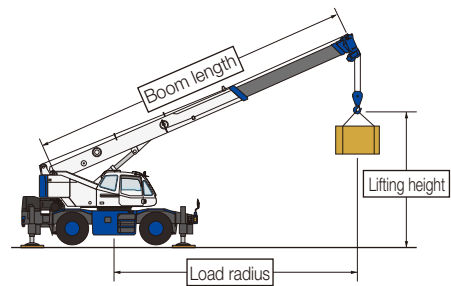
Telescoping mode	1, 2	1	1	2	1	2
2nd Boom	0	50	100	0	100	0
3rd Boom	0	0	0	33	33	0
4th Boom	0	0	0	33	33	0
Top Boom	0	0	0	33	33	0

COUNTERWEIGHT 11.2 t  
ON OUTRIGGERS FULLY EXTENDED 7.3 m SPREAD  
360° ROTATION  
SMART CW2

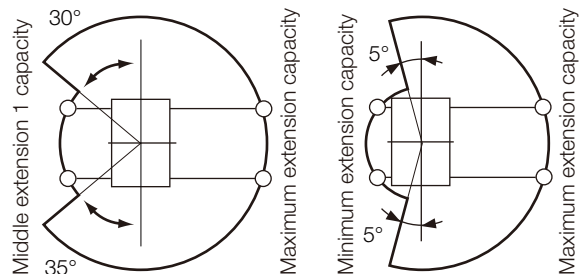
C	A		D			
	12.8	17.6	22.4	22.4	31.9	
0°	10.7	8.9	15.5	4.9	20.2	2.1
Telescoping mode	1, 2	1	1	2	2	4.3
						29.6
						2.2

★ With attachment sheaves  
A: Boom length (m)  
B: Load radius (m)  
C: Loaded boom angle (°)  
D: Minimum boom angle (° for indicated length (no load))



### ■ Precautions on rated lifting capacity table [with the outriggers set up]

1. Rated lifting capacities are based on actual load radius increased by boom deflection.
2. The weight of lifting device such as hook blocks, slings, etc., must be considered as part of the load and deducted from the lifting capacities.
3. For lifting capacity of single top, the net capacity shall not exceed the single line pull including the mass of the main boom hook block attached to the boom.
4. The lifting capacity data on the Load Moment Indicator is based on the standard number of parts of line listed in the chart.  
Standard number of parts of line for each boom length should be according to each machine's table.
5. The rated capacity on the sides changes depending on the extension width of the left and right outriggers. When a load is lifted with a larger outrigger extension width and slewed to a side with a smaller extension width, the rated lifting capacity decreases.



- ① Select a rated lifting capacity table suitable for the outrigger extension width and counterweight mass to be used.
- ② Read the boom length and telescoping mode fields.  
(This item is not provided for models without multiple telescoping modes set.)
- ③ Read the load radius field.
- ④ The cell where the boom length column and load radius row intersect shows the applicable rated lifting capacity.

### 3 HOW TO READ RATED LIFTING CAPACITY TABLES

■ Jib rated lifting capacity table

COUNTERWEIGHT 11.2 t  
ON OUTRIGGERS FULLY EXTENDED 7.3 m SPREAD  
360° ROTATION  
SMART CW1

(Unit: × 1,000 kg)

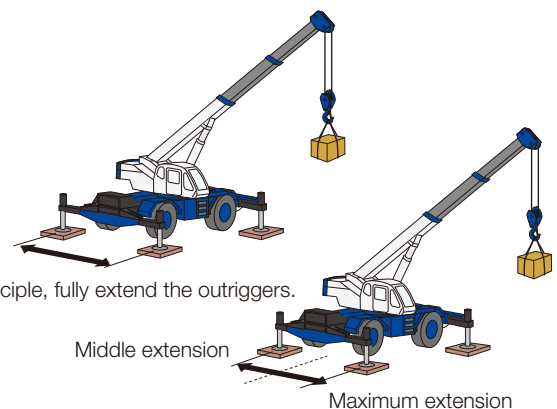
B	51 m Boom + 10.1 m JIB			B	51 m Boom + 17.7 m JIB		
	3.5° Offset	25° Offset	45° Offset		3.5° Offset	25° Offset	45° Offset
14.0	4.70			14.0			
16.0	4.70			16.0	3.00		
18.0	4.70	4.70		18.0	3.00		
20.0	4.70	4.70	4.40	20.0	3.00		
22.0	4.70	4.70	4.30	22.0	3.00	2.80	
24.0	4.70	4.40	4.10	24.0	3.00	2.70	
26.0	4.00	4.00	3.80	26.0	3.00	2.60	2.20
28.0	3.40	3.70	3.50	28.0	3.00	2.50	2.10
30.0	2.90	3.30	3.30	30.0	2.90	2.50	2.10
32.0	2.40	2.80	3.00	32.0	2.50	2.40	2.00
34.0	2.00	2.40	2.60	34.0	2.10	2.30	1.90
36.0	1.70	2.00	2.20	36.0	1.80	2.30	1.90
38.0	1.40	1.60	1.80	38.0	1.50	2.00	1.80
40.0	1.10	1.30	1.40	40.0	1.20	1.70	1.80
42.0		1.00	1.10	42.0	1.00	1.40	1.70
44.0				44.0		1.10	1.40
46.0				46.0		0.90	1.10
Telescoping mode	1, 2	1, 2	1, 2	Telescoping mode	1, 2	1, 2	1, 2

B: Load radius (m)

- ① Select a rated lifting capacity table suitable for the outrigger extension width and the counterweight mass to be used.
- ② Read the boom length, jib length, and jib offset angle fields.
- ③ Read the load radius field.
- ④ Read the telescoping mode field to be selected. (This item is not provided for models without multiple telescoping modes set.)
- ⑤ The cell where the jib offset angle column and load radius row intersect shows the applicable rated lifting capacity.

#### Important points for creating work plan

- Do not use a mobile crane on any place that may cause differential settlement caused by a soft ground or a buried object being damaged, resulting in overturning. Therefore, before the use, place a steel sheet or the like to reinforce the ground so that any settlement will not occur.
- In principle, fully extend the outriggers. Only if the maximum extension width cannot be attained, create a plan to be on the safe side with the middle or minimum extension selected as an exception. With the outriggers set to the maximum extension on the lifting side, and those set to the middle extension on the opposite side, working in accordance with the rated lifting capacity table for the maximum extension width on the lifting side is allowed by registering the corresponding working status to Load Moment Indicator.



- The rated lifting capacity is a load with which Load Moment Indicator automatically stops crane operations at the moment ratio 100%. If a work plan is created with almost the maximum rated lifting capacity, the automatic stop at the moment ratio 100% will be activated for some reason such as the load mass, installation place on the site, and errors on the detectors. This may require replacement of the crane. Create a work plan to be on the safe side regarding the rated lifting capacity.

### 3 HOW TO READ RATED LIFTING CAPACITY TABLES

■ Rated lifting capacity table when outriggers are not used

COUNTERWEIGHT 11.2 t  
ON RUBBER STATIONARY  
SMART CW1 (Unit: × 1,000 kg)

Over front					360° Rotation				
B \ A		12.8	22.4	31.9	B \ A		12.8	22.4	31.9
4.0		27.40			4.0		17.70		
4.5		24.60			4.5		15.00		
5.0		22.30			5.0		12.50		
5.5		20.30			5.5		10.40		
6.0		18.60	15.30		6.0		8.80	9.70	
6.5		17.10	15.30		6.5		7.50	8.60	
7.0		15.70	15.30		7.0		6.50	7.80	
7.5		14.50	15.30	12.50	7.5		5.60	7.00	6.60
8.0		13.40	14.30	12.50	8.0		4.80	6.30	6.00
8.5		12.30	13.20	12.20	8.5		4.10	5.60	5.50
9.0		11.00	12.20	11.40	9.0		3.50	5.00	5.00
10.0			10.50	9.90	10.0			4.00	4.10
11.0			8.90	8.70	11.0			3.20	3.40
12.0			7.60	7.60	12.0			2.50	2.80
14.0			5.70	6.00	14.0			1.50	1.90
16.0			4.30	4.80	16.0				1.10
18.0			3.20	3.70	18.0				
20.0			2.50	2.90	20.0				
22.0				2.20	22.0				
24.0				1.70	24.0				
26.0				1.30	26.0				
28.0				0.90	28.0				
D		0°			41°			57°	
Telescoping mode	1, 2	2	2	2	Telescoping mode	1, 2	2	2	2
2nd Boom	0	0	0	0	2nd Boom	0	0	0	0
3rd Boom	0	33	67	67	3rd Boom	0	33	67	67
4th Boom	0	33	67	67	4th Boom	0	33	67	67
Top Boom	0	33	67	67	Top Boom	0	33	67	67


A: Boom length (m)  
 B: Load radius (m)  
 C: Loaded boom angle (°)  
 D: Minimum boom angle (°) for indicated length (no load)

- ① Select a rated lifting capacity table suitable for the counterweight mass.  
 Select either "ON RUBBER STATIONARY" or "TRAVELING" depending on the operating conditions.
- ② Select either "Over front" or "360° Rotation" depending on the operating conditions.
- ③ Read the boom length field.
- ④ Read the load radius field.
- ⑤ Read the telescoping mode field to be selected. (This item is not provided for models without multiple telescoping modes set.)
- ⑥ The cell where the boom length column and load radius row intersect shows the applicable rated lifting capacity.

### 3 HOW TO READ RATED LIFTING CAPACITY TABLES

[2] Rated lifting capacity tables for vehicles equipped with pin lock type boom and dismountable counterweight mechanism

The capacity is determined in combination of the outrigger extension width and counterweight mass.



**COUNTERWEIGHT 18.2t**  
**ON OUTRIGGERS FULLY EXTENDED 8.2m SPREAD**  
**360° ROTATION (Unit:x1,000kg)**

A	1	1	9	10	1	2	9	10	1	2	10	11	1	2	10	
B	1	2	26	28	3	12	27	29	4	13	30	32	5	14	31	
D \ C	13.1m	17.4m			21.8m				26.2m				30.6m			
2.5	145.0	37.0	90.7	79.0	37.0	37.0	79.0	79.0								
3.0	110.6	37.0	90.7	79.0	37.0	37.0	79.0	79.0		37.0						
3.5	100.3	37.0	90.7	79.0	37.0	37.0	79.0	79.0	37.0	37.0	66.0	57.6				
4.0	91.4	37.0	90.1	79.0	37.0	37.0	79.0	79.0	37.0	37.0	66.0	57.6			37.0	
4.5	83.8	37.0	83.7	79.0	37.0	37.0	79.0	77.9	35.8	37.0	66.0	57.6			37.0	
5.0	77.1	37.0	77.1	75.4	35.7	37.0	75.8	73.7	33.9	37.0	66.0	57.6	27.9		37.0	
5.5	71.3	37.0	71.3	71.6	33.9	37.0	71.0	70.0	32.1	37.0	66.0	56.0	26.8		37.0	
6.0	66.2	37.0	66.1	66.6	32.3	37.0	66.0	66.7	30.5	37.0	63.5	53.6	25.8		37.0	
6.5	61.6	37.0	61.6	62.0	30.8	37.0	61.4	62.2	29.1	37.0	60.5	51.4	24.8		37.0	
7.0	57.6	37.0	57.5	58.0	29.4	37.0	57.4	58.1	27.8	37.0	57.8	49.3	23.8		37.0	
7.5	53.3	37.0	53.3	53.8	28.2	37.0	53.1	54.0	26.6	37.0	53.7	47.4	23.0		37.0	
8.0	49.4	37.0	49.3	49.9	27.1	37.0	49.1	50.1	25.5	36.6	49.8	45.7	22.2		37.0	
9.0	42.8	37.0	42.8	43.3	25.1	35.0	42.6	43.5	23.6	33.8	43.2	42.6	20.5		36.0	
10.0	37.3	35.0	37.6	38.1	23.3	32.6	37.4	38.3	21.9	31.4	38.0	39.1	19.0		33.7	
11.0	33.1	33.4	33.9	34.4	21.8	30.5	33.2	34.0	20.5	29.3	33.8	34.8	17.7		31.6	
12.0	31.4	29.9	30.4	30.9	20.5	28.7	29.5	30.5	19.2	30.3	31.3	31.3	16.6		29.8	
14.0	24.2	22.2	23.0	23.8	18.3	25.4	21.9	23.1	17.1	22.7	24.2	24.2	14.7		25.4	
16.0					16.6	20.1	16.8	18.0	15.4	17.6	19.0	19.0	13.1		20.1	
18.0					15.3	16.3	13.2	14.4	14.0	16.6	13.9	15.3	11.9		16.3	
20.0									12.8	13.7	11.2	12.5	10.9		13.5	
22.0									11.9	11.6	9.1	10.4	10.0		11.3	
24.0													9.3		9.6	
26.0													8.6		8.2	
28.0													8.0		7.1	
E	31.0	33.3	32.5	34.1	24.2	32.1	30.3	32.0	24.2	31.2	30.5	31.5	24.2	30.7	29.0	
F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Telescoping conditions (%)																
Tele.1	0	0	0	0	0	0	45	0	0	0	45	0	0	0	90	
Tele.2	0	0	45	0	0	0	45	45	0	0	45	45	0	45	45	
Tele.3	0	0	0	45	0	0	0	45	0	45	45	45	0	45	45	
Tele.4	0	0	0	0	0	45	0	0	45	45	45	45	90	45	0	
Tele.5	0	45	0	0	90	45	0	0	90	45	0	0	90	45	0	
G	22	6	14	14	6	6	12	12	6	10	9	6	6	6	6	

\*Over front with special equipment

- A: Boom block
- B: Boom number
- C: Boom length (m)
- D: Load radius (m)
- E: Maximum capacity without boom pin
- F: Minimum boom angle ( ° ) for indicated length (no load)
- G: Number of parts of line

- ① Select a rated lifting capacity table suitable for the outrigger extension width and counterweight mass to be used.
- ② Read the boom length and telescoping mode fields.
- ③ Read the load radius field.
- ④ The cell where the boom length column and load radius row intersect shows the applicable rated lifting capacity.

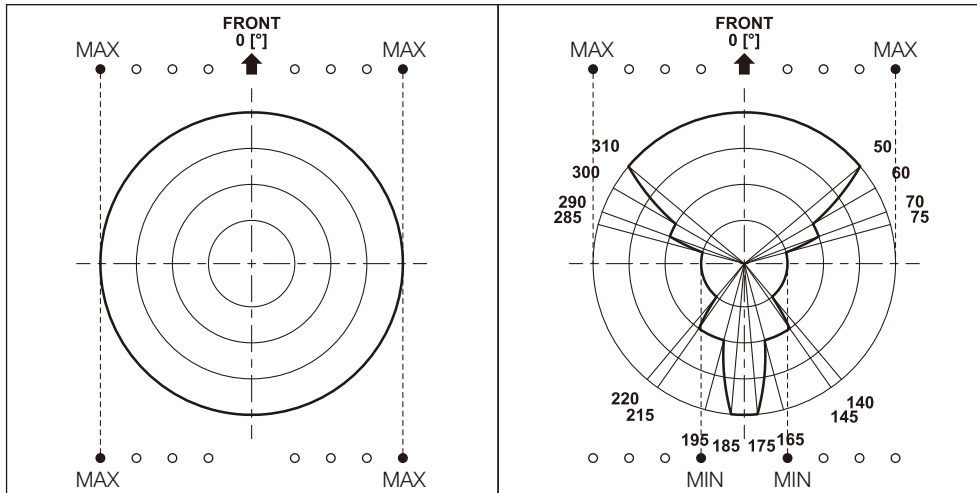


### 3 HOW TO READ RATED LIFTING CAPACITY TABLES

#### [3] Working area for rough terrain crane

The working area is determined to achieve the optimum lifting capacity depending on the slewing direction even when the outriggers are extended to different widths. The sizes of circles in each working area chart correspond to the capacities determined by the outrigger widths.

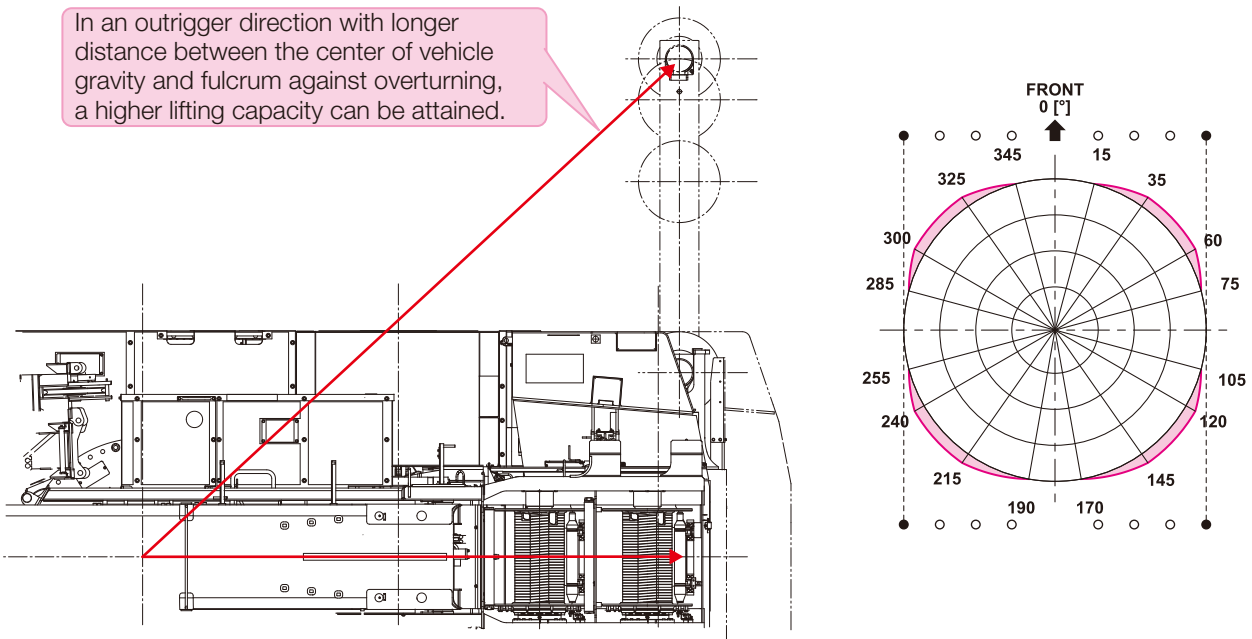
By referring to a working area chart suitable for the outrigger extension width setting, the appropriate rated lifting capacity table for each slewing area can be referred to.



#### Smart Chart

In contrast to the working area with the same capacity throughout 360 degrees, this function increases the stability in the outrigger directions according to the extension statuses of the outriggers.

In an outrigger direction with longer distance between the center of vehicle gravity and fulcrum against overturning, a higher lifting capacity can be attained.



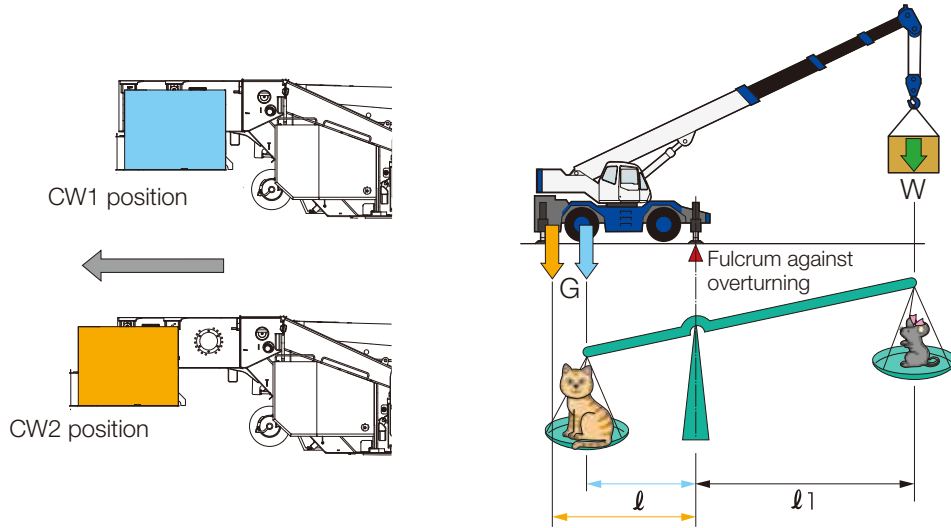
### 3 HOW TO READ RATED LIFTING CAPACITY TABLES

#### [4] SMART COUNTERWEIGHT

(1) A mechanism to improve the crane stability by modifying the counterweight installation position is called the SMART COUNTERWEIGHT.

CW1 position: Used to operate in a narrow site with smaller tail swing

CW2 position: Used to attain a higher lifting capacity by moving the counterweight rearward



Courtesy by TADANO



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