

Dynamic and Drag Induced Loads on Marine Cranes

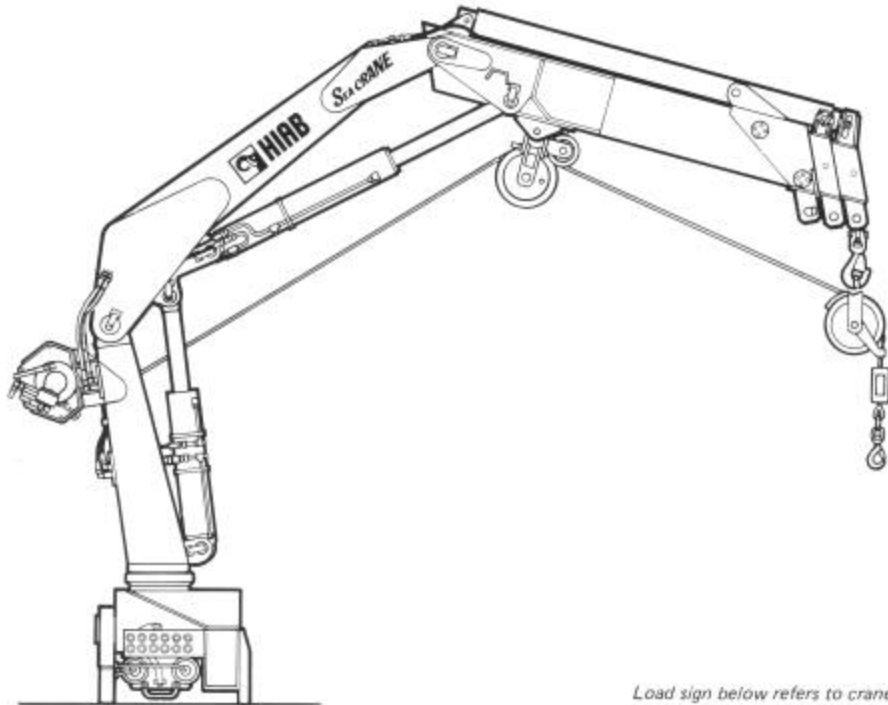
Steve Etchemendy, Director, Marine Operations, MBARI



Cranes and Dynamic Loads

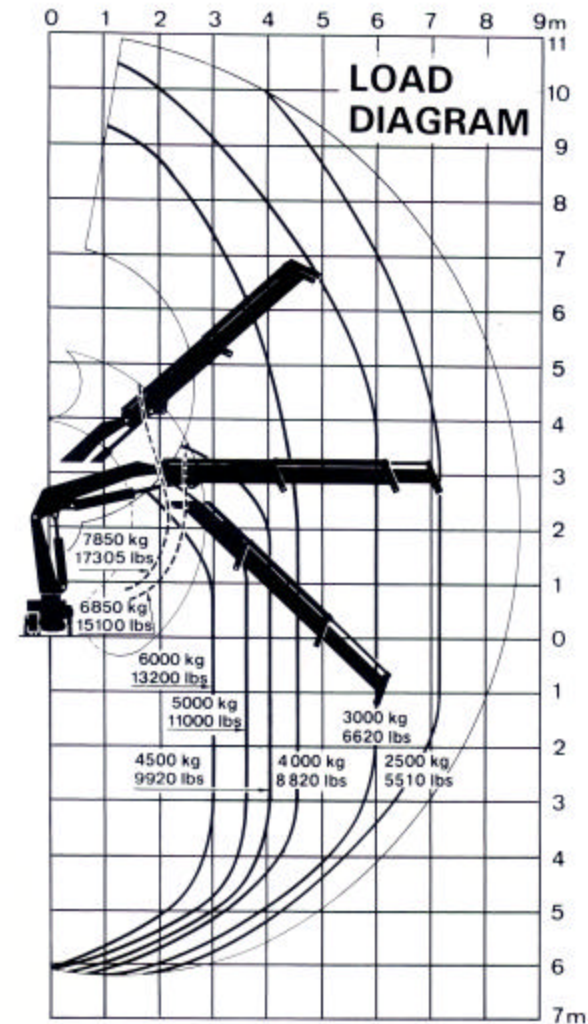
- Crane load charts are land based.
- At sea the dynamic loads induced by the ship's motions in response to the seas must be added to calculations for safe working loads.
- Just using the load chart on the side of the crane when deploying objects at sea may result in exceeding the safe working load of the crane, causing damage to the crane or perhaps accidents.

A Typical Crane Load Chart



Load sign below refers to crane with double hydraulic extension

	1.7	3.0	4.6	6.5	8.4	10.5	12.5	14.1
m	1.7	3.0	4.6	6.5	8.4	10.5	12.5	14.1
ft	5'7"	9'10"	15'1"	21'4"	27'7"	34'5"	41'	46'3"
kg	10000	6000	3870	2700	2060	1510	1190	1050
lb	22040	13230	8530	5950	4540	3330	2620	2310



ABS Guidelines (dynamic loads)

ABS Rules for Building and Classing Underwater Vehicles and Hyperbaric Facilities 2002

- For loads not associated with manned operation, (not launching a manned submersible) the allowable load must factor in a 1.75 g vertical, .75 g longitudinal and .75 g transverse acceleration.
- I.E. if you have a load of 2000 Kg at sea use $2000 \times 1.75 = 3500$ Kg as the load when you use the load chart.

Submerged Loads

- Ship motions (heave, pitch and roll) are translated down the wire and result in your submerged load being accelerated in response to the force induced by ship motions.
- Not only is the mass of the object being moved but also the added mass of the water it is displacing!

Peak Tension

- Peak tension = weight + inertial effects + drag effects
- Inertial effects = (mass + added mass) X acceleration
- Drag effects = Drag coefficient [1/2 (water density X area X velocity squared)]

Example

- Drag: A 1 meter by 1 meter square block (at depth) that weighed 1000 lbs would induce a peak tension of 2,600 lbs if the ship was inducing a .3 g acceleration into the crane/wire.
- Inertial effects: The same 1 meter by 1 meter (1000 lb) block would result in an inertial force of 1840 lbs.
- The forces are 90 degrees out of phase so the peak load would be the drag induced 2,600 lbs of force.

Take Home Message

- When launching heavy objects at sea you must add 75% to the static weight of an object to account for dynamic loads (load X 1.75). The only exception is if you have actual measured accelerations for the ship you are on.
- When lowering an object into the sea the effects of drag induced loads and ship motion induced inertial loads can dramatically increase the force of your lifting gear.