

XIV. UNDER-KEEL CLEARANCE

A. UNDER-KEEL CLEARANCE: Under-keel clearance (UKC) means the minimum clearance available between the deepest point on the vessel and the bottom in still water.

$$\text{UKC} = (\text{Charted Depth of Water} + \text{Height of Tide}) - (\text{Static Deep Draft})$$

Masters and pilots should use their vessel's deepest draft in still water when calculating UKC. Masters and pilots should apply a plus or minus allowance for the tide when calculating depth of water, and consider the following factors:

1. Vessel's trim and list characteristics;
2. Depth of the transit area;
3. Depth at the facility or anchorage;
4. Tide and current conditions; and
5. Weather impact on water depth.

In the Ports of Los Angeles and Long Beach, actual tide heights do not normally vary significantly from predicted tide heights. Nonetheless, real-time wind and tidal height information is available on the Internet at NOAA's P.O.R.T.S. website.

See: <http://tidesandcurrents.noaa.gov/ports/index.shtml?port=ll>

The master should discuss the vessel's anticipated UKC with the pilot.

B. MINIMUM UNDER-KEEL CLEARANCE GUIDELINES FOR ALL VESSELS: These guidelines for minimum UKC apply during normal weather for the ports of Los Angeles and Long Beach (POLA/POLB). Severe weather or other abnormal conditions may demand case-by-case evaluation. Masters and pilots shall use prudent seamanship at all times when piloting vessels in the POLA/POLB harbors and approaches.

1. Port of Los Angeles:
 - a. Between the Los Angeles Approach Channel Lighted Buoy #1 and the Los Angeles Main Channel Buoy #11, minimum under-keel clearance before correction for roll and pitch is 10% of the vessel's draft.
 - b. In the channel between the Los Angeles Main Channel Buoy #11 and a position off the designated berth, minimum under-keel clearance is 2.0' (0.61m).
 - c. In the final approach to the berth, and while at berth, the vessel must always remain afloat.
 - d. At anchorages inside the breakwater, minimum under-keel clearance is 2.5' (0.76m).
 - e. Shifts via outer harbor between Los Angeles and Long Beach, minimum under-keel

clearance is 3' (.91m).

2. Port of Long Beach:

- a. Between the Long Beach seabuoy and the Long Beach Channel Buoy #3, minimum under-keel clearance before correction for roll and pitch is 10% of the vessel's draft.
- b. In the channel between the Long Beach Channel Buoy #3 and a position off the designated berth, minimum under-keel clearance is 2.0' (0.61m).
- c. In the final approach to the berth, and while at berth, the vessel must always remain afloat.
- d. At anchorages inside the breakwater, minimum under-keel clearance is:
 - i. 4' (1.22m) for anchorages B-7 and B-11 when vessels draft is 50' (15.24m) or more; and
 - ii. 2.5' (0.76m) for all other anchorages.
- e. For shifts via outer harbor between Long Beach and Los Angeles, minimum under-keel clearance is 3' (.91m).

The above guidelines are intended to include safety margins for sinkage due to squat and for an increase in draft due to pitch and roll during the weather and sea state conditions normally encountered in the Los Angeles and Long Beach harbors and approaches.

The pilot organization management, the vessel's master/operator, and the USCG Captain of the Port (COTP) should concur with any deviation below the above guidelines.

Terminal or vessel operators may require minimum under-keel clearances that are more restrictive than the above guidelines. Vessel masters should be aware of this and should consider terminal policy, fleet operating requirements, and the guidelines contained in the Los Angeles Long Beach Harbor Safety Plan when deciding upon their minimum allowable under-keel clearances.

Tank vessel masters and operators should also be guided by the under-keel clearance regulations for tank vessels contained in 33 CFR 157.455.

C. EVALUATING UNDER-KEEL CLEARANCE: While the above guidelines should ensure adequate UKC under normally encountered circumstances of weather, sea state and vessel configuration, the LALB Harbor Safety Committee recommends that all vessel masters should estimate the anticipated UKC that they expect their vessel will encounter during the various phases of the transit, particularly during severe weather or other abnormal conditions. In complying with the above guidelines, the master should consider sea state conditions that might cause an increase in draft due to pitch and roll and plan/adjust transit speeds with regard to vessel

squat characteristics.

Studies indicate that swell crests and troughs affect vessel immersion (heave) when a vessel is rising and falling with swells off the beam. However, the studies also indicate that vessels will normally experience significant and measurable roll before increased draft due to heave becomes a problem. Therefore, the sound practice of measuring roll and calculating the corresponding increase to vessel draft before entering port helps the master evaluate safe under-keel clearance.

FORMULA FOR INCREASE IN DRAFT DUE TO LIST

The formula for calculating the increase in draft for “X” degrees of list is:

$$\text{Draft Increase} = \text{Vessel Beam} \div 2 \times \text{Sine of List Angle}$$

Examples:	Vessel Beam (feet)	Increase in Draft Due to List (in feet)		
		1° List	2° List	3° List
	50	0.44 feet	0.87 feet	1.31 feet
	75	0.65 feet	1.31 feet	1.96 feet
	90	0.79 feet	1.57 feet	2.36 feet
	105	0.92 feet	1.83 feet	2.75 feet
	130	1.13 feet	2.27 feet	3.40 feet
	150	1.31 feet	2.62 feet	3.93 feet
	175	1.53 feet	3.05 feet	4.58 feet
	200	1.75 feet	3.49 feet	5.23 feet

FORMULA FOR INCREASE IN DRAFT DUE TO PITCH

The formula for calculating the increase in draft for “X” degrees of pitch is:

$$\text{Draft Increase} = \text{Vessel Length} \div 2 \times \text{Sine of Pitch Angle}$$

(Formula assumes tipping center is at midpoint)

Examples:	Vessel Length (feet)	Increase in Draft Due to Pitch (in feet)		
		0.5° Pitch	1.0° Pitch	2.0° Pitch
	500	2.18 feet	4.36 feet	8.72 feet
	600	2.62 feet	5.24 feet	10.47 feet
	700	3.05 feet	6.11 feet	12.21 feet
	800	3.49 feet	6.98 feet	13.96 feet
	900	3.93 feet	7.85 feet	15.70 feet
	1000	4.36 feet	8.73 feet	17.45 feet
	1100	4.80 feet	9.60 feet	19.19 feet
	1200	5.24 feet	10.47 feet	20.94 feet
	1300	5.67 feet	11.34 feet	22.68 feet
	1400	6.11 feet	12.22 feet	24.43 feet