Planning for Load Handling Activities

March 2024 Draft Revisions

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ASME Codes and Standards
FOREWORD

As load handling activities grow in complexity, there is an increased need to develop a set of recognized planning guidelines. While some guidance for planning of load handling activities, also referred to as lift planning, has been available in publications, literature from equipment manufacturers, and in-house procedures of various organizations and companies, there has not been any published comprehensive, broadly authoritative guidance available. The absence of uniform considerations or comprehensive practices has created an uneven range of planning activities.

In 2008, the B30 Standard Committee created a Task Group to consider the feasibility of developing a standard for lift planning. Based upon the report of the Task Group, the B30 Standard Committee favored the creation of a standard but recognized that such a standard would not fit the equipment-based orientation of B30. The American Society of Mechanical Engineers (ASME) and the American National Standards Institute (ANSI) were petitioned to form a committee to develop a lift planning standard.

The formation of the ASME P30 Standards Committee, Planning for the Use of Cranes, Derricks, Hoists, Cableways, Aerial Devices, and Lifting Accessories, was approved by ASME on June 8, 2010, and a Project Initiation Notification System (PINS) was posted in ANSI Standards Action on July 2, 2010. The Committee held its inaugural meeting on September 20, 2010, with the intent to develop a standard that provides guidance on general planning considerations and practices for load handling operations occurring in all industries, so that users could apply the Standard as a template and adapt it to the needs of their specific industry or situation.

The first edition of ASME P30.1 was approved by ANSI on January 14, 2014. The 2019 edition contains changes to Nonmandatory Appendix A, additional guidance on rigging planning and how to establish a limiting wind speed for a load handling activity as part of the lift-planning process. The P30.1-20XX edition contains updates to Nonmandatory Appendix C Establishing a Limiting Wind Speed, references and definitions.

ASME P30.1-20XX was approved by the P30 Committee and by ASME, and was approved by ANSI and designated as an American National Standard on TBD.
The records contained within are listed below.

<table>
<thead>
<tr>
<th>Record</th>
<th>Draft Revisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>23-374</td>
<td>Appendix C-7 Revisions</td>
</tr>
<tr>
<td>23-2792</td>
<td>Appendix C-7(e) revision</td>
</tr>
<tr>
<td>23-981</td>
<td>Chapter 1-2 Definitions</td>
</tr>
<tr>
<td>24-449</td>
<td>References appendix</td>
</tr>
</tbody>
</table>
C-7 CALCULATING WIND FORCES ON A LOAD TO BE HANDLED - LIMITING WIND SPEED FOR LHE WITH SUSPENDED LOADS

If a suspended load presents a large area to the prevailing wind it may be necessary to calculate or reevaluate the wind force when establishing a LWS for the LHA; this is particularly so when the area is large relative to the weight of the load. Typically, it is suggested to start by calculating the wind forces using the wind velocity that the LHE manufacturer specifies as the LWS for the LHE itself. Check whether those forces are satisfactory for stability and control of the LHE and, if not, reduce the LWS and repeat until the wind forces are sufficiently low.

The following equations can be used to calculate reference values such as wind pressure and wind force occurring during a LHA. Manufacturer’s specific instructions for the LHE being used take precedence.

(a) The wind pressure, \( q \), created by wind velocity, \( V \), acting on an object can be calculated for a specific maximum wind speed (the proposed LWS at the load). The equation to determine wind pressure, \( q \), is the following, with \( V \) measured in mph:

\[
q = 0.00256V^2 \text{ [lb/ft}^2]\]

(b) The wind area \( A_s \) (sail area) of a load (ft\(^2\)) is the surface area of the load presented to the wind. Wind forces are greatest when the wind acts normal (perpendicular) to that area.

(c) The drag area \( A_w \) is a function of the wind area and the shape of the object. The drag area is usually expressed as a product of the wind area \( (A_s) \) and the drag coefficient \( (C) \), also referred to as the shape factor or force coefficient, appropriate to the shape of the object. ASCE 7, chapter 29 offers coefficients for several different structure types and geometries. The drag area of an object is given by:

\[
F = qCA_w \text{ [lb]}
\]

\[
A_w = A_sC \text{ [ft}^2]\]

(d) The wind force, \( F \), is the external force acting on an object caused by wind during the LHA. Typically, it is suggested to start by calculating the wind forces using the wind velocity that the LHE manufacturer specifies as the LWS for the LHE itself. Check whether those forces are satisfactory for stability and control of the LHE and, if not, reduce the LWS and repeat until the wind forces are sufficiently low. The wind force acting on an object is given by:

\[
F = qAw \text{ [lb]}
\]

(e) If \( q \) is the pressure at the LWS, then \( F \) is the force on the object at that design maximum operational wind speed. If the force \( F \) proves to be too high, then the LWS should be lowered, reducing until the wind force is at a level that can be safely sustained by the LHE and at a level at which the load can be safely controlled.

(f) For some LHE the LWS is defined based on an assumed drag area proportional to the lifted weight. For these LHE there is an Allowable Area Exposed to Wind, \( A_{allow} \), which is the sail area accounted by the LHE manufacturer during the design process. \( A_{allow} \) can be calculated by multiplying the Load Chart Capacity (LC) of the LHE at the specific configuration times the

Area Exposed to Wind per Mass(weight) Unit \( A_{allow} \), For LHE designed per EN 13000, \( A_{allow} \) is 1.2 \( m^2/\)mton (0.00586 \( ft^2/\)lb).

For Mobile and Locomotive Cranes supporting objects with a drag area \( A_w \) larger than the sail area accounted by the manufacturer \( A_{allow} \) the LWS can be expressed as:

\[
LWS = LWS_{CHART} \sqrt{\frac{0.00586M^2}{A_w}} \text{ [mph]}
\]

\[
LWS = LWS_{CHART} \frac{1.2}{mton} \frac{M^2}{A_w} \text{ [m/s]}
\]

\[LWS_{CHART}\] is a general or configuration specific maximum permissible wind speed per manufacturer specifications. The calculated LWS must always be less than or equal to \( LWS_{CHART}\).

The last component of the equation is the load mass effect, \( (M) \) (lbs). This value depends on the manufacturer's approach. For some manufacturers the value to used is the Load Chart capacity (LC), for others the value to be used is the hoisted gross weight suspended from the LHE. Consult with the LHE manufacturer or qualified person to determine the proper multiplier.

### C-7.1 LIMITING WIND SPEED CALCULATION STEPS FOR MOBILE AND LOCOMOTIVE CRANES

The following calculation steps can be used to evaluate the manufacturer’s provided maximum permissible wind speed \( LWS_{CHART}\) and determine whether a derate is required based on the payload’s geometry, dimensions, (large sail area) and hoisted gross weight. The calculated wind speed will be the established Limiting Wind Speed (LWS) for the LHA. The calculations steps are valid for Mobile and Locomotive Cranes designed per EN 13000 only. See Figure C-7-2.

**STEPS:**

1. Establish the Load Chart Capacity (LC) for the LHA based on the LHE configuration. See Figure C-7-1.
2. Calculate the Allowable Area Exposed to Wind (\( A_{allow} \)), Multiply (LC) time \( A_{unit} \)
3. Calculate the drag area \( (A_w) \) for the suspended payload. Drag coefficient will vary based on the payload’s geometry.
4. Compare \( A_w \) to \( A_{allow} \) and determine whether \( A_{allow} \) the LWS needs to be calculated.

(a) If \( A_{allow} \) is greater than the \( A_w \) then the LHE maximum permissible wind per manufacturer’s specification \( (LWS_{CHART}) \) does not need to be reevaluated.

(b) When the Allowable Area Exposed to Wind \( (A_{allow}) \) is lesser than the Drag Area \( (A_w) \) then a new Limiting Wind Speed (LWS) must be calculated. The derated wind speed will take into account the payload’s sail area.
5. Find the permissible wind speed per manufacturer specifications \( (LWS_{CHART}) \). This value can be Load Chart...
specific or configuration/model specific. Consult with LHE manufacturer for additional information.

(5.1) When LWS$_{\text{CHART}}$ does not need to be reevaluated, then LWS$_{\text{CHART}}$ is established as the LWS for the LHA.

(6) The value to be used for the load mass effect multiplier (M) is specific to the manufacturer’s approach to calculating Limiting Wind Speed. Consult with the LHE manufacturer or qualified person to determine the proper multiplier.

(7) For payloads with $A_{\text{allow}}$ less than $A_w$, the established LWS equation provided in section C-7 can be used. The calculated LWS must always be less than or equal to LWS$_{\text{CHART}}$.

(8) Calculate Wind Pressure (q).

(9) Calculate Wind Force (F) acting on payload for additional lift planning parameters.
Figure C-7-1 LHA & CORRESPONDING LHE LOAD CHART
**Figure C-7-2 LIMITING WIND SPEED CALCULATIONS FOR MOBILE AND LOCOMOTIVE CRANES**

**LIMITING WIND SPEED (LWS)**

PER PLANNING FOR LOAD HANDLING ACTIVITIES

By:  
Rev:  
Ckd:  
Date:  

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**DRAG AREA CHECK**

<table>
<thead>
<tr>
<th>(1) CRANE LOAD CHART CAPACITY</th>
<th>U.S. CUSTOMARY UNITS</th>
<th>U.S. SI UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRANE LOAD CHART CAPACITY</td>
<td>LC:</td>
<td>0.0 lb</td>
</tr>
<tr>
<td>AREA EXPOSED TO WIND PER MASS UNIT</td>
<td>A(_{\text{unit}}):</td>
<td>0.00585 ft(^2)/lb</td>
</tr>
</tbody>
</table>

(2) ALLOWABLE AREA EXPOSED TO WIND

\[ A_{\text{allow}} = L \times C \]

<table>
<thead>
<tr>
<th>U.S. CUSTOMARY UNITS</th>
<th>U.S. SI UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A_{\text{allow}} ):</td>
<td>0 ft(^2)</td>
</tr>
</tbody>
</table>

PAYLOAD SURFACE AREA

\[ A_d = L \times W \]

<table>
<thead>
<tr>
<th>U.S. CUSTOMARY UNITS</th>
<th>U.S. SI UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A_d ):</td>
<td>0 ft(^2)</td>
</tr>
</tbody>
</table>

DRAG COEFFICIENT

\[ C: \]

(3) DRAG AREA

\[ A_d = A_d \times C \]

<table>
<thead>
<tr>
<th>U.S. CUSTOMARY UNITS</th>
<th>U.S. SI UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A_d ):</td>
<td>0 ft(^2)</td>
</tr>
</tbody>
</table>

(4) DOES A **NEW** (LWS) NEED TO BE CALCULATED?

If \( A_{\text{allow}} > A_d \) -> NO
If \( A_{\text{allow}} < A_d \) -> YES

---

**LIMITING WIND SPEED (LWS)**

(5) MANUFACTURER PERMISSIBLE WIND SPEED

\[ LWS_{\text{CHART}}: \]

<table>
<thead>
<tr>
<th>U.S. CUSTOMARY UNITS</th>
<th>U.S. SI UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( m_{\text{ch}} ):</td>
<td>0.0 lbs</td>
</tr>
</tbody>
</table>

(6) LOAD MULTIPLIER

\[ m_{\text{ch}} \]

(7) LIMITING WIND SPEED

\[ LWS = LWS_{\text{CHART}} \times \left( \frac{A_{\text{allow}}}{A_d} \right) \]

<table>
<thead>
<tr>
<th>U.S. CUSTOMARY UNITS</th>
<th>U.S. SI UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LWS:</td>
<td>0.00 m/s</td>
</tr>
</tbody>
</table>

(8) WIND PRESSURE CREATED BY VELOCITY

\[ q = 0.0025xLWS^2 \]

<table>
<thead>
<tr>
<th>U.S. CUSTOMARY UNITS</th>
<th>U.S. SI UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>q:</td>
<td>0.00 lb/ft(^2)</td>
</tr>
</tbody>
</table>

(9) WIND FORCE ON LHE

\[ F = qCA_d \]

<table>
<thead>
<tr>
<th>U.S. CUSTOMARY UNITS</th>
<th>U.S. SI UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>F:</td>
<td>0 lbs</td>
</tr>
</tbody>
</table>
C-7  CALCULATING LIMITING WIND SPEED FOR LHE WITH SUSPENDED LOADS

If a suspended load presents a large area to the prevailing wind it may be necessary to calculate or reevaluate the LWS for a the LHA; this is particularly so when the area is large relative to the weight of the load.

The following equations can be used to calculate reference values such as wind pressure and wind force occurring during a LHA. Manufacturer’s specific instructions for the LHE being used take precedence.

(a) The wind pressure, q, created by wind velocity, V, acting on an object can be calculated for a specific maximum wind speed (the proposed LWS at the load). The equation to determine wind pressure, q, is the following, with V measured in mph:
\[ q = 0.00256V^2 \] \[ \text{[lb/ft}^2\text{]} \]

(b) The wind area \( A_s \) (sail area) of a load (ft\(^2\)) is the surface area of the load presented to the wind. Wind forces are greatest when the wind acts normal (perpendicular) to that area.

(c) The drag area \( A_w \) is a function of the wind area and the shape of the object. The drag area is usually expressed as a product of the wind area (\( A_s \)) and the drag coefficient (C), (also referred to as the shape factor or force coefficient) appropriate to the shape of the object. ASCE 7, chapter 29 offers coefficients for several different structure types and geometries. The drag area of an object is given by:
\[ A_w = A_s C \] \[ \text{[ft}^2\text{]} \]

(d) The wind force, \( F \), is the external force acting on an object caused by wind during the LHA. Typically, it is suggested to start by calculating the wind forces using the wind velocity that the LHE manufacturer specifies as the LWS for the LHE itself. Check whether those forces are satisfactory for stability and control of the LHE and, if not, reduce the LWS and repeat until the wind forces are sufficiently low. The wind force acting on an object is given by:
\[ F = qA_w \] \[ \text{[lb]} \]

(e) For some LHE the LWS is defined based on an assumed drag area proportional to the lifted weight.

The equations in this section are an example that may be used as a supplementary tool for planning. They are not a substitute for manufacturer’s instructions. User should confirm with the LHE manufacturer or a qualified person as to the applicability of the following formulas.

For these LHE there is an Allowable Area Exposed to Wind, \( A_{allow} \), which is the sail area accounted by the LHE manufacturer during the design process. \( A_{allow} \) can be calculated by multiplying the Load Chart Capacity (LC) of the LHE at the specific configuration times the Area Exposed to Wind per Mass(weight) Unit \( A_{unit} \). For LHE designed per EN 13000, \( A_{unit} \) is 1.2 m\(^2\)/mton (0.00586 ft\(^2\)/lb)

For Mobile and Locomotive Cranes supporting objects with a drag area \( A_w \) larger than the sail area
accounted by the manufacturer $A_{\text{allow}}$, the LWS can be expressed as follow:

$$LWS = LWS_{\text{CHART}} \sqrt{\frac{0.00586 \text{ft}^2 \text{M}}{\text{lbf} \text{Aw}}} \quad \text{[mph]}$$

$$LWS = LWS_{\text{CHART}} \sqrt{\frac{1.2 \text{m}^2 \text{ton} \text{M}}{\text{Aw}}} \quad \text{[m/s]}$$

$LWS_{\text{CHART}}$ is a general or configuration specific maximum permissible wind speed per manufacturer specifications. The calculated LWS must always be less than or equal to $LWS_{\text{CHART}}$.

The last component of the equation is the load mass effect, $(M)$, (lbs). This value depends on the manufacturer’s approach. For some manufacturers the value to used is the Load Chart capacity $(LC)$, for others the value to be used is the hoisted gross weight suspended from the LHE. Consult with the LHE manufacturer or qualified person to determine the proper multiplier.
**Record:** # 23-981  
**Standard:** P30.1  
**Subject:** Chapter 1-2 Definitions  
**Date:** April 2023 updated July 2023

**crane mat:** a structural element or assembly placed under the LHE capable of distributing the load primarily along its length.

**ground mat:** mats covering the ground, a protective cover used to limit tires or tracks digging in and from damaging the ground support surface. Also known as access mat, mud mat, swamp mat, or ground protection mat.

**outrigger float:** rigid footing component that attaches to the bottom of an outrigger or stabilizer.

**outrigger pad:** a structural element or assembly placed under an outrigger, a float of the LHE capable of distributing the load in all directions.

Rationale: Adding definitions to terms used in Appendix D
NONMANDATORY APPENDIX D APPENDIX E
INDUSTRY REFERENCES

ASME B30.11, Monorails and Underhung Cranes (withdrawn 2018 — requirements found in latest revision of B30.17)
ASME B30.15, Mobile Hydraulic Cranes (withdrawn 1982 — requirements found in latest revision of B30.5)
EN 13000, Cranes - Mobile Cranes
__Publisher: European Committee For Standardization, CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Standard Specifications for Highway Bridges, 17th Edition
NAVFAC_DM7_01, Soil Mechanics
__Publisher: Naval Facilities Engineering Command, 200 Stovall Street, Alexandria, Virginia 22332-2300

Rationale:
1. Add EN 13000 which is used in the revised appendix C
2. Add 2 new references used in the new appendix D
3. Re-number this appendix accordingly.
4. Remove obsolete references and specification of editions.