ASME BTH-1–2017
(Revision of ASME BTH-1–2014)

Design of Below-the-Hook Lifting Devices

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The next edition of this Standard is scheduled for publication in 2020. This Standard will become effective 1 year after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME Web site under the Committee Pages at http://cstools.asme.org/ as they are issued.

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FOREWORD

There have been many formal requests for interpretation of the limited structural design criteria stated within ASME B30.20, Below-the-Hook Lifting Devices, a safety standard. As a consequence, industry has for quite some time expressed a need for a comprehensive design standard for below-the-hook lifting devices that would complement the safety requirements of ASME B30.20. All editions of ASME B30.20 have included structural design criteria oriented toward the industrial manufacturing community requiring a minimum design factor of 3, based on the yield strength of the material; recent editions have also included design criteria for the fatigue failure mode. However, members of the construction community expressed the need for design criteria more suitable to their operating conditions, including a lower design factor, and the necessity to address other failure modes such as fracture, shear, and buckling, and design topics such as impact and fasteners.

A Design Task Group was created in 1997 to begin work on a design standard as a companion document to ASME B30.20. The ASME BTH Standards Committee on the Design of Below-the-Hook Lifting Devices was formed out of the Design Task Group and held its organizational meeting on December 5, 1999.

ASME BTH-1–2005, Design of Below-the-Hook Lifting Devices, contained five chapters: Scope and Definitions, Lifter Classifications, Structural Design, Mechanical Design, and Electrical Components. This Standard, intended for general industry and construction, set forth two design categories for lifters based on the magnitude and variation of loading, and operating and environmental conditions. The two design categories provided different design factors for determining allowable static stress limits. Five Service Classes based on load cycles were provided. The Service Class establishes allowable stress range values for lifter structural members and design parameters for mechanical components. ASME BTH-1–2005 was approved by the American National Standards Institute (ANSI) on October 18, 2005.

ASME BTH-1–2008 incorporated editorial revisions and two new mechanical design sections for grip ratio and vacuum lifting device design. ASME BTH-1–2008 was approved by ANSI on September 17, 2008.

ASME BTH-1–2011 incorporated revisions throughout the Standard and the addition of a new mechanical design section for fluid power systems. ASME BTH-1–2011 was approved by ANSI on September 23, 2011.

ASME BTH-1–2014 incorporated into Chapter 4 a section on lifting magnets. Other technical revisions included new requirements for fluid pressure control and electrical system guarding. Along with these technical changes, the nonmandatory Commentary for each chapter was moved to its own respective Nonmandatory Appendix. ASME BTH-1–2014 was approved by ANSI on June 24, 2014.

This revision of ASME BTH-1 includes the addition of Chapter 6: Lifting Magnet Design, an accompanying Nonmandatory Appendix with commentary for the new chapter, and other revisions. Following the approval by the ASME BTH Standards Committee, ANSI approved this edition as an American National Standard, with the new designation ASME BTH-1–2017, on January 6, 2017.

ASME BTH STANDARDS COMMITTEE
Design of Below-the-Hook Lifting Devices

(The following is the roster of the Committee at the time of approval of this Standard.)

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CORRESPONDENCE WITH THE BTH COMMITTEE

General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to:

Secretary, BTH Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Interpretations. Upon request, the BTH Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the BTH Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the BTH Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a “yes” or “no” reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of “Yes” or “No,” with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The BTH Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the BTH Standards Committee.

ASME BTH-1–2017
SUMMARY OF CHANGES

Following approval by the ASME BTH Standards Committee and ASME, and after public review, ASME BTH-1–2017 was approved by the American National Standards Institute on January 6, 2017.

ASME BTH-1–2017 includes editorial changes, revisions, and corrections identified by a margin note, **(17)**.

Page	*Location*	*Change*
2–5	1-5.1	(1) Definitions of *applied load(s), dead load, load cycle, maximum stress, minimum stress,* and *rated load* added (2) Definitions of *cycle, load; load(s), applied; load, dead; load, rated; rigging hardware; sling; stress, maximum;* and *stress, minimum* deleted (3) Definitions of *shall* and *should* and location where *design factor* is first used revised
	1-5.3	(1) Definitions of *equalizing sheave* and *running sheave* added (2) Definitions of *sheave, equalizing* and *sheave, running* deleted (3) Location where *back-driving*, L_{10} *bearing life,* and *vacuum pad* are first used revised
	1-5.4	(1) Definitions of *electrical power supply, electric motor, externally powered electromagnet*, and *master switch* added (2) Definitions of *electromagnet, externally powered; motor, electric; power supply, electrical;* and *switch, master* deleted (3) Location where *brake, control system, rectifier,* and *sensor(s)* are first used revised
	1-5.5	Added
	Fig. 1-5.5-1	Added
6–10	1-6.1	(1) Units for a, D_p, and ϕ and nomenclature for h_c, h_p, M_y , $S_{xc,}$ and S_{xt} added (2) Nomenclature for F_r, F_{yf}, and F_{yw} deleted (3) Nomenclature for n_i revised
	1-6.2	(1) Units for A and θ added (2) Nomenclature for S_u and S_y revised
	1-6.3	Added
	1-7	References updated

Page	*Location*	*Change*
11	2-2	Revised
	2-2.3	Added
12–15	3-1.2	Revised
	3-1.3.1	Design Category C lifters added
	3-1.3.2	Subparagraph (c) added
	3-1.7	Added
	3-2.1	Nomenclature for F_u revised
	3-2.2	Revised
	3-2.3.2	Revised
	Table 3-2.2-1	Revised in its entirety
	3-2.3.3	Revised
17	3-3.2	(1) In paragraph following eq. (3-40), last sentence added (2) Nomenclature for F_u revised
18	3-3.3.1	Nomenclature for ϕ added
21, 22	3-4.6	Nomenclature for $C_f\, q$ revised
23–34	Table 3-4.4-1	Description for 5.2, Potential Crack Site Initiation for 6.2, and Stress Category for 8.5 revised
36	4-5.4	Reference updated
39–40	4-7.5	Nomenclature for S_u revised
	4-7.6	Reference updated
	4-7.6.3	Nomenclature for S_y following eq. (4-15) revised
41	4-9.2	First paragraph revised
	Fig. 4-9.2-1	In illustration (b), second graphic added
42	4-10.4	Added
	4-12	Deleted
43	5-2.1	Revised
44	5-4.6	Subparagraph (c) added
45	5-5	Editorially revised
	5-6	(1) In paras. 5-6.2 and 5-6.3, subpara. (c) added (2) Paragraph 5-6.4 Deleted
46–48	Chapter 6	Added
49	A-4.2	Revised
50–52	A-4.7	Reference updated
	A-7	References updated
54	B-2.3	Added

Page	*Location*	*Change*
55–57	C-1.3	First, eighth, and last paragraphs revised
	C-1.7	Added
	C-2	First paragraph revised
	C-2.2	References in second paragraph updated
58	C-2.3.2	Third paragraph and last two sentences in last paragraph added
	C-2.3.3	Last sentence added
	C-2.4	First paragraph revised
59	C-2.6	Reference to AISC tables updated
60, 61	C-3.2	Second paragraph revised
	C-3.3.1	Third paragraph revised
63	C-5.2	References updated
64	D-2.6	Reference updated
65	D-5.4	Reference updated
69	Nonmandatory Appendix F	Added

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DESIGN OF BELOW-THE-HOOK LIFTING DEVICES

Chapter 1
Scope, Definitions, and References

1-1 PURPOSE

This Standard sets forth design criteria for ASME B30.20, Below-the-Hook Lifting Devices. This Standard serves as a guide to designers, manufacturers, purchasers, and users of below-the-hook lifting devices.

1-2 SCOPE

This Standard provides minimum structural and mechanical design and electrical component selection criteria for ASME B30.20, Below-the-Hook Lifting Devices.

The provisions in this Standard apply to the design or modification of below-the-hook lifting devices. Compliance with requirements and criteria that may be unique to specialized industries and environments is outside the scope of this Standard.

Lifting devices designed to this Standard shall comply with ASME B30.20, Below-the-Hook Lifting Devices. ASME B30.20 includes provisions that apply to the marking, construction, installation, inspection, testing, maintenance, and operation of below-the-hook lifting devices.

The provisions defined in this Standard address the most common and broadly applicable aspects of the design of below-the-hook lifting devices. A qualified person shall determine the appropriate methods to be used to address design issues that are not explicitly covered in the Standard so as to provide design factors and/or performance consistent with the intent of this Standard.

1-3 NEW AND EXISTING DEVICES

The effective date of this Standard shall be one year after its date of issuance. Lifting devices manufactured after the effective date shall conform to the requirements of this Standard.

When a lifter is being modified, its design shall be reviewed relative to this Standard, and the need to meet this Standard shall be evaluated by the manufacturer or a qualified person.

1-4 GENERAL REQUIREMENTS

1-4.1 Design Responsibility

Lifting devices shall be designed by, or under the direct supervision of, a qualified person.

1-4.2 Units of Measure

A dual unit format is used. Values are given in U.S. Customary units as the primary units followed by the International System of Units (SI) in parentheses as the secondary units. The values stated in U.S. Customary units are to be regarded as the standard. The SI units in the text have been directly (softly) converted from U.S. Customary units.

1-4.3 Design Criteria

All below-the-hook lifting devices shall be designed for specified rated loads, load geometry, Design Category (see section 2-2), and Service Class (see section 2-3). Resolution of loads into forces and stress values affecting structural members, mechanical components, and connections shall be performed by an accepted analysis method.

1-4.4 Analysis Methods

The allowable stresses and stress ranges defined in this Standard are based on the assumption of analysis by classical strength of material methods (models), although other analysis methods may be used. The analysis techniques and models used by the qualified person shall accurately represent the loads, material properties, and device geometry; stress values resulting from the analysis shall be of suitable form to permit correlation with the allowable stresses defined in this Standard.

1-4.5 Material

The design provisions of this Standard are based on the use of carbon, high-strength low-alloy, or heat-treated constructional alloy steel for structural members and many mechanical components. Other materials may be used, provided the margins of safety and fatigue life are equal to or greater than those required by this Standard.