ASME B18.2.4.1M-2002

[Revision of ANSI B18.2.4.1M-1979 (R1995)]

METRIC HEX NUTS, STYLE 1

AN AMERICAN NATIONAL STANDARD



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The American Society of Mechanical Engineers

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FOREWORD

American National Standards Committee B18 for the standardization of bolts, screws, nuts, rivets, and similar fasteners was organized in March 1922 as Sectional Committee B18 under the aegis of the American Engineering Standards Committee (later the American Standards Association, then the United States of America Standards Institute and, as of October 6, 1969, the American National Standards Institute, Inc.), with the Society of Automotive Engineers and the American Society of Mechancial Engineers as joint sponsors. Subcommittee 2 was subsequently established and charged with the responsibility for technical content of standards covering wrench head bolts and nuts.

At its meeting on December 4, 1974, Committee B18 authorized preparation of a series of standards for metric fasteners. Sucommittee 2 was assigned responsibility for developing standards for metric hex bolts, screws, and nuts.

At a meeting on September 22, 1976, Subcommittee 2 organized the contents of a standard covering six different styles of hex nuts. Actual drafting was postponed until ISO/TC2 could reach final decisions relating to basic dimensions and characteristics of hex bolts, screws, and nuts. At ISO/TC2 meetings held in April 1977, final actions were taken; Committee B18 affirmed the TC2 decisions at a meeting on June 29, 1977; and drafting of this Standard was started.

In February 1978, Committee B18 established a cooperative program with the Department of Defense to draft American National Standards for metric fasteners in such a way that they could be used directly by the government for procurement purposes. The Department of Defense requested that each of the six nut products be covered in separate standards, and Subcommittee 2 accepted this approach at its meeting on June 27, 1978.

The previous standard was approved by letter ballot of Committee B18 on July 2, 1979, and was subsequently approved by the secretariats and submitted to the American National Standards Institute for designation as an American National Standard. This was granted on December 6, 1979. B18.2.4.1M was last reaffirmed without change in 1995.

This Standard was developed by the American Society of Mechanical Engineers B18 Standards Committee on Fasteners. This Standard was approved by the American National Standards Institute on January 24, 2002.

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Standardization of Bolts, Nuts, Rivets, Screws, Washers, and Similar Fasteners

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

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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, B18 Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

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 B18 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 B18 Standards Committee.

The request for 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.

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. 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 this format will be rewritten in this 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.

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Metric Hex Nuts, Style 1

1 GENERAL

1.1 Scope

(a) This Standard covers the complete general and dimensional data for metric hex nuts, Style 1, recognized as American National Standard.

(b) The inclusion of dimensional data in this Standard is not intended to imply that all of the nut sizes in conjunction with the various options described herein are stock items. Purchasers should consult with suppliers concerning lists of stock production hex nuts, Style 1.

2 COMPARISON WITH ISO STANDARDS

(a) Hex nuts, Style 1, as covered in this Standard, have been coordinated to the extent possible with ISO 4032. The dimensional differences between this ASME Standard and ISO 4032 are very few and relatively minor, except those of the M10 size. None affect the functional interchangeability of nuts manufactured to the requirements of either.

This Standard specifies some requirements that are not included in ISO 4032. **Dimensional requirements shown in bold type are in addition to or differ from ISO 4032.**

(b) At its meeting in Varna, May 1977, ISO/TC2 studied several technical reports analyzing design considerations influencing determination of the best series of width across flats for hex bolts, screws, and nuts. A primary technical objective was to achieve a logical ratio between underhead (nut) bearing surface area (which determines the magnitude of the com-pressive stress on the bolted members) and the tensile stress area of the screw thread (which governs the clamping force that can be developed by tightening the fastener). M10 nuts with 15 mm width across flats are currently being produced and used in the United States and many other countries of the world. This size, however, is not an ISO standard. **When M10 nuts are ordered, nuts with 16 mm width across flats shall be furnished, unless 15 mm width across flats is specified.**

(c) Letter symbols designating dimensional characteristics are in accordance with those used in ISO standards, except where capitals have been used instead of lower case letters used in ISO standards.

3 REFERENCES

The following is a list of publications referenced in ths Standard. Unless otherwise specified, the reference standard(s) shall be the most recent issue at the time of order placement.

ASME B1.3M Screw Thread Gaging Systems for Dimensional Acceptability

ASME B1.13M Metric Screw Threads - M Profile

ASME B18.12 Glossary of Terms for Mechanical Fasteners

ASME B18.18.1M Inspection and Quality Assurance for General Purpose Fasteners

ASME B18.18.2M Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners

ASME B18.24.2 Part Identifying Number (PIN) Code System Standard for B18 Internally Threaded Products

ASME Y14.5M Dimensioning and Tolerancing

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900.

ASTM A563M Carbon and Alloy Steel Nuts [Metric]
ASTM F467M Nonferrous Nuts for General Use [Metric]
ASTM F812/F812M Surface Discontinuities of Nuts Inch and Metric Series
ASTM F836M Style 1 Stainless Steel Metric Nuts

Publisher: American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ISO 4032 Hexagon Nuts, Style 1 - Product Grades A and B

Publisher: International Organzation for Standardization (ISO) 1 rue de Varembé, Case Postale 56, CH-1211, Genève 20, Switzerland/Suisse.

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4 TERMINOLOGY

For definitions of terms relating to fasteners or component features thereof used in this Standard, refer to ASME B18.12.

5 DIMENSIONS

(a) Unless otherwise stated, all dimensions in this Standard are in millimeters, and apply before any coating. When plating or coating is specified, the finished product dimensions shall be as agreed upon between supplier and purchaser.

(b) Symbols specifying geometric characteristics are in accord with ASME Y14.5M.

6 WIDTH ACROSS FLATS

(a) The width across flats shall be the distance, measured perpendicular to the axis of the nut, between two opposite wrenching flats.

(b) The minimum width across flats does not apply for 25 percent of the minimum nut thickness as measured from either face.

(c) Maximum width across flats shall not be exceeded, except that for milled-from-bar nuts made of nonferrous materials, the specified maximum width across flats may be exceeded to conform with the commercial tolerances of cold finished bar stock material.

7 THICKNESS

The nut thickness shall be the overall distance, measured parallel to the axis of the nut, from the top of the nut to the bearing surface, and shall include the thickness of the washer face where provided, but shall exclude raised identification markings where they are permitted.

8 TOPS AND BEARING SURFACES

(a) M16 and smaller nuts shall be double chamfered. M20 and larger nuts, at the manufacturer's option, shall be either double chamfered or have a washer faced bearing surface and a chamfered top.

(b) The diameter of the bearing surface shall not exceed the width across flats nor be less than the bearing face diameter specified in Table 1. The measurement of bearing face diameter on washer faced nuts shall be taken at 0.1 mm above the bearing surface (see figure above Table 1.)

(c) The bearing surface within a diameter equal to 0.8 times the maximum width across flats shall be flat and perpendicular to the axis of the thread pitch diameter within the total runout limit specified in Table 1.

(d) The tops of washer faced nuts shall be flat and the diameter of the chamfer circle shall be equal to the maximum width across flats within a tolerance of minus 15 percent.

(e) The length of chamfer at hex corners shall be from 5 to 15 percent of the nominal thread diameter. The surface of the chamfer may be slightly convex or rounded.

9 CORNER FILL

A rounding or lack of fill at the junction of hex corners with the chamfer shall be permissible, provided that the width across corners is within specified limits at and beyond a distance equal to 17.5 percent of the nominal thread diameter from the chamfered face.

10 TRUE POSITION OF HEXAGON TO THE TAPPED HOLE

At maximum material condition (MMC), the axis of the hexagon shall be located at true position with respect to the axis of the thread pitch diameter within a tolerance zone having a diameter equivalent to 4 percent of the maximum width across flats.

11 COUNTERSINK

The tapped hole shall be countersunk on the bearing face(s). The countersink included reference angle shall be 90 deg to 120 deg. The maximum countersink diameter shall be 1.15 times the nominal thread diameter (major diameter) for nuts M4 and smaller, the nominal thread diameter plus 0.75 mm for nuts M5 through M8, and 1.08 times the nominal thread diameter for M10 and larger nuts. The minimum countersink diameter shall be the nominal thread diameter.

12 THREADS

12.1 Thread Series and Tolerance Class

Threads shall be metric threads with Class 6H tolerances in accordance with ASME B1.13M.

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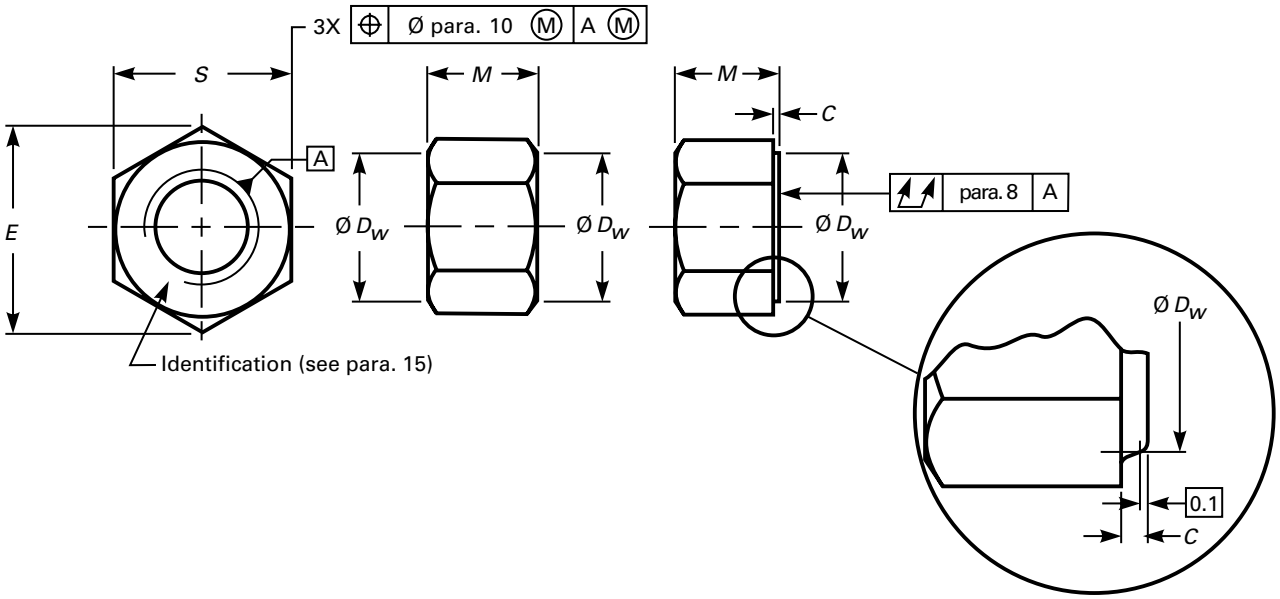

TABLE 1 DIMENSIONS OF HEX NUTS, STYLE 1

Nominal Nut Dia and Thread Pitch	*S* Width Across Flats [Note (1)]		*E* Width Across Coners [Note (2)]		*M* Thickness [Note (3)]		D_w Bearing Face Dia [Note (4)]	*C* Washer Face Thickness [Note (4)]		Total Runout of Bearing Surface FIM [Note (4)]
	Max	Min	Max	Min	Max	Min	Min	Max	Min	Max
M1.6 × 0.35	3.20	3.02	3.70	3.41	1.30	1.05	2.3	. . .	. . .	. . .
M2 × 0.4	4.00	3.82	4.62	4.32	1.60	1.35	3.1	. . .	. . .	. . .
M2.5 × 0.45	5.00	4.82	5.77	5.45	2.00	1.75	4.1	. . .	. . .	. . .
M3 × 0.5	5.50	5.32	6.35	6.01	2.40	2.15	4.6	. . .	. . .	. . .
M3.5 × 0.6	6.00	5.82	6.93	6.58	2.80	2.55	5.1	. . .	. . .	. . .
M4 × 0.7	7.00	6.78	8.08	7.66	3.20	2.90	6.0	. . .	. . .	. . .
M5 × 0.8	8.00	7.78	9.24	8.79	4.70	4.40	7.0	. . .	. . .	0.30
M6 × 1	10.00	9.78	11.55	11.05	5.20	4.90	8.9	. . .	. . .	0.33
M8 × 1.25	13.00	12.73	15.01	14.38	6.80	6.44	11.6	. . .	. . .	0.36
M10 × 1.5 [Note (5)]	**15.00**	**14.73**	**17.32**	**16.64**	**9.10**	**8.70**	**13.6**	. . .	. . .	**0.39**
M10 × 1.5 [Note (6)]	16.00	15.73	18.45	17.77	8.40	8.04	14.6	. . .	. . .	0.39
M12 × 1.75	18.00	17.73	20.78	20.03	10.80	10.37	16.6	. . .	. . .	0.42
M14 × 2	21.00	20.67	24.25	23.35	12.80	12.10	19.4	. . .	. . .	0.45
M16 × 2	24.00	23.67	27.71	26.75	14.80	14.10	22.4	. . .	. . .	0.48
M20 × 2.5	30.00	29.16	34.64	32.95	18.00	16.90	27.9	0.8	0.4	0.56
M24 × 3	36.00	35.00	41.57	39.55	21.50	20.20	32.5	0.8	0.4	0.64
M30 × 3.5	46.00	45.00	53.12	50.85	25.60	24.30	42.5	0.8	0.4	0.76
M36 × 4	55.00	53.80	63.51	60.79	31.00	29.40	50.8	0.8	0.4	0.89

NOTES:
(1) Refer to para. 6.
(2) Refer to para. 9.
(3) Refer to para. 7.
(4) Refer to para. 8.
(5) Refer to para. 2.
(6) Refer to para. 2(b). When M10 nuts are ordered, nuts with 16 mm width across flats shall be furnished unless 15 mm width across flats is specified.

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12.2 Thread Gaging

Thread acceptability shall be in accordance with ASME B1.3M System 21.

12.3 Overtapped Threads

Nuts intended for use with externally threaded fasteners, which are plated or coated with a plating or coating thickness (e.g., hot-dip galvanized) requiring overtapping of the nut thread to permit assemblability, shall have overtapped threads in conformance with requirements specified in ASTM A563M.

13 MATERIAL AND MECHANICAL PROPERTIES

13.1 Steel

Carbon steel nuts without specified heat treatment shall conform to the material and mechanical property requirements specified for Property Class 5 nuts in ASTM A563M. Carbon steel nuts with specified heat treatment shall conform to the material and mechanical property requirements specified for Property Class 10 nuts in ASTM A563M.

13.2 Corrosion-Resistant Steels

Corrosion-resistant stainless steel nuts shall conform to the requirements of ASTM F836M.

13.3 Nonferrous Metal

Nonferrous metal nuts shall conform to the requirements of ASTM F467M.

14 FINISH

Unless otherwise specified, nuts shall be furnished with a natural (as processed) finish, unplated or uncoated.

15 IDENTIFICATION SYMBOLS

Nuts for which no standard exists shall be marked as agreed between purchaser and manufacturer.

15.1 Carbon and Alloy Steel Nuts

Carbon and alloy steel nuts shall be marked to identify the property class and the manufacturer in accordance with requirements specified in ASTM A563M.

15.2 Stainless Steel Nuts

Stainless steel nuts shall be marked to identify the property class and manufacturer in accordance with the requirements specified in ASTM F836M.

15.3 Nonferrous Nuts

Nonferrous nuts shall be marked to identify the property class and manufacturer in accordance with the requirements specified in ASTM F467M.

16 INSPECTION AND QUALITY ASSURANCE

Unless otherwise specified by the purchaser in the original inquiry and purchase order, acceptability of nuts shall be determined in accordance with ASME B18.18.1M.

17 DIMENSIONAL CONFORMANCE

(a) Unless otherwise specified, the following designated characteristics defined within the notes of each product table shall be inspected in accordance with ASME B18.18.2M and shall be within their specified limits.

Characteristic	Inspection Level
Width Across Corners	C
Thickness	C
Thread Acceptability	C

If verifiable in-process inspection is used, inspection sample sizes and reporting shall be in accordance with the applicable ASME, ASTM, or SAE quality system consensus standard.

(b) For nondesignated characteristics, the provisions of ASME B18.18.1M shall apply. Should a nondesignated dimension be determined to be outside its specified limits, it shall be deemed conforming to this Standard if the user, who is the installer, accepts the dimension based on fit, form, and function considerations.

18 DESIGNATION

(a) Hex nuts, Style 1, shall be designated by the following data, preferably in the sequence shown: product name and designation of the standard, nominal diameter and thread pitch, 15 mm width across flats for size M10 if applicable (see para. 2.2), steel property class or material identification, and protective coating if required.

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NOTE: It is common practice in ISO standards to omit thread pitch from the product designation when screw threads are the metric coarse thread series, e.g., M10 is M10 x 1.5.

EXAMPLES:

Hex nut, Style 1, ASME B18.2.4.1M, M10 x 1.5, with 15 mm WAF, ASTM A563M Class 10, zinc plated per ASTM F871M and ASTM B633 Fe/Zn5 Type II.

Hex nut, Style 1, ASME B18.2.4.1M, M20 x 2.5, silicon bronze, ASTM F467M Grade 651.

(b) The recommended B18 part identifying number (PIN) code system for metric hex nuts, Style 1, is included in ASME B18.24.2. This system may be used by any user needing a definitive part numbering system.

19 OPTIONS

Options, where specified, shall be at the discretion of the manufacturer unless otherwise agreed between manufacturer and purchaser.

20 WORKMANSHIP

Nuts shall be free of surface irregularities that might affect their serviceability, such as burrs, seams, laps, loose scale, and other irregularities. When control of surface discontinuities is important for the application intended, ASTM F812/F812M should be specified.

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AMERICAN NATIONAL STANDARDS FOR BOLTS, NUTS, RIVETS, SCREWS WASHERS, AND SIMILAR FASTENERS

Small Solid Rivets . . . . . B18.1.1-1972(R1995)
Large Rivets . . . . . B18.1.2-1972(R1995)
Metric Small Solid Rivets . . . . . B18.1.3M-1983(R1995)
Square and Hex Bolts and Screws (Inch Series) B18.2.1-1996
Square and Hex Nuts (Inch Series) . . . . . B18.2.2-1987(R1999)
Metric Hex Cap Screws B18.2.3.1M-1999
Metric Formed Hex Screws . . . . . B18.2.3.2M-1979(R1995)
Metric Heavy Hex Screws . . . . . B18.2.3.3M-1979(R1995)
Metric Hex Flange Screws . . . . . B18.2.3.4M-1984(R1995)
Metric Hex Bolts . . . . . B18.2.3.5M-1979(R1995)
Metric Heavy Hex Bolts . . . . . B18.2.3.6M-1979(R1995)
Metric Heavy Hex Structural Bolts . . . . . B18.2.3.7M-1979(R1995)
Metric Hex Lag Screws . . . . . B18.2.3.8M-1981(R1999)
Metric Heavy Hex Flange Screws B18.2.3.9M-2001
Square Head Bolts (Metric Series) B18.2.3.10M-1996
Metric Hex Nuts, Style 1 . . . . . B18.2.4.1M-2002
Metric Hex Nuts, Style 2 . . . . . B18.2.4.2M-1979(R1995)
Metric Slotted Hex Nuts . . . . . B18.2.4.3M-1979(R1995)
Metric Hex Flange Nuts . . . . . B18.2.4.4M-1982(R1999)
Metric Hex Jam Nuts . . . . . B18.2.4.5M-1979(R1998)
Metric Heavy Hex Nuts . . . . . B18.2.4.6M-1979(R1998)
Fasteners for Use in Structural Applications B18.2.6-1996
Clearance Holes for Bolt Screws and Studs B18.2.8-1999
Socket Cap, Shoulder, and Set Screws, Hex and Spline Keys (Inch Series) B18.3-1998
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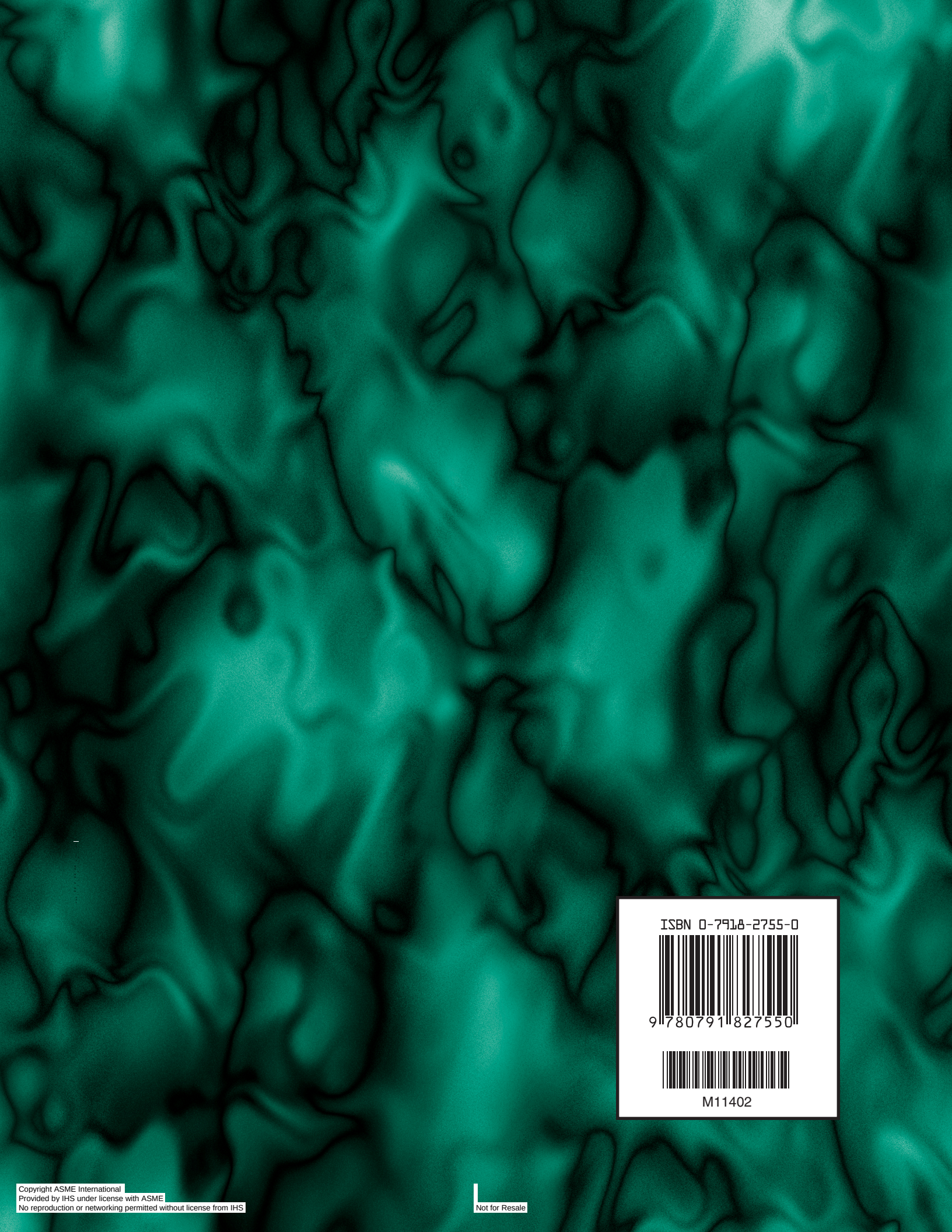
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