Incorporating Standards into Capstone Design Courses

Standards and Conformity Assessment in Design

The value of incorporating standards into engineering education programs based on the role of standards in product design

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Objective

To highlight the value of standards in collegiate education and capstone design. Standards can be utilized to:

- Augment the learning experience
- Increase student knowledge of available design and marketing tools and practices
- Facilitate the classroom-to-workplace transition
- Provide experience in aligning real-world applications and market issues.

OVERALL

A heightened focus on standards (their development, content and application, the benefits of their use, and their market application) will position students and curricula more competitively.

Concerns

Concerns surrounding a lack of standards use in the classroom

- Inability to appropriately select and apply standards without basic knowledge
- Loss of time and direction "reinventing" what may already be standardized.
- Missed opportunity to apply standards to engineering design, product development, marketing, and acceptance.
- Failure to strategically approach and apply standards by US-based industries.

Session Outline

- Augment the learning experience with standards in the classroom
  - *As a basis for design and evaluation*
  - *Incorporated into the laboratory exercises*
- Enhance the curriculum by demonstrating the classroom-to-workplace transition
  - *As a foundation for understanding market issues, design approvals, and promotion*
- Basic, Strategic Standards Issues
  - *NTTAA*
  - *US National Standards Strategy*
- ASTM International efforts for Standards Education
  - *Student Membership, committee-sponsored events, press releases*

Standards in the Classroom for Design and Evaluation

1.11 GRADES OF REINFORCING STEEL

Reinforcing bars may consist of billet steel, axle steel, or rail steel. Most bars are made from new or billet steel, but very occasionally they are rolled from old train rails or locomotive axles. These latter steels, having been cold-worked for many years, are not as ductile as the new billet steels.

There are several types of reinforcing bars designated by the ASTM, which are listed at the end of this paragraph. In this listing, Grade 40 means the steel has a specified yield point of 40,000 psi; Grade 50 means 50,000 psi; and so on.

1. ASTM A615, billet steel, Grades 40 and 60.
2. ASTM A615, billet steel, Grade 75 for #11, #14, and #18 bars.
3. ASTM A616, rail steel, Gr
4. ASTM A617, axle steel, G
5. ASTM A706, low-alloy ste

Designers in almost all part
encounter rail or axle steel bars (
such limited areas of the country.
reinforcing bars listed by the Con
manufacture rail steel bars and o

Almost all reinforcing bars c
all of the material used to make t
steel as from old car bodies. Bars
tended for certain uses when welc
tance. Bars conforming to this sp
local suppliers.

Designation: A 615/A 615M – 04a

American Association State Highway and Transportation Officials Standard
AASHTO No.: M 31

Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement[1]

This standard is issued under the fixed designation A 615/A 615M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

A 615/A 615M – 04a

1. Scop

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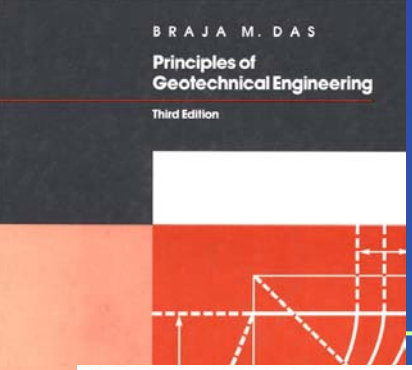
TABLE 1 Deformed Bar Designation Numbers, Nominal Weights [Masses], Nominal Dimensions, and Deformation Requirements

Bar Designation No.[A]	Nominal Weight, lb/ft [Nominal Mass, kg/m]	Nominal Dimensions[B]			Deformation Requirements, in. [mm]		
		Diameter, in. [mm]	Cross-Sectional Area, in.^{2} [mm^2]	Perimeter, in. [mm]	Maximum Average Spacing	Minimum Average Height	Maximum Gap (Chord of 12.5 % of Nominal Perimeter)
3 [10]	0.376 [0.560]	0.375 [9.5]	0.11 [71]	1.178 [29.9]	0.262 [6.7]	0.015 [0.38]	0.143 [3.6]
4 [13]	0.668 [0.994]	0.500 [12.7]	0.20 [129]	1.571 [39.9]	0.350 [8.9]	0.020 [0.51]	0.191 [4.9]
5 [16]	1.043 [1.552]	0.625 [15.9]	0.31 [199]	1.963 [49.9]	0.437 [11.1]	0.028 [0.71]	0.239 [6.1]
6 [19]	1.502 [2.235]	0.750 [19.1]	0.44 [284]	2.356 [59.8]	0.525 [13.3]	0.038 [0.97]	0.286 [7.3]
7 [22]	2.044 [3.042]	0.875 [22.2]	0.60 [387]	2.749 [69.8]	0.612 [15.5]	0.044 [1.12]	0.334 [8.5]
8 [25]	2.670 [3.973]	1.000 [25.4]	0.79 [510]	3.142 [79.8]	0.700 [17.8]	0.050 [1.27]	0.383 [9.7]
9 [29]	3.400 [5.060]	1.128 [28.7]	1.00 [645]	3.544 [90.0]	0.790 [20.1]	0.056 [1.42]	0.431 [10.9]
10 [32]	4.303 [6.404]	1.270 [32.3]	1.27 [819]	3.990 [101.3]	0.889 [22.6]	0.064 [1.63]	0.487 [12.4]
11 [36]	5.313 [7.907]	1.410 [35.8]	1.56 [1006]	4.430 [112.5]	0.987 [25.1]	0.071 [1.80]	0.540 [13.7]



Standards in the Classroom for Laboratory Exercises

Description		ASTM D-698; AASHTO T-99 Method A	Method B	Method C	Method D	ASTM D-1557; AASHTO T-180 Method A	Method B	Method C	Method D
Mold: Volume	ft^3 cm^3	1/30 943.9	1/13.33 2124.3	1/30 943.9	1/13.33 2124.3	1/30 943.9	1/13.33 2124.3	1/30 943.9	1/13.33 2124.3
Height	in. mm	4.58 116.33	4.58 116.33	4.58 116.33	4.58 116.33	4.58 116.33	4.58 116.33	4.58 116.33	4.58 116.33
Diameter	in. mm	4 101.6	6 152.4	4 101.6	6 152.4	4 101.6	6 152.4	4 101.6	6 152.4
Weight (mass) of hammer	lb kg	5.5 2.5							
Height of drop of hammer	in. mm	12 304.8							
Number of layers of soil		3							
Number of blows per layers		25							
Tested on soil fraction passing sieve		No. 4							

Designation: D 698 – 00a$^{\epsilon 1}$

Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3(600 kN-m/m^3))^1

This standard is issued under the fixed designation D 698; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ϵ^1 NOTE—Paragraph 10.4.3 was corrected editorially in November 2003.

1. Scope*

1.1 These test methods covers laboratory compaction methods used to determine the relationship between water content and dry unit weight of soils (compaction curve) compacted in a 4 or 6-in. (101.6 or 152.4-mm) diameter mold with a 5.5-lbf (24.4-N) rammer dropped from a height of 12 in. (305 mm) producing a compactive effort of 12,400 ft-lbf/ft^3(600 kN-m/m^3).

1.3.1.4 *Blows per layer*—25.

1.3.1.5 *Use*—May be used if 20 % or less by mass of the material is retained on the No. 4 (4.75-mm) sieve.

1.3.1.6 *Other Use*—If this method is not specified, materials that meet these gradation requirements may be tested using Methods B or C.

1.3.2 *Method B*:

1.3.2.1 *Mold*—4-in. (101.6-mm) diameter.

1.3.2.2 *Material*—Passing ⅜-in. (9.5-mm) sieve.

Standards in the Classroom for Laboratory Exercises

United States Environmental Protection Agency | Office of Research and Development Washington DC 20460 | EPA/600/R-92/128 July 1992

EPA

Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies

The American Society for Testing and Materials (ASTM) has developed a number of methods that have direct application to soil sampling. These methods often need to be modified slightly to meet the needs of the environmental scientist that requires samples for chemical analyses since the ASTM methods are designed primarily for engineering tests. The techniques that are utilized should be closely coordinated with the laboratory in order to meet the specific requirements of the analytical methods used.

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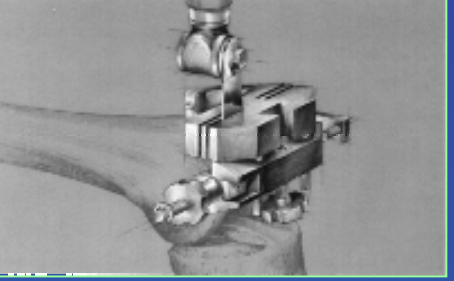


From Classroom to Workplace
Market Issues & Design Approvals

GUIDANCE FOR THE PREPARATION OF PREMARKET NOTIFICATIONS (510(k)s) FOR CEMENTED, SEMI-CONSTRAINED TOTAL KNEE PROSTHESES

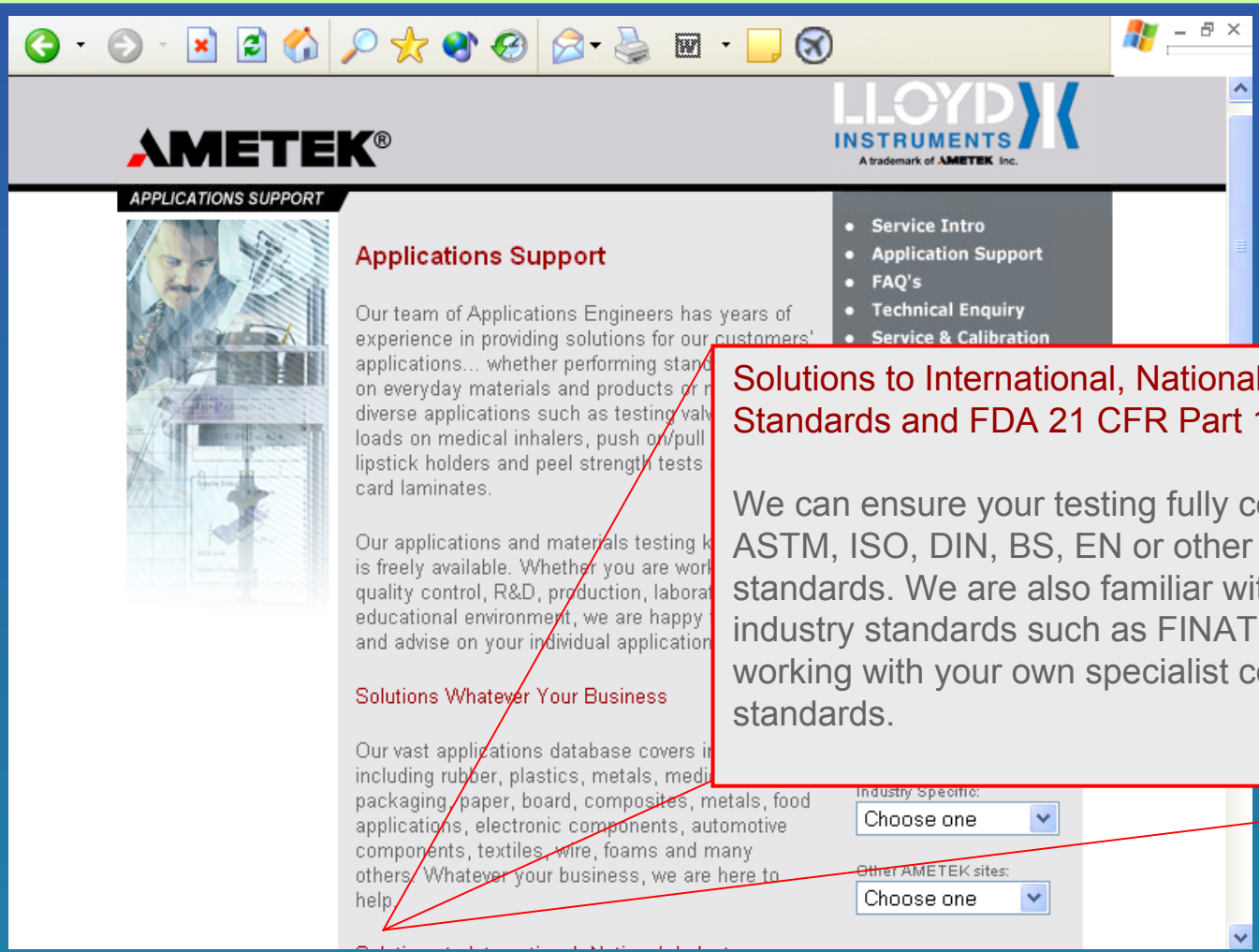
H. Materials

Provide the voluntary standards to which the materials used in each component of the device conform. Most of the materials used in legally marketed or predicate knee prostheses conform to an American Society for Testing and Materials (ASTM) … standard for implant usage. If not, then data must be provided demonstrating the material's biocompatability. In addition, information about the processes and effects of any additional manufacturing techniques…must be provided.

Range of Motion and Constraint Data on the expected range of motion for the device should include all modes of rotation …

ASTM Standard F-1223 provides a standard test method for evaluating constraint… it may be used for comparison purposes to commercially available total knee prostheses. Alternatively, constraint may be measured using a worst case analysis of the anterior, posterior, medial, lateral and rotational tibiofemoral shearing forces…

From Classroom to Workplace
Marketing & Promotion



Strategic Educational Point NTTAA / P.L. 104 – 113

- …Federal agencies and departments shall use technical standards that are developed or adopted by voluntary consensus standards bodies, using such technical standards as a means to carry out policy objectives or activities determined by the agencies and departments.

- …Federal agencies and departments shall consult [and "participate"] with voluntary, private sector, consensus standards bodies…

Strategic Educational Point US National Standards Strategy

- Education needed regarding regional trade disadvantages
  - The European Union is aggressively and successfully promoting its technology and practices to other nations around the world through its own standards processes and through its national representation in the international standards activities ….
  - The exclusion of technology supporting U.S. needs from international standards can be a significant detriment to U.S. competitiveness. The U.S. will lose market share as competitors work hard to shape standards to support their own technologies and methods.

- Educational component in US National Standards Strategy

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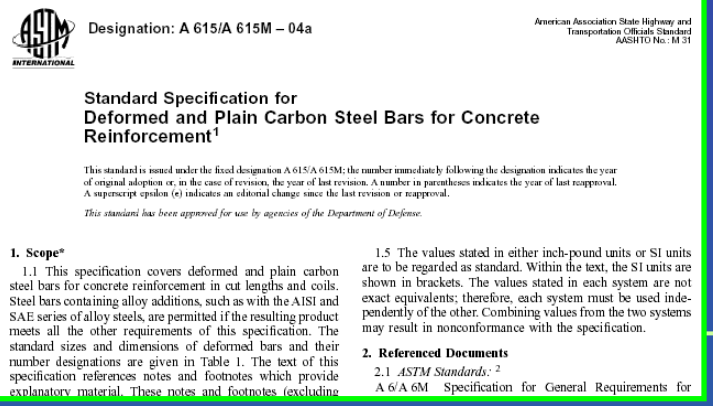
ASTM International on Standards Education

- Educational programs
  - By committee (student paper competitions, scholarships/grants)
  - Society Wide: Student Membership
- *Standardization News* (SN) articles
  - Publicity regarding standards in education
  - Awareness to members, users, and general public
- Student membership
  - Easy and inexpensive access
  - Opportunities and incentives to continue after graduation; grow the next generation of participants and users



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This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers deformed and plain carbon steel bars for concrete reinforcement in cut lengths and coils. Steel bars containing alloy additions, such as with the AISI and SAE series of alloy steels, are permitted if the resulting product meets all the other requirements of this specification. The standard sizes and dimensions of deformed bars and their number designations are given in Table 1. The text of this specification references notes and footnotes which provide explanatory material. These notes and footnotes (excluding

1.5 The values stated in either inch-pound units or SI units are to be regarded as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 6/A 6M Specification for General Requirements for

Conclusions

- The business environment needs a workforce that is prepared to understand and apply standards
- Greater exposure to standardization enables students to be competitively positioned and to provide added value to the workplace
- Standards education strengthen a curriculum's market relevance by marrying technical design to real market issues
- Opportunities exist for incorporating standards into curricula

Thoughts on Conclusions

- Stronger effort needed to incorporate standards into curriculums
  - Capstone projects provide an optimal insertion point
  - Students will be prepared for the technical and market issues surrounding standards in a dynamic, global marketplace
  - Position US-based collegiate curriculums more competitively
  - Not limited to engineering or science based curricula
  - Continued cooperation among SDO's to provide extracurricular activities
- Coordinated effort to develop pre-packaged modules for educational use

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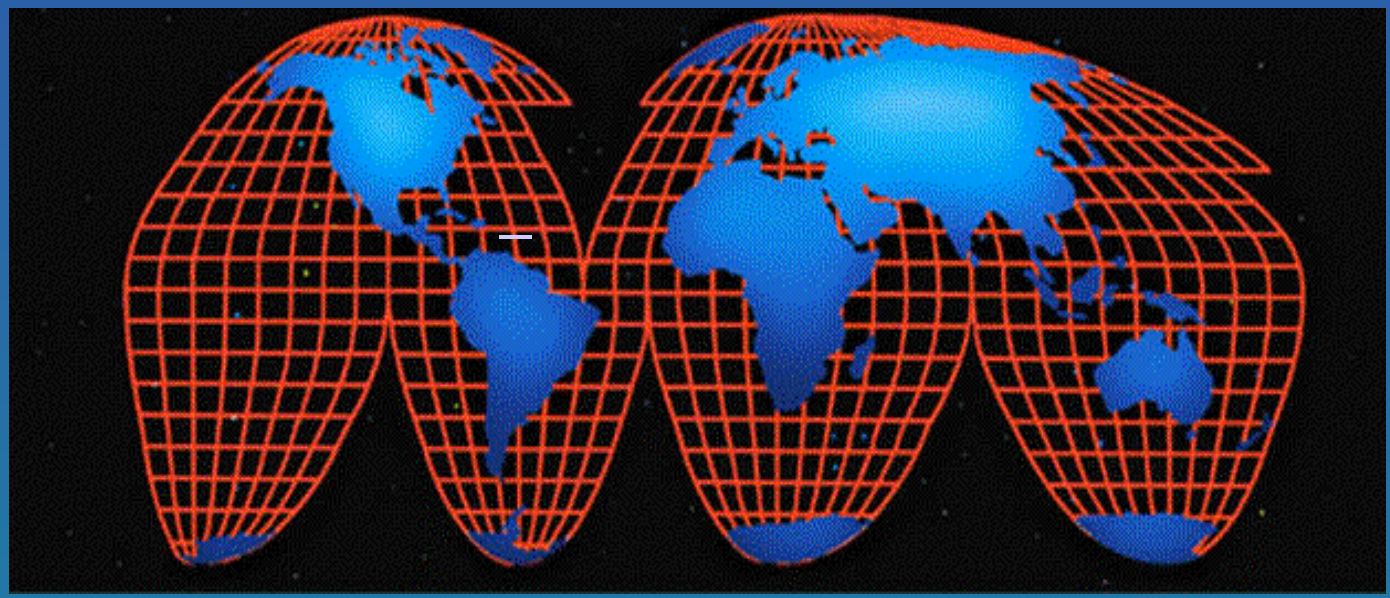
Thank you

Questions?



ASTM International

Standards Worldwide

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