

# Introduction to Engineering Standards in Capstone Design

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William E. Kelly  
Chairman, ANSI Committee on Education  
Department of Civil Engineering  
The Catholic University of America  
Washington, DC 20064

[kellyw@cua.edu](mailto:kellyw@cua.edu)



## Robert Pool in *Beyond Engineering: How Society Shapes Technology*

“Of all the mistakes the U.S. nuclear industry made in the 1960’s and 1970’s, the single most damaging was the failure to settle on one or a few standard designs for nuclear plants. Standardization maximizes learning. It allows people to learn from others’ experience as well as from their own. But the utilities never saw the need for it.”



# Outline

- ABET Criteria – minor changes for 2005-2006
- Engineering standards
- Including “constraints” in design
- Assessment opportunities
- Opportunities to enhance general education
- Summary



# ABET Criterion 4 (2005-2006)

- Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.



# What are Engineering Standards?

- Codes
- Standards
  - Specifications
  - Test methods
- Technical regulations
- Conformity assessment
- Management systems standards



# Criterion 3 ( c )

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as

- economic
- environmental
- social
- political
- ethical
- health and safety
- manufacturability
- sustainability



# Health and Safety

- Technical regulations (mandatory standards) that apply
- Building code considerations
- Environmental management systems ISO
- Occupational Safety and Health Administration (OSHA)
- Food and Drug Administration (FDA)
- Consumer Product Safety Commission (CPSC)
- Nuclear Regulatory Commission (NRC)



# Environmental

- ASTM International's testing procedures
- State regulations
- Federal regulations
- International conventions or guidance
- Reporting schemes
- ISO 14000





# Conformity Assessment

- Conformity assessment issues may also have to be addressed
  - Will the product have to be listed or certified? (For example, UL)
  - Is the product a systems component and will it have to meet specifications?
  - How is compliance determined?



# Capstone Courses and Outcomes Assessment

- Capstone courses can be a good place to focus assessment activities
  - Some of the constraints provide good summative assessment opportunities
  - They can also provide good opportunities to relate the technical and general education components of the curriculum
  - Standards could provide one unifying theme in technical education.



# More from ABET Criterion 3

- Engineering programs must demonstrate that their graduates have:
  - (f) an understanding of professional and ethical responsibility
  - (g) an ability to communicate effectively
  - (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
  - (i) a recognition of the need for, and an ability to engage in life-long learning
  - (j) a knowledge of contemporary issues

Underlined new for 2005-2006



# Standards Assessment Opportunities

- Complete ANSI's online courses at [www.StandardsLearn.org](http://www.StandardsLearn.org)
  - Introduction to standards
  - National standards systems
  - International standards system (*coming soon*)
  - An online certificate is awarded - (i) life-long learning



# Standards Assessment Opportunities

- Present short report on standards and codes applying to project – (g) communications
- Research potential international barriers to a product e.g. EU regulations on waste reduction and recycling related to electronic products (h) understand the impact of engineering solutions in a global, economic, environmental, and societal context
- Review proposed standards on social responsibility and there potential effects on industry practices - ethics (f), contemporary issues (j)



# ASME Online Standards Course

The screenshot shows the ASME Online Standards Course website. At the top, there is a navigation bar with links for HOME, SEARCH, JOIN, SHOP, and HELP. Below this is a secondary navigation bar with links for PPC Home, How it Works, Module Listing, For Faculty, Contributors, Feedback, and Contact Us. The main content area is titled 'Codes & Standards' and includes a sub-menu with 'Introduction', 'Resources', 'Quiz', 'Faculty', and 'Glossary'. On the left side, there is a sidebar with a 'back to menu' link and a list of course modules: Introduction, Codes vs. Standards, Codes and Standards Today, ASME's Role in Codes and Standards, Conformity Assessment, Global Issues in Standards Development, Requirements of Standards, and Conclusion. The main content area features an 'Introduction' section with three paragraphs of text. The first paragraph describes a fire in Baltimore in 1904. The second paragraph discusses ASME's history with standards starting in the 1880s. The third paragraph mentions the 1915 Boiler and Pressure Vessel Code. To the right of the main content is a blue box titled 'Educational Goals:' containing a list of seven bullet points.

ASME

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- 1 Codes vs. Standards
- 2 Codes and Standards Today
- 3 ASME's Role in Codes and Standards
- 4 Conformity Assessment
- 5 Global Issues in Standards Development
- 6 Requirements of Standards
- 7 Conclusion

**Codes & Standards**

Resources Quiz Faculty Glossary

**Introduction**

In 1904, more than 1,500 Baltimore buildings were destroyed in a fire that burned for 30 hours. Fire companies from as far away as New York came to help, but many of them were useless because their hose couplings did not fit the Baltimore hydrants, and differed from each other's. It was just one of many events that made clear the need for codes and standards.

ASME turned its attention to standards in the early 1880s. In 1883, it formed a committee on standards and gauges, and in 1884 the organization published its first uniform test code on boiler tests. Soon after, the organization decided that pipes and pipe threads should also be standardized.

It was not until 1915, however, that ASME first published its Boiler and Pressure Vessel Code, which was written to address the problem of exploding boilers. This code has become law in 49 U.S. states, in Canada and in 60 other countries throughout the world. Since its development, boiler disasters have been reduced to almost zero ([see Figure 1](#)).

**Educational Goals:**

- Understand the difference between codes and standards, and the difference between performance and design standards
- Understand the importance of codes and standards in engineering
- Be familiar with the standards development process, and ASME's role in it
- Know the six steps of conformity assessment
- Be familiar with standards organizations such as ANSI, ISO and IEC
- Know the difference between the U.S. approach to standards and the approach of most other nations
- Understand the challenges facing the U.S. as it



# Opportunities to Enhance General Education

- For some of the constraints students need to address in design, the requisite knowledge and background to discuss them could (must?) come from non-engineering courses or special engineering courses designed to supplement general education.
- There is a an opportunity to assess students general education and how it complements the technical education.
- This feedback can be used to modify/improve the general education component



# Project Examples

- ANSI is considering developing some examples to demonstrate the use of standards in a simple setting.
  - One that is being considered is design of a playground







# Playground Design

**ASTM standard  
F-1487-95,  
*Safety Performance  
Specifications for  
Playground  
Equipment for  
Public Use***

**EPA's  
Recommended  
Recovered Materials  
*Content Levels for  
Playground  
Equipment***

**U.S. Consumer  
Product Safety  
Commission (CPSC)  
Publication No. 325  
Handbook for Public  
Playground Safety**

**Building Permit?**

**Accessibility?**



# Summary

- Criterion 4 requires incorporation of engineering standards — workshop will attempt to show you “how to”.
- Criterion 3 & 4 “constraints” have standards aspects discussion of which from an engineering perspective can contribute to and complement students’ general education.

