

Engineering Standards What They are, Where & Why They're Used

Dr. Hodge Jenkins

Some Definitions:

Standard: A standard is a document that defines the characteristics of a product, process or service, such as dimensions, safety aspects, and performance requirements.

Code: Laws or regulations that specify minimum standards to protect public safety and health such as codes for construction of buildings. Voluntary standards are incorporated into building codes

Specification: A set of conditions and requirements of precise and limited application that provide a detailed description of a procedure, process, material, product, or service for use primarily in procurement and manufacturing. Standards may be referenced or included in specifications.

Technical Regulation: A mandatory government requirement that defines the characteristics and/or the performance requirements of a product, service or process (see also Regulation).

Why Standards and Codes?

- **Standardization**

- Parts from different vendors fit together
- Common design specs
- Consistent quality
- e.g., Pipe wall thickness, schedule 40
- Wire sizes, nail sizes, bolt sizes

- **Safety & Legal Enforcement of Safety**

- Building safety, fire prevention/protection
- Individual & Public Safety
- e.g., Safe drinking water, safe nuclear plants

Standards needed for function

- **Functional Based**

- 110V /60Hz or 220V/50Hz
- Piping (Schedule 40, 50, ...)

- **Professional Society Based**

- ANSI & ASME (Boiler & Pressure Vessel Code)
- IEEE communication standards

Parts Standardization

- Every mass produced product usually has a standard
- IEEE has many, many standards for electronics
- DIN, ISO, ANSI for size, shapes, etc.
- US ANSI pipe standards
 - Diameters
 - Thickness
 - Materials
 - Flange bolt patterns

It's the law

- Legal Requirements US & Internationally
 - UL listed, CSA
 - ANSI, JIS, ISO, DIN
- EPA, USNRC
 - Code of Federal Regulations (CFR)
- Building codes, National Electrical Code, etc.

Some Background:

- The U.S. federal government is the largest single creator & user of standards: more than 45,000 (by current estimates)!
- About 210 organizations are designated Standard Development Organizations (SDO's)
- Most Standards (about 90%) come from about 20 of these SDO's
- ASTM, ASME, IEEE, AISI (ASM), ASCE, MilStd (Mil Specs), are some of the most important SDO's



Who makes Standards and Codes ?

- AIA Aerospace Industries Association of America
- AAI Aluminum Association, Inc
- AASHTO American Association of State Highway and Transportation Officials
- ACI American Concrete Institute
- AISC American Institute of Steel Construction
- AISI American Iron and Steel Institute
- ANSI American National Standards Institute
- ASCE American Society of Civil Engineers
- ASME American Society of Mechanical Engineers
- ASTM American Society for Testing and Materials
- AISE Association of Iron and Steel Engineers
- BOCA Building Officials and Code Administrators
- FAA Federal Aviation Administration
- ISO International Organization for Standardization
- MIL SPEC United States Military
- NIST National Institute of Standards and Technology
- OSHA Occupational Safety and Health Administration
- SAE Society of Automotive Engineers
-Professional Societies and Government

Taking them Global!

- **ANSI** and (U.S. National Committee (**USNC**)) are the U.S. clearing house for Standards and a founding member of **ISO**!
- Internationally there are Standards Organizations in every major Industrial Nation and several Umbrella Groups:
 - International Organization for Standardization (ISO)
 - International Electrotechnical Commission (IEC)
 - International Telecommunication Union (ITU)



How they're used:

- Standards are a “**COMMUNICATION**” tool that allows all users to speak the same language about products or processes
- They provide a “**Legal**,” or at least enforceable, means to evaluate acceptability & sale-ability of products and/or services
- They can be taught and applied globally!
- They, ultimately, are **designed to protect the public** from questionable designs, products and practices
- Thus they fall (in engineering terms) into the “MOM AND APPLE PIE” area of our profession!
- They teach us, as engineers, **how we can best meet environmental, health, safety and societal responsibilities**



How did standards develop?

- **Selection from competing technologies**

- Westinghouse AC power, Edison DC power
- Communications standards
- Military requirements (Civil War)

- **Failures**

- ASME Boiler & PV Code (Boston Molasses Disaster, aka the Great Molasses Flood of 1919)
- Building fire codes
- Tacoma Narrow Bridge failure
- World Trade Center bombing
- ...

Common, Everyday Standards

- Fasteners (#10-24 UNC bolt, M8 bolt)
- Plumbing sizes (Sch. 30, 40,..)
- Lumber sizes (2x4...not the real dimensions)
- Electrical Wire sizes (12, 14, 16 Gauge)
- Electrical service 110 VAC, 60 Hz
- Air pollution controls: Car Inspections
- Building Codes

Standards I have used professionally

- Westinghouse Nuclear
 - ASME B&PV Code
 - US CFR & TR Laws
- USPS R&D
 - ANSI
 - Drafting standards
 - Component specs
- Fisher Scientific
 - UL & CSA
 - Appliance design: ovens, centrifuges
- Molytek, Inc., Lucent
 - ISO, DIN, JIS
 - Process & Product

The **National Institute of Standards and Technology (NIST)**, an agency of the U.S. Department of Commerce, conducted a three-year building and fire safety investigation to study the factors contributing to the collapse of the WTC Towers.

September 11, 2001, was not the first time that tragedy helped to identify the need for standards. More than a century ago, a great fire ravaged Baltimore, Maryland, for more than 30 hours in early 1904.

The fire was reported first at the John Hurst and Company building at 10:48 a.m. on Sunday morning, February 7, and quickly spread. By 1:30 p.m., units from surrounding communities were arriving. To halt the fire, officials tried to use a firewall, then dynamited buildings around the existing fire. These tactics, however, were unsuccessful and the fire continued until late afternoon on Mon., February 8. More than 1,231 firefighters were required to bring the blaze under control. One reason for the fire's duration was the lack of national standards in fire-fighting equipment. Although fire engines from Wilmington and Washington, DC, and cities as far away as Philadelphia, Atlantic City, and New York City responded, many were useless because their hose couplings failed to fit Baltimore hydrants. As a result, the fire burned over 30 hours, destroying 1,526 buildings spanning 70 city blocks.

The **National Fire Protection Association**, which had been established in 1896 after a number of disastrous large-scale fires, then set about to develop uniform sprinkler systems and standard hose couplings.



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Standards Developing Organizations

AA - Aluminum Association
AAMI – Association for the Advancement of Medical Instrumentation
AASHTO - American Association of State Highway and Transportation Officials
AATCC - American Assoc of Textile Chemists and Colorists
ABMA - American Bearing Manufacturers Association
ABS - American Bureau of Shipping
ACI - American Concrete Institute
ADA - Americans with Disabilities Act
AEC - AEC Construction Standards
AECMA - European Association of Aerospace Industries
AGA - American Gas Association
AGMA - American Gear Manufacturers Association
AIA-NAS - Aerospace Industries Association/National Aerospace Standards
AIAA - American Institute of Aeronautics and Astronautics
AIIM - Association for Information and Image Management
AMT - The Association For Manufacturing Technology
ANS - American Nuclear Society
ANSI - American National Standards Institute
API - American Petroleum Institute
ARINC - Aeronautical Radio, Inc
ARMY - Army Regulations and Pamphlets
ASABE - American Society of Agricultural and Biological Engineers
ASHRAE - American Society of Heating, Refrigerating, and Air-conditioning Engineers
ASME - American Society of Mechanical Engineers
ASQ - American Society for Quality

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ANSI

American National Standards Institute: An Introduction!

Go
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More than 10,000 National
Standards in the USA alone

Open Standards
(process of developing)

Throughout its history, ANSI has maintained as its primary goal the enhancement of global competitiveness of U.S. business and the American quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems and promoting their integrity. The Institute represents the interests of its nearly 1,000 company, organization, government agency, institutional and international members through its office in New York City, and its headquarters in Washington, D.C.

National Standardization

ANSI facilitates the development of American National Standards (ANS) by accrediting the procedures of standards developing organizations (SDOs). These groups work cooperatively to develop voluntary national consensus standards. Accreditation by ANSI signifies that the procedures used by the standards body in connection with the development of American National Standards meet the Institute's essential requirements for openness, balance, consensus and due process.

ANSI is often asked about the total number of standards (and standards setting bodies) in the United States. It is estimated that in the U.S. today there are hundreds of "traditional" standards developing organizations - with the 20 largest SDOs producing 90% of the standards - and hundreds more "non-traditional" standards development bodies, such as consortia. This means that the level of U.S. participation is quite expansive as the groups themselves are comprised of individual committees made up of experts addressing the technical requirements of standards within their specific area of expertise.

At year-end 2006, about 200 of these standards developers were accredited by ANSI; there were more than 10,000 American National Standards (ANS).

In order to maintain ANSI accreditation, standards developers are required to consistently adhere to a set of requirements or procedures known as the *"ANSI Essential Requirements,"* that govern the consensus development process. Due process is the key to ensuring that ANS are developed in an environment that is equitable, accessible and responsive to the requirements of various stakeholders. The open and fair ANS process ensures that all interested and affected parties have an opportunity to participate in a standard's development. It also serves and protects the public interest since standards developers accredited by ANSI must meet the Institute's requirements for openness, balance, consensus and other due process safeguards.

That is why American National Standards are usually referred to as "open" standards. In this sense, "open" refers to a process used by a recognized body for developing and approving a standard. The Institute's definition of openness has many elements, but basically refers to a collaborative, balanced and consensus-based approval process. The content of these standards may relate to products, processes, services, systems or personnel.

Learning About Them

Why Standards Matter

ANSI's first introductory level e-learning course is for those who may not be familiar with standards, ANSI or the U.S. voluntary standards and conformity assessment systems.

- **U.S. Standards – Today and Tomorrow**

This course focuses on the U.S. national standards systems and is an intermediate-level course that supplements basic standards education. It provides more in-depth knowledge about the development, role and impact of domestic standards on government, business, trade and professional associations, and includes a module for university faculty and students. The courses on this website complement ANSI's instructor-led education and training courses.

The Impact of Standards on Business and Industry

- **Roughly 80% of global merchandise trade is affected by standards and by regulations that embody standards**
- Standards and conformity assessment programs **play a key role in the transfer of technology**, from the research and development stage, to production, and ultimately to a product's success in the marketplace.
- Strategic utilization of these Standards can simplify product development, reduce unnecessary duplication, lower costs, increase productivity, ensure safety, permit interchangeability, compatibility, and interoperability, enhance the acceptance of new products, maintain uniformity in product quality and much more.
- Industry participation in the standards development process is essential

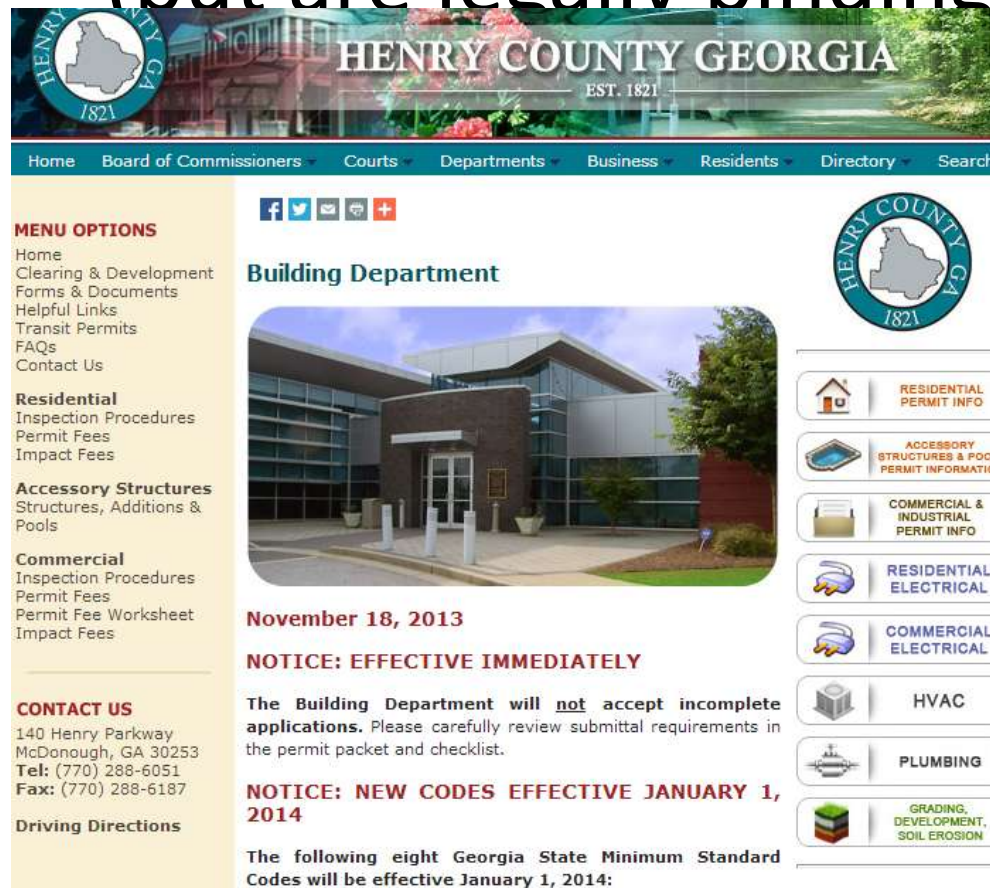


Standards in the news:

- **ISO 9000** – a quality standard used by business to say “We are QUALITY” (in US this has evolved into Q9001 as ‘nationalized’ by AQS)
- **UL** rating – used as an “international” safety rating (hence Standard)
- **ISO 14000** – the international Environmental Management Guideline (standard) – and hence the ‘de-facto’ product life cycle and sustainability standard for business, industry, and Engineering Design
- **ANSI/ASME Y14.1 and Y14.5** – international drafting standards for engineering drawings
- Even Clothes sizes are controlled by International Standards!



Building Codes are like Standards too (but are legally binding) :



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Building Department

November 18, 2013

NOTICE: EFFECTIVE IMMEDIATELY

The Building Department will not accept incomplete applications. Please carefully review submittal requirements in the permit packet and checklist.

NOTICE: NEW CODES EFFECTIVE JANUARY 1, 2014

The following eight Georgia State Minimum Standard Codes will be effective January 1, 2014:

International Building Code	2012 Edition
International Residential Code	2012 Edition
International Plumbing Code	2012 Edition
International Mechanical Code	2012 Edition
International Fuel Gas Code	2012 Edition
International Energy Conservation Code	2009 Edition
International Fire Code	2012 Edition
National Electrical Code	2011 Edition

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ASTM E2248, ASTM E2298 Detail Charpy Impact Tests

June 13, 2009 // Published as a news service by IHS

ASTM International Committee E28 on Mechanical Testing approved ASTM E2248 Test Method for Impact Testing of Miniaturized Charpy V-Notch Specimens and ASTM E2298 Test Method for Instrumented Impact Testing of Metallic Materials.

"Conventional noninstrumented Charpy tests give useful comparative information but generally do not offer any detailed insight into the failure mechanisms or provide quantifiable material properties," said Enrico Lucon, senior researcher, Institute of Nuclear Material Science at the Belgian Nuclear Research Center.

"Particularly for structural integrity evaluations, using instrumented Charpy impact test data can improve the understanding of failure mechanisms at high loading rates," said Lucon. "On the other hand, in the case of thin-walled structures or for optimizing material consumption, miniature Charpy specimens may represent an attractive option."

Lucon said instrumenting the machine striker to measure and record the force on the notched sample during impact, as described in ASTM E2298, gives a clearer picture of the events occurring, providing additional insight into the behavior of material under impact loading.

Testing procedures described in ASTM E2248 will be helpful for users who need to reduce the size of Charpy specimens either because the investigated component is thin or because the available material is limited in quantity.

Source: ASTM International.

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ANSI/ASME Y14.24-1999	 Types and Applications of Engineering Drawings	ASME	ANSI ESS
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ANSI/ASME Y14.32.1M-1994 (R1999)	 Chassis Frames Passenger Car and Light Truck Ground Vehicle Practices	ASME	ANSI ESS
ANSI/ASME Y14.34M-1996 (R2002)	 Associated Lists	ASME	ANSI ESS
ANSI/ASME Y14.35M-1997 (R2003)	 Revision of Engineering Drawings and Associated Documents	ASME	ANSI ESS
ANSI/ASME Y14.36M-1996 (R2002)	 Surface Texture Symbols	ASME	ANSI ESS
ANSI/ASME Y14.41-2003	 Product Definition Data Set Practices - Digital	ASME	ANSI ESS
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found using a search engine available at ANSI with URL:
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... And Internationally ISO 1101 Geometric Dimension and Tolerancing Standard

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ISO 1101/NP Amd2	Indication of special specification operators for form, orientation, location and run-out	ISO	Dev Phone: Development Project; No document available.
ISO 1101:2004	Geometrical Product Specifications (GPS) -- Geometrical tolerancing -- Tolerances of form, orientation, location and run-out	ISO	ANSI ESS
ISO 11012:2009	Heavy commercial vehicles and buses - Open-loop test methods for the quantification of on-centre handling - Weave test and transition test	ISO	ANSI ESS
ISO 11014:2009	Safety data sheet for chemical products - Content and order of sections	ISO	ANSI ESS
ISO 11016:1999	Oil of star anise, Chinese type (<i>Illicium verum</i> Hook. f.)	ISO	ANSI ESS
ISO 11019:1998	Oil of roots of lovage (<i>Levisticum officinale</i> Koch)	ISO	ANSI ESS
EN ISO 1101	Geometrical Product Specifications (GPS) - Geometrical tolerancing - Tolerances of form, orientation, location and run-out	CEN	Buy from hardcopy resellers
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SAE J 2370-2003 (SAE J2370-2003)	Geometric Dimensions and Tolerancing for Curved Hose	SAE	ANSI ESS
ANSI/ASME Y14.43-2003	 Dimensioning and Tolerancing Principals for Gages and Fixtures	ASME	ANSI ESS
ASME Y14.5-2009	Dimensioning and Tolerancing	ASME	ANSI ESS
ASME Y14.5.2-2000	Certification of Geometric Dimensioning and Tolerancing Professionals	ASME	ANSI ESS

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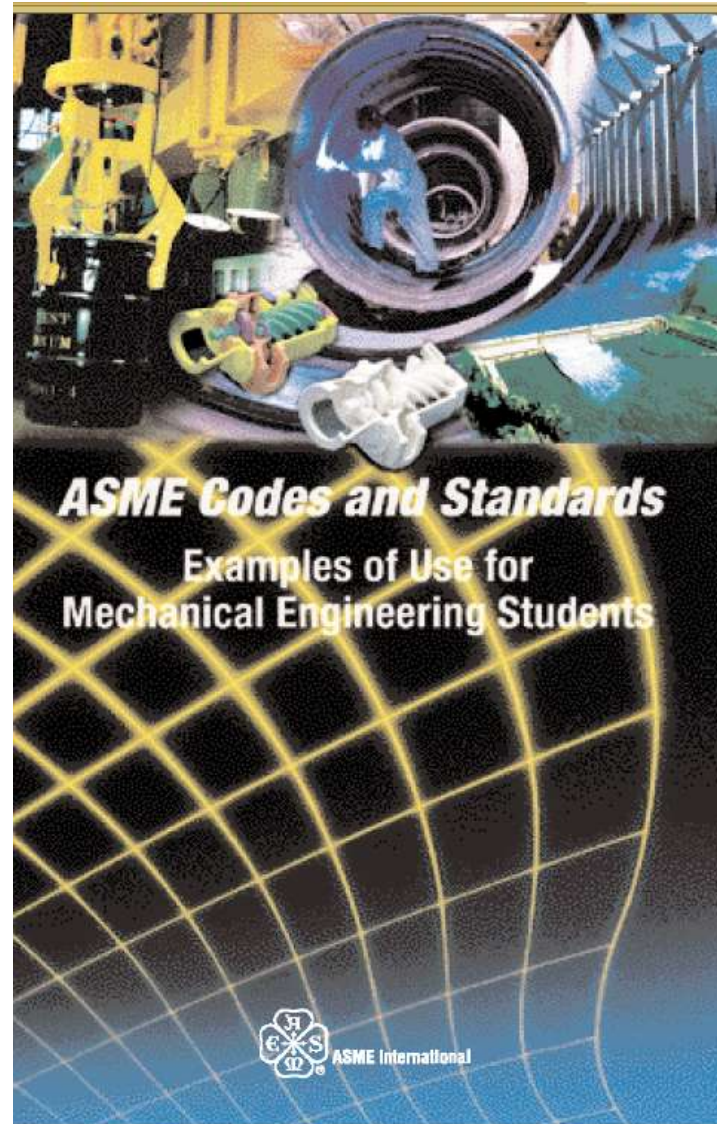
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ASTM A1020/A1020M-02(2007)	Standard Specification for Steel Tubes, Carbon and Carbon Manganese, Fusion Welded, for Boiler, Superheater, Heat Exchanger and Condenser Applications	ASTM	ANSI ESS
ASTM A1048/A1048M-06	Standard Specification for Pressure Vessel Forgings, Alloy Steel, Higher Strength Chromium-Molybdenum-Tungsten for Elevated Temperature Service	ASTM	ANSI ESS
ASTM A178/A178M-02(2007)	Standard Specification for Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes	ASTM	ANSI ESS
ASTM A192/A192M-02(2007)	Standard Specification for Seamless Carbon Steel Boiler Tubes for High-Pressure Service	ASTM	ANSI ESS
ASTM A209/A209M-03(2007)	Standard Specification for Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes	ASTM	ANSI ESS
ASTM A210/A210M-02(2007)	Standard Specification for Seamless Medium-Carbon Steel Boiler and Superheater Tubes	ASTM	ANSI ESS
ASTM A213/A213M-09a	Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes	ASTM	ANSI ESS
ASTM A249/A249M-08	Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes	ASTM	ANSI ESS
ASTM A250/A250M-05	Standard Specification for Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes	ASTM	ANSI ESS

Take a Look at the Professional Societies Pages too for Standards!

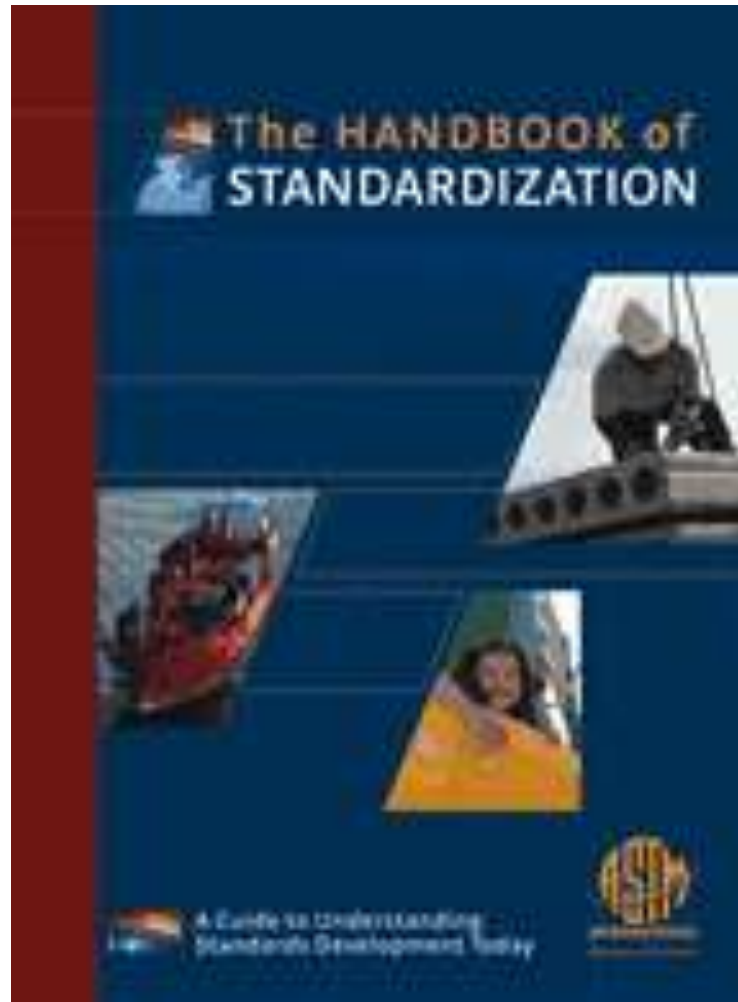
This is a 20 page introduction to standards available from ASME (for students)

It available as a pdf document at:

<http://files.asme.org/ASMEORG/Publications/Codes/5134.pdf>



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The American version of the update replaces ANSI/ISO/ASQ Q9001-2000. **You will have two years from the date of release** to certify to the new revision.



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Life cycle assessment

From Wikipedia, the free encyclopedia

"Cradle-to-grave" redirects here. For other uses, see [Cradle to the Grave \(disambiguation\)](#).

A **Life Cycle Assessment** ('LCA', also known as 'life cycle analysis', 'ecobalance', and '[cradle-to-grave](#) analysis') is the investigation and evaluation of the environmental impacts of a given product or service caused or necessitated by its existence.

Contents [\[hide\]](#)

- Goals and purpose of LCA
- Four main phases
 - Goal and scope
 - Life cycle inventory
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- LCA uses and tools
- Variants
 - Cradle-to-grave
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'CRADLE –TO-GRAVE' Thinking for an Engineer



3R Concepts

- Waste Mgmt Hierarchy
 - Reduce
 - Reuse
 - Recycle
- Barter
- Dematerialization
- Dumpster diving
- Ecodesign
- Ethical consumerism
- Freeganism
- Extended producer responsibility
- Industrial ecology
- Industrial metabolism
- Material flow analysis
- Product stewardship
- Simple living
- Zero waste

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Goals and purpose of LCA

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The goal of LCA is to compare the full range of environmental and social damages assignable to products and services, to be able to choose the least burdensome one. At present it is a way to account for the effects of the cascade of technologies responsible for goods and services. It is limited to that, though, because the similar cascade of impacts from the commerce responsible for goods and services is unaccountable because what people do with money is unrecorded. As a consequence LCA succeeds in accurately measuring the impacts of the technology used for delivering products, but not the whole impact of making the economic choice of using it.

The term 'life cycle' refers to the notion that a fair, [holistic](#) assessment requires the assessment of [raw material](#) production, manufacture, distribution, use and disposal including all intervening transportation steps necessary or caused by the product's existence. The sum of all those steps - or phases - is the life cycle of the product. The concept also can be used to optimize the environmental performance of a single product ([ecodesign](#)) or to optimize the environmental performance of a company.

Lest we also forget: Ethics in Engineering!

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Finally:

- There's plenty here to consider – but it's part of the professional engineering job!
- Make Standards part of your Life-long Learning process – check often for changes as they will effect your products and processes as an engineer or manager
- Find out what is appropriate for your project/product
 - Include appropriate Standards a part of your specification
- As a test case, Each team ***MUST*** include a section in their team's ***PDR Document*** (brief but relatively through) on applicable standards and specifications applicable to their project
 - *Which standards are applicable*
 - *How they were used*

