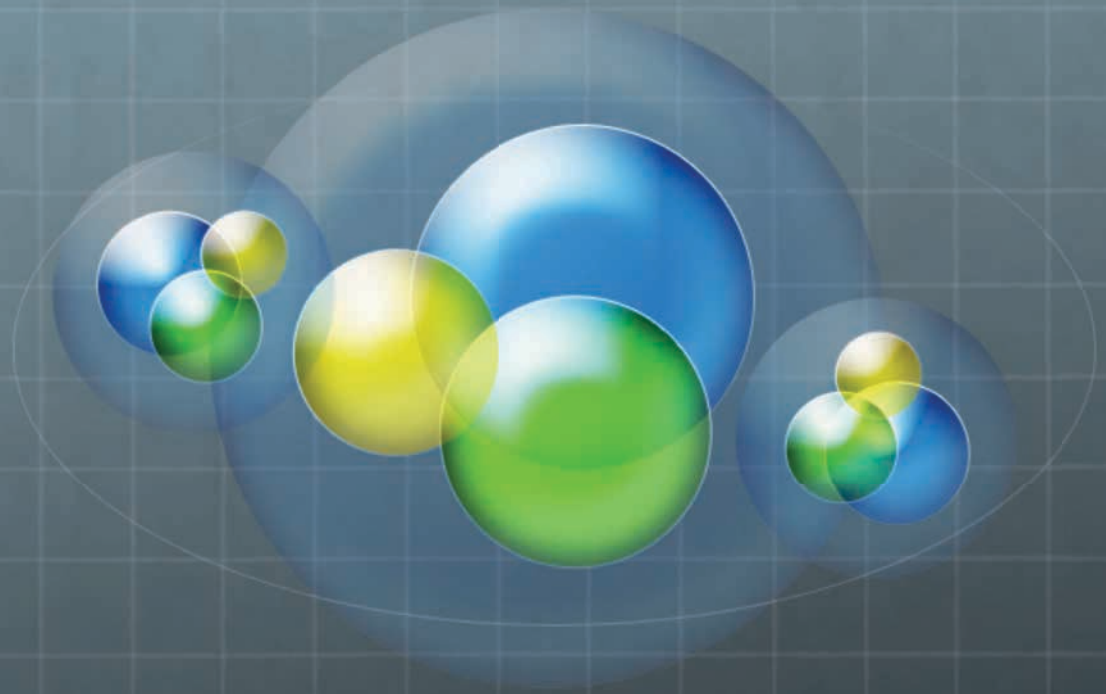


Real World Considerations

Industry Standards
That Influence Engineering Design

Standards (and related constraints)

Most product designs are obligated to conform to national or international constraints that control characteristics of the design that influences its ability to perform in the outside world, by ensuring:

- Public Safety (limits risk of harm to individuals who use the design)
- Environmental Safety (reduces negative impact on ecosystems and environment)
- Socially and Environmentally responsible procurement, manufacturing, and disposal

or by enabling:

- Consistent and predictable communication with other devices
- Reliable physical connection to other devices (shape and form)

or by avoiding:

- Interference with other devices (e.g. FCC regulations of transmission frequencies)

Did you know?

About 210 organization are Standard Development Organizations (SDO's). ASTM, ASME, IEEE, UL are some of the most common for electronic & electromechanical devices.

Standards (and related constraints)

Standard = "something set up and established by authority as a rule for the measure of quantity, weight, extent, value, or quality."

For engineers, a standard is a document that defines the expected characteristics of a product, process, or service including dimensions, safety, and performance constraints.

Code = "Collection of laws or regulations pertaining to a specific activity or subject."

For engineers, a code is a law or regulation that specifies the minimum standards required to ensure public safety & health

Regulation = "rules and administrative codes issued by governmental agencies at all levels, municipal, county, state and federal." Although regulations are not laws, they do have the force of law,

For engineers, a regulation is a mandatory rule that defines a performance requirement or characteristic of a product

Standards Who's Who?

ANSI = American National Standards Institute

"ANSI (American National Standards Institute) is the primary organization for fostering the development of technology standards in the United States." ANSI is essentially the clearing house for standards in the United States and one of the founding members of ISO.

ISO = International Organization for Standardization

"ISO is an independent, non-governmental international organization with a membership of 162 national standards bodies. Through its members, it brings together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges."

Standards Who's Who?

IEC= International Electrotechnic Commission

"Founded in 1906, the IEC (International Electrotechnical Commission) is the world's leading organization for the preparation and publication of International Standards for all electrical, electronic and related technologies. These are known collectively as electrotechnology"

ITU = International Telecommunication Union

"ITU is the United Nations specialized agency for information and communication technologies – ICTs.We allocate global radio spectrum and satellite orbits, develop the technical standards that ensure networks and technologies seamlessly interconnect, and strive to improve access to ICTs to underserved communities worldwide.ITU is committed to connecting all the world's people – wherever they live and whatever their means. Through our work, we protect and support everyone's fundamental right to communicate."

Standards Who's Who?

Especially for Electrical Engineers and Electronics Designs

IEEE = Institute of Electronics and Electrical Engineers

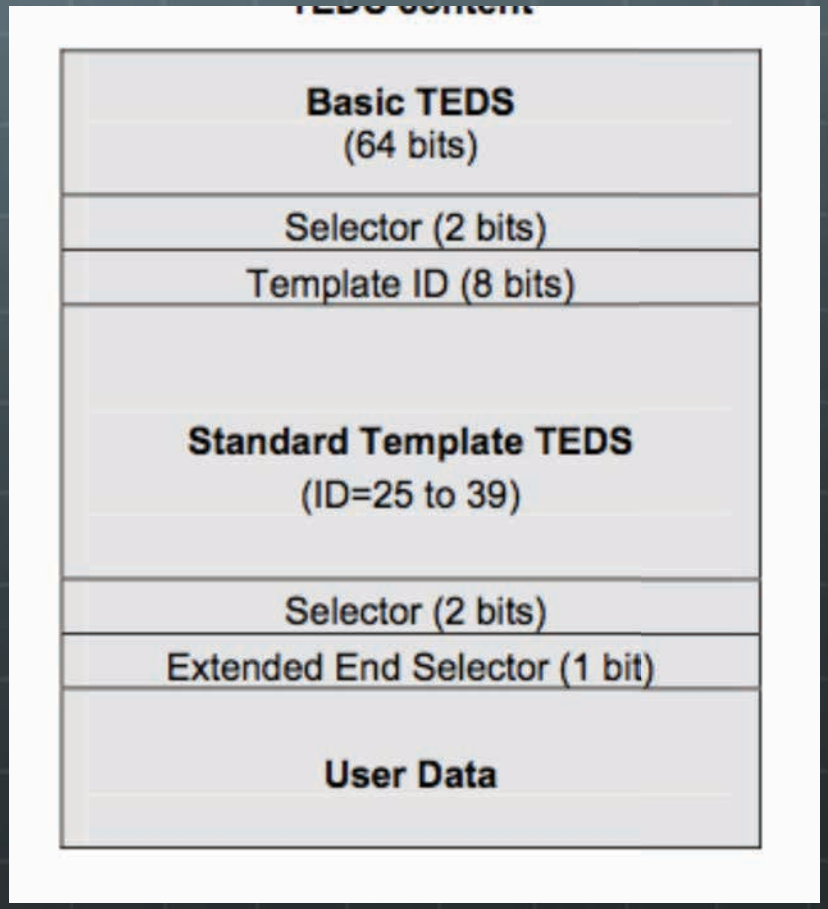
IEEE-SA = Institute of Electronics and Electrical Engineers Standards Association

- **Aerospace Electronics**
- **Antennas & Propagation**
- **Batteries**
- **Communications**
- **Computer Technology**
- **Consumer Electronics**
- **Electromagnetic Compatibility**
- **Green & Clean Technology**
- **Healthcare IT**
- **Industry Applications**
- **Instrumentation & Measurement**
- Nanotechnology
- National Electrical Safety Code
- Nuclear Power
- Power & Energy
- Power Electronics
- Smart Grid
- Software & Systems Engineering
- Transportation
- Wired & Wireless

Standards
Examples for Engineering Design

IEEE 1451:
Transducer Electronic Data Sheets (TEDS)

A TEDS contains the critical information needed to make an analog sensor or transducer "plug and play" with other sensors, transducers, or interfaces to the transducer. It gives the information needed to use the signal from an analog sensor or transducer, stored either electronically (in an EPROM) or in a conventional (virtual) datasheet format.



Standards Examples for Engineering Design

IEEE 1451: Transducer Electronic Data Sheets (TEDS)

Select	Property	Description	Access	Bits	Data Type (and Range)	Units
–	TEMPLATE	Template ID	–	8	Integer (value = 32)	–
–	%ElecSigType	Electrical signal type	ID	-	Assign = 2, "Resistance Sensor"	–
Select Case – Selects Type of Physical Measurand (Units)				6	Select Case	–
Cases 0 - 45	%MinPhysVal	Minimum physical value	CAL	32	Single	Various*
	%MaxPhysVal	Maximum physical value	CAL	32	Single	Various*
Select Case – Selects Full-Scale Electrical Value Precision				2	Select Case	–
Case 0 (7 bit)	%MinElecVal	Minimum resistance	CAL	7	ConRes (0 to 1.3k, step 10)	Ohms
	%MaxElecVal	Maximum resistance	CAL	7	ConRes (0 to 1.3k, step 10)	Ohms
Case 1 (10 bit)	%MinElecVal	Minimum resistance	CAL	10	ConRes (0 to 1M, step 1k)	Ohms
	%MaxElecVal	Maximum resistance	CAL	10	ConRes (0 to 1M, step 1k)	Ohms
Case 2 (16 bit)	%MinElecVal	Minimum resistance	CAL	16	ConRes (0 to 65.4k, step 1)	Ohms
	%MaxElecVal	Maximum resistance	CAL	16	ConRes (0 to 65.4k, step 1)	Ohms
Case 3 (32 bit)	%MinElecVal	Minimum resistance	CAL	32	Single	Ohms
	%MaxElecVal	Maximum resistance	CAL	32	Single	Ohms
–	%MapMeth	Mapping Method	ID	2	Linear , Inverse m/(x+b), or Inverse b+m/x	–
–	%RespTime	Response time	ID	6	ConRelRes (1E-6 to 7.9, ±15%)	seconds
–	%ExciteAmplNom	Excitation current, nominal	ID	8	ConRelRes (1E-6 to 0.12, ±2%)	Amps
–	%ExciteAmplMax	Excitation current, max.	ID	8	ConRelRes (1E-6 to 0.12, ±2%)	Amps
–	%CalDate	Calibration date	CAL	16	DATE	–
–	%CalInitials	Calibration initials	CAL	15	CHR5	–
–	%CalPeriod	Calibration period	CAL	12	UNINT	days
–	%MeasID	Measurement location ID	USR	11	UNINT	–

* Units for %MinPhysVal and %MaxPhysVal are determined by value of Select Case "Physical Measurand (Units)" as summarized in Table 15.

Here is an example for a sensor which produces resistance as its output.

Note that, while the syntax is cumbersome, what is being provided here is primarily the limits of operation of the sensor (albeit in an electronic format)

Standards Who's Who?

Especially for Electrical Engineers and Electronics Designs

UL = Underwriters Laboratories

- Electrical Components
- Electronic Equipment
- Wire and Cable
- Appliances
- Information Technology Equipment
- Fire Protection Equipment
- Fire Suppression Equipment
- Signaling and Alarms
- Equipment for use in Hazardous Locations

Standards
Examples for Engineering Design

NFPA (National Fire Protection Association) Standard 79

This standard addresses the use of color indicator lights on machinery (and other electronic devices) to indicate which color means what in a uniform (standardized) way.

RED light indicates:

Emergency Stop, Stop, or Off

YELLOW light indicates:

Attention, Caution, Start of an operation to avoid dangerous conditions

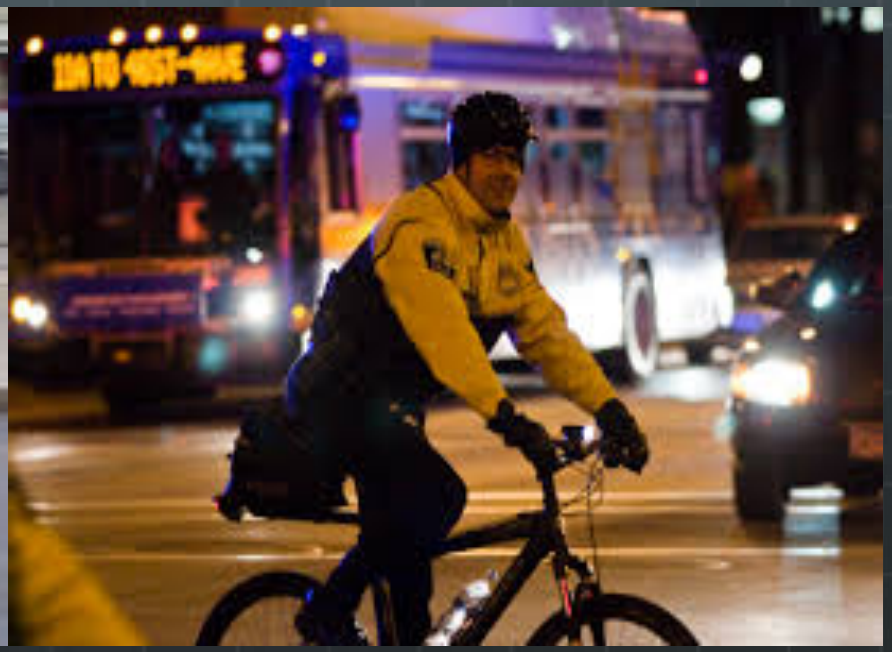
WHITE or CLEAR light indicates:

A circuit has been energized or a function or movement of the machine has begun.

Codes
Examples for Engineering Design

Washington State Bicycling Laws
http://www.wsdot.wa.gov/bike/Laws.htm

Riding at Night - For night bicycle riding, a white front light (not a reflector) visible for 500 feet and a red rear reflector are required. A red rear light may be used in addition to the required reflector (RCW 46.61.780).



Codes
Examples for Engineering Design

California State Driving and Bicycling Laws

http://articles.latimes.com/2011/dec/18/business/la-fi-five-carlaws-20111218

"It's illegal in California to drive or bicycle while wearing "a headset covering, or earplugs in, both ears." Exceptions are made for drivers of emergency vehicles and trash trucks, or anyone using "earplugs or molds that are specifically designed to attenuate injurious noise levels." "

Regulations Examples for Engineering Design

US Environmental Protection Agency, Emissions Standards

Federal emissions standards (regulations) for emissions from on-road and off-road vehicles.

- Light-Duty Vehicles and Trucks and Motorcycles
- Heavy-Duty Engines and Vehicles
- Non-road Engines and Vehicles
- Fuel Sulfur Standards

Regulations
Examples for Engineering Design

OSHA (Occupational Safety and Health Administration)

"OSHA requires employers to ensure the safety of all employees in the work environment. Eye and face protection must be provided whenever necessary to protect against chemical, environmental, and radiological hazards or mechanical irritants."

OSHA

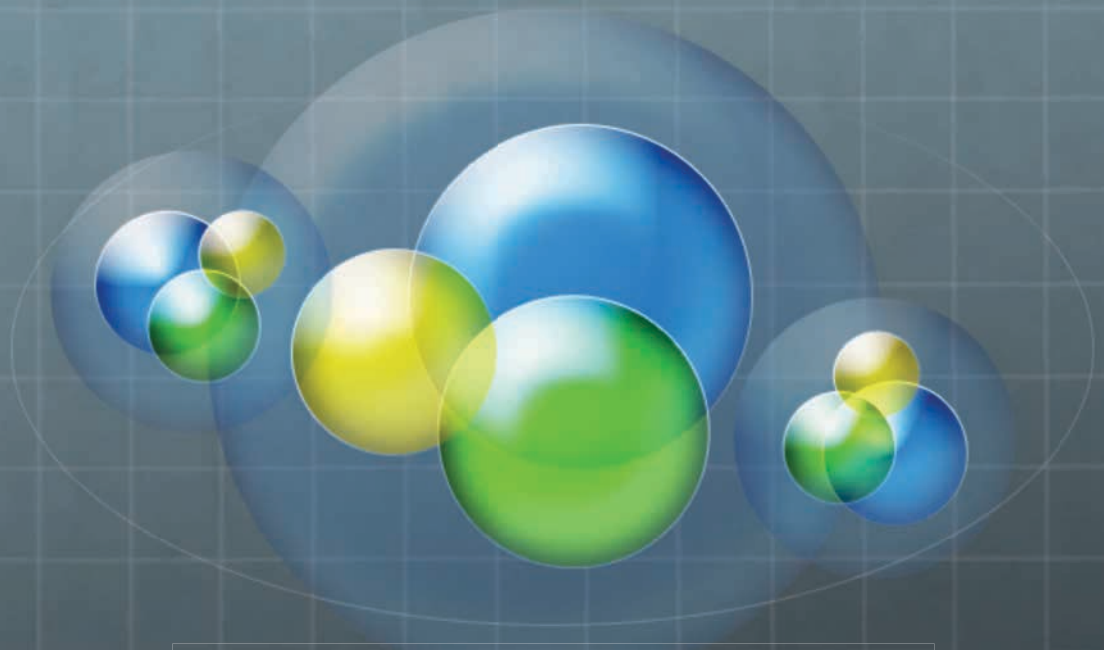
https://www.osha.gov/SLTC/etools/eyeandface/employer/requirements.html

Are Standards REALLY necessary? Examples from Engineering Design

The Great Baltimore Fire raged in Baltimore, Maryland, United States on Sunday, February 7 and Monday, February 8, 1904. 1,231 firefighters helped bring the blaze under control, both professional paid Truck and Engine companies from the city's B.C.F.D. and volunteers from the surrounding counties and outlying towns of Maryland, as well as out-of-state units that arrived on the major railroads. It destroyed much of central Baltimore, including over 1,500 buildings covering an area of some 140 acres (57 ha). **One reason for the fire's long duration involved the lack of national standards in firefighting equipment. Despite fire engines from nearby cities, many were unable to help since their hose couplings could not fit Baltimore's fire hydrants.**

Source: https://en.wikipedia.org/wiki/Great_Baltimore_Fire

Want to know more? ANSI offers useful introductory e-learning courses:
http://www.standardslearn.org/



Real World Considerations

Standards (codes and regulations) allow engineers to meet the environmental, health, safety, and social responsibilities of the engineering profession without having to "reinvent" the wheel in every engineering design cycle. Although they may seem cumbersome, standards (as well as codes and regulations) improve the likelihood that a design/product will succeed and not be derailed by an unanticipated consequence.