SAE INTERNATIONAL

CASE STUDIES

Examples of SAE International Standards Used in the Classroom

AGENDA

Background

Real world examples of SAE standards in the classroom

- Example 1 - Combustion Engine Processes Engine Performance Measures Course
- Example 2 - Automotive Human Factors Course
- Example 3 - Introduction to Fluid and Thermal Energy Transport Course

SAE recognizes young professionals need to be educated on the importance, use, and benefits of technical standards.

Most young engineers don’t know what a standard is or why it is important!

Many faculty don't use standards regularly.

Lack of standards knowledge may result in:

- reinventing processes already codified in standards
- proliferation of needless (non standard) parts
- poor product quality/substandard performance
- lack of customer acceptance or product refusal (nonstandard operation)
- poor conformity/connectivity to other systems (nonstandard interfaces)
- excessive time searching for standards data (lack of knowledge of standards)

Therefore, education is needed to promote awareness and use of standards.

Currently, industry simply "accepts the 'output' from universities and must train employees about standard in-house. [1]

Undergraduate students do not know that other professionals have faced many of the same problems and have developed standard methods, designs, and design requirements. [2]

There is a gap between what universities are teaching and what engineers in industry are expected to know. [2]

ABET accreditation requires:

Students must be prepared for engineering practice through a 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.* [3]

Many engineering decisions are driven by standards.

Engineers working in the mobility industry must comply with government standards for occupant safety, fuel economy, emissions, and end-of-life recycling. They must also comply with industry standards (e.g., SAE) for parts, materials, and testing. Furthermore, engineers must comply with corporate standards.

Exposing students to professional engineering standards, while they are still in school, will help prepare them for their careers.

SAE International has a wealth of resources that can help prepare them for entering the workforce.

These resources include professional codes and recommended practices, technical papers, and professional contacts.

Because of the need to cover many fundamental engineering topics in core courses, there is limited time to expose students to professional practice. Furthermore, many faculty are unaware of standards or their importance.

Therefore SAE International has created standards education materials for students and faculty members.

Example 1: ME 374C/382R – Combustion Engine Processes Engine Performance Measures (U. of Texas)

About the Course:

Fundamental examination of the physical, thermodynamic, and thermochemical factors that govern engine performance with a focus on 4-stroke spark ignition engines.

SAE International standard(s) used:

SAE J1349 Engine Power Test Code - Spark Ignition and Compression Ignition - As Installed Net Power Rating

SAE J2723 Engine Power Test Code - Engine Power and Torque Certification

How are the students exposed to the standard(s)?:

Three lectures are devoted to engine performance measures. These lectures refer to SAE J1349 for standard atmospheric pressures, test parameters, and correction factors. SAE certification of claimed rated torque and power is also briefly discussed.

Example 2: IOE 437 – Automotive Human Factors (U. of Michigan)

About the Course:

This course provides an overview of human factors and driving to help engineers design motor vehicles that are safe and easy to use. Sometimes the course focus is referred to as human-machine interface design or ergonomics.

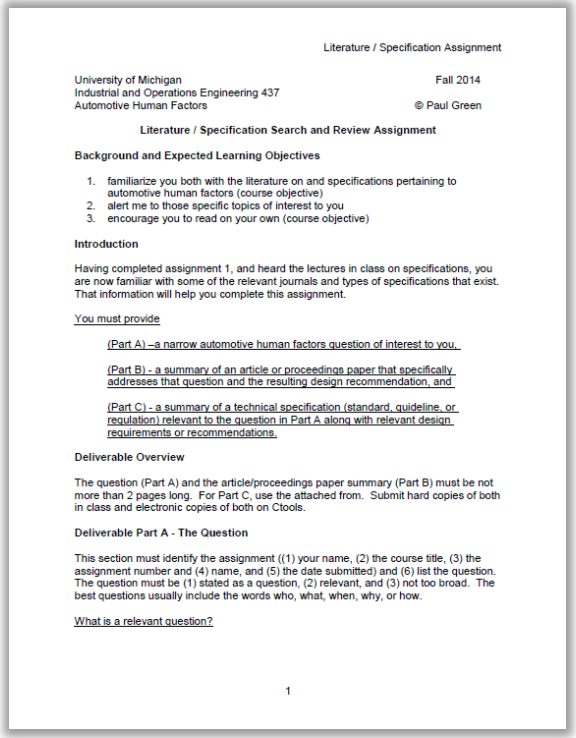
SAE International standard(s) used:

U.S. DOT, SAE, ISO standards and guidelines are considered. The focus is on SAE Safety and Human Factors J-docs because of their importance and accessibility.

Example 2: IOE 437 – Automotive Human Factors (U. of Michigan)

How are the students exposed to the standard(s)?: **(click the image to view the assignment)**

After a lecture on standards, accompanied by an extensive list of automotive human factors standards, students identify a course-relevant question of interest. They find a standard, guideline, or regulation relevant to that question. Then they answer the question using that standard and write a detailed summary of its content and identifying information (number of pages, specifications referenced, etc.).



Literature / Specification Assignment

University of Michigan
Industrial and Operations Engineering 437
Automotive Human Factors

Fall 2014
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Literature / Specification Search and Review Assignment

Background and Expected Learning Objectives

1. familiarize you both with the literature on and specifications pertaining to automotive human factors (course objective)
2. alert me to those specific topics of interest to you
3. encourage you to read on your own (course objective)

Introduction

Having completed assignment 1, and heard the lectures in class on specifications, you are now familiar with some of the relevant journals and types of specifications that exist. That information will help you complete this assignment.

You must provide

(Part A) –a narrow automotive human factors question of interest to you,

(Part B) - a summary of an article or proceedings paper that specifically addresses that question and the resulting design recommendation, and

(Part C) - a summary of a technical specification (standard, guideline, or regulation) relevant to the question in Part A along with relevant design requirements or recommendations.

Deliverable Overview

The question (Part A) and the article/proceedings paper summary (Part B) must be not more than 2 pages long. For Part C, use the attached from. Submit hard copies of both in class and electronic copies of both on Ctools.

Deliverable Part A - The Question

This section must identify the assignment ((1) your name, (2) the course title, (3) the assignment number and (4) name, and (5) the date submitted) and (6) list the question. The question must be (1) stated as a question, (2) relevant, and (3) not too broad. The best questions usually include the words who, what, when, why, or how.

What is a relevant question?

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Example 3: ME 331 – Introduction to Fluid and Thermal Energy Transport (Oakland University)

About the Course:

This is an introductory course in fluid mechanics and heat transfer that includes topics on: conservation and momentum principles, viscous and inviscid flow, laminar and turbulent flow, introduction to viscous and thermal boundary layer theory, one-dimensional conduction heat transfer, and fundamentals of convection heat transfer. The course includes a laboratory.

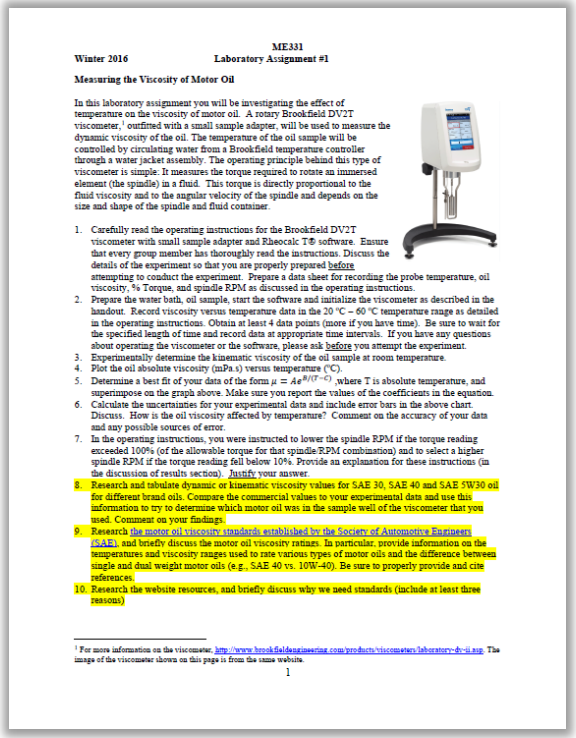
SAE International Standard(s) Used:

SAE J300 Engine Oil Viscosity Classification

Example 3: ME 331 – Introduction to Fluid and Thermal Energy Transport (Oakland University)

How are the students exposed to the standard(s)?: **(click the image to view the assignment)**

In the first laboratory exercise, students are given a sample of an unknown (to the students) motor oil, and asked to determine the SAE viscosity grade of the sample. They have access to a laboratory-grade viscometer and are given training on the use of the viscometer. Students measure the viscosity of their sample oil, across a temperature range, and then investigate the standard to learn how the oils are classified and to determine the viscosity classification of that sample.



ME331

Winter 2016 **Laboratory Assignment #1**

Measuring the Viscosity of Motor Oil

In this laboratory assignment you will be investigating the effect of temperature on the viscosity of motor oil. A rotary Brookfield DV2T viscometer,[1] outfitted with a small sample adapter, will be used to measure the dynamic viscosity of the oil. The temperature of the oil sample will be controlled by circulating water from a Brookfield temperature controller through a water jacket assembly. The operating principle behind this type of viscometer is simple. It measures the torque required to rotate an immersed element (the spindle) in a fluid. This torque is directly proportional to the fluid viscosity and to the angular velocity of the spindle and depends on the size and shape of the spindle and fluid container.

1. Carefully read the operating instructions for the Brookfield DV2T viscometer with small sample adapter and Rheocalc T® software. Ensure that every group member has thoroughly read the instructions. Discuss the details of the experiment so that you are properly prepared before attempting to conduct the experiment. Prepare a data sheet for recording the probe temperature, oil viscosity, % Torque, and spindle RPM as discussed in the operating instructions.
2. Prepare the water bath, oil sample, start the software and initialize the viscometer as described in the handout. Record viscosity versus temperature data in the 20 °C – 60 °C temperature range as detailed in the operating instructions. Obtain at least 4 data points (more if you have time). Be sure to wait for the specified length of time and record data at appropriate time intervals. If you have any questions about operating the viscometer or the software, please ask before you attempt the experiment.
3. Experimentally determine the kinematic viscosity of the oil sample at room temperature.
4. Plot the oil absolute viscosity (mPa.s) versus temperature (°C).
5. Determine a best fit of your data of the form $\mu = Ae^{B/(T-C)}$ where T is absolute temperature, and superimpose on the graph above. Make sure you report the values of the coefficients in the equation.
6. Calculate the uncertainties for your experimental data and include error bars in the above chart. Discuss. How is the oil viscosity affected by temperature? Comment on the accuracy of your data and any possible sources of error.
7. In the operating instructions, you were instructed to lower the spindle RPM if the torque reading exceeded 100% (of the allowable torque for that spindle/RPM combination) and to select a higher spindle RPM if the torque reading fell below 10%. Provide an explanation for these instructions (in the discussion of results section). Justify your answer.
8. Research and tabulate dynamic or kinematic viscosity values for SAE 30, SAE 40 and SAE 5W30 oil for different brand oils. Compare the commercial values to your experimental data and use this information to try to determine which motor oil was in the sample well of the viscometer that you used. Comment on your findings.
9. Research the motor oil viscosity standards established by the Society of Automotive Engineers (SAE), and briefly discuss the motor oil viscosity ratings. In particular, provide information on the temperatures and viscosity ranges used to rate various types of motor oils and the difference between single and dual weight motor oils (e.g., SAE 40 vs. 10W-40). Be sure to properly provide and cite references.
10. Research the website resources, and briefly discuss why we need standards (include at least three reasons)

[1] For more information on the viscometer, http://www.brookfieldengineering.com/products/viscometers/laboratory-dv-ii.asp. The image of the viscometer shown on this page is from the same website.

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Contact Information

www.sae.org

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