Pressure Vessel Design

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Techniques of Geoscientific Experimentation

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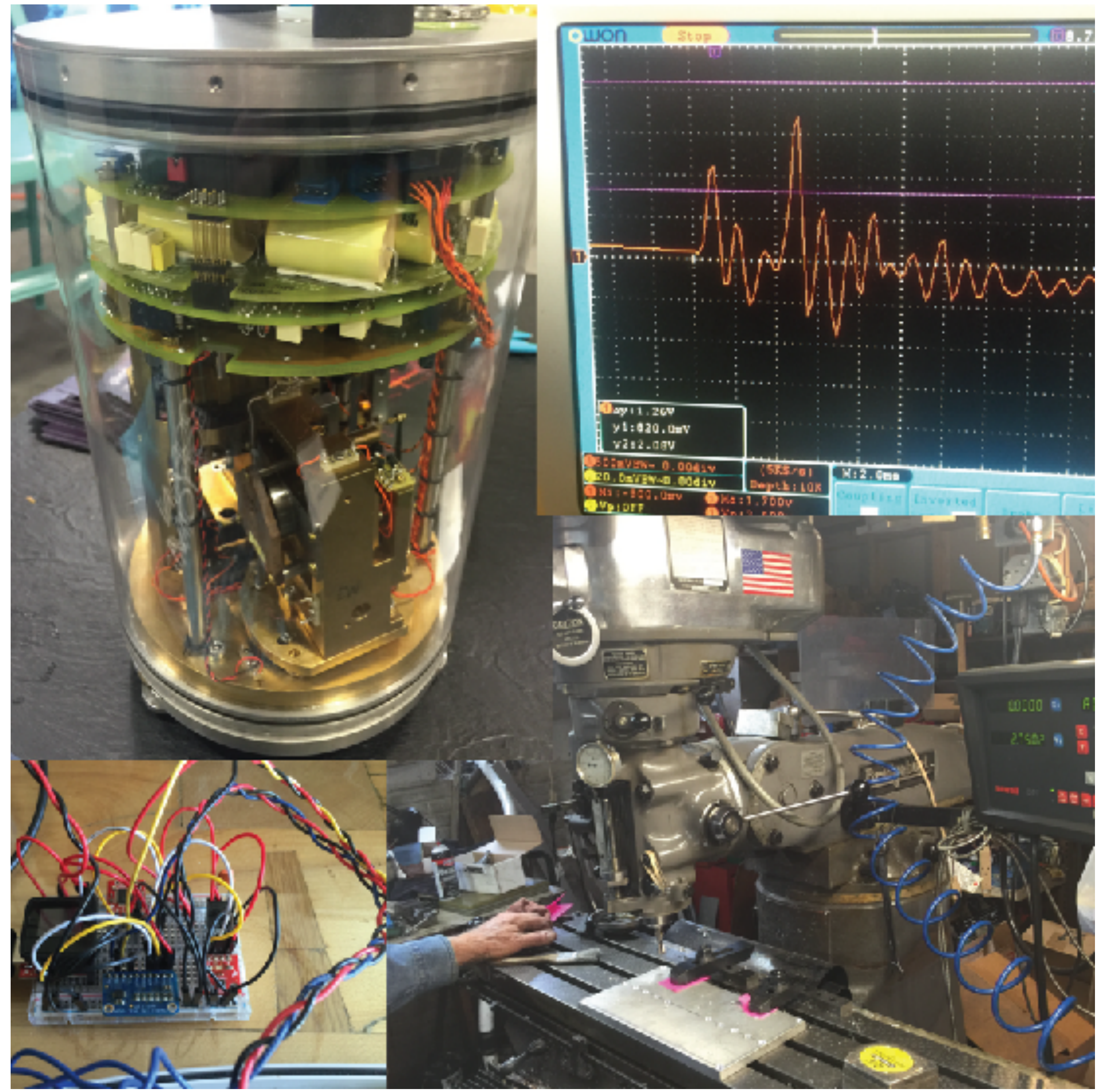
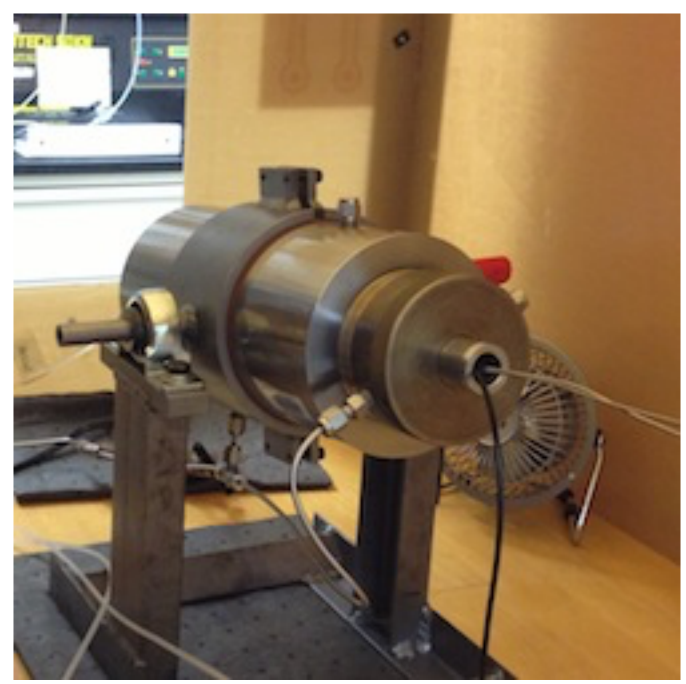


Pressure vessels are everywhere in the experimental lab



Generally we simulate the behavior of the vessel

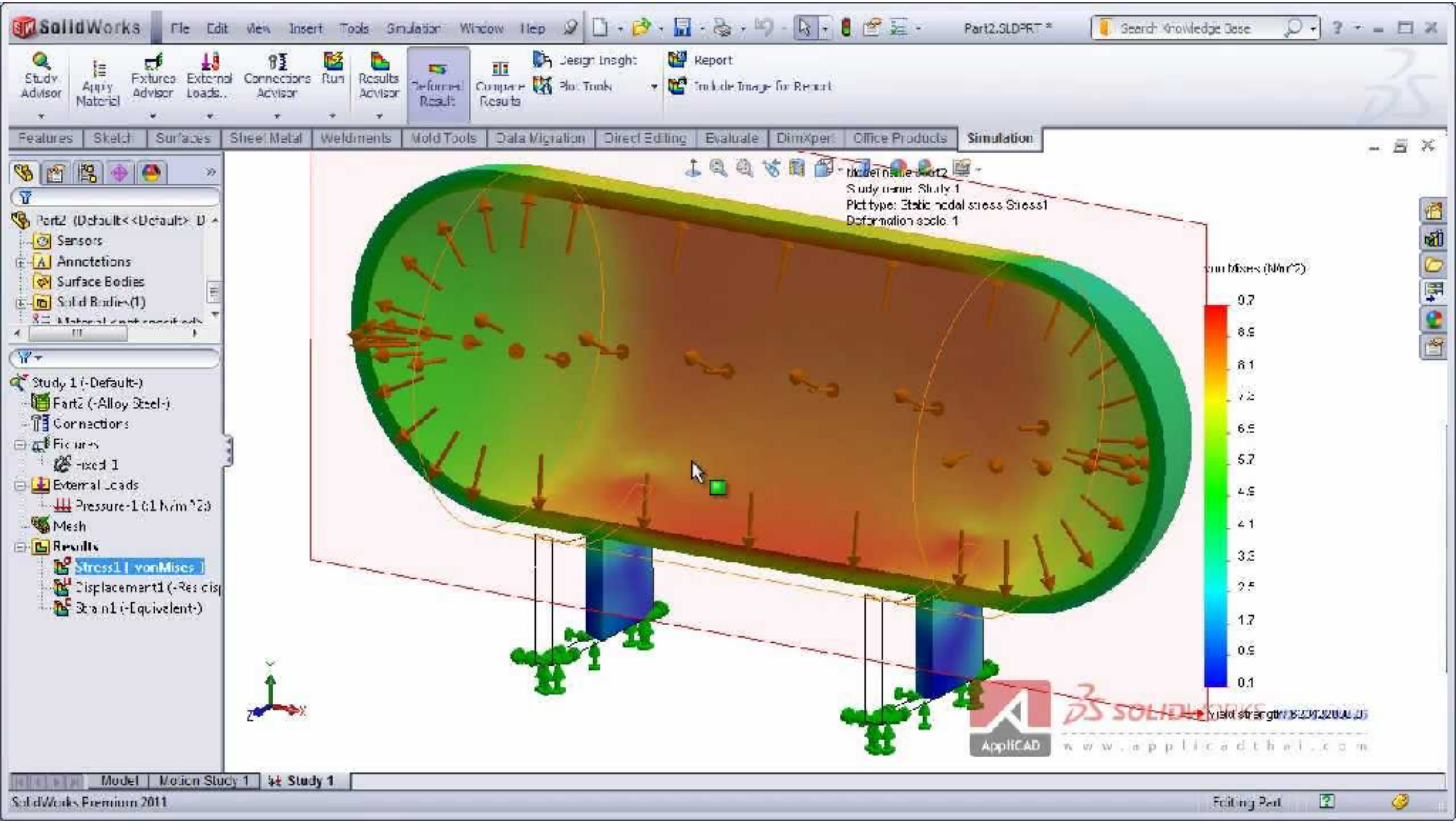


Image: youtube.com

But there are analytical solutions for simple geometries

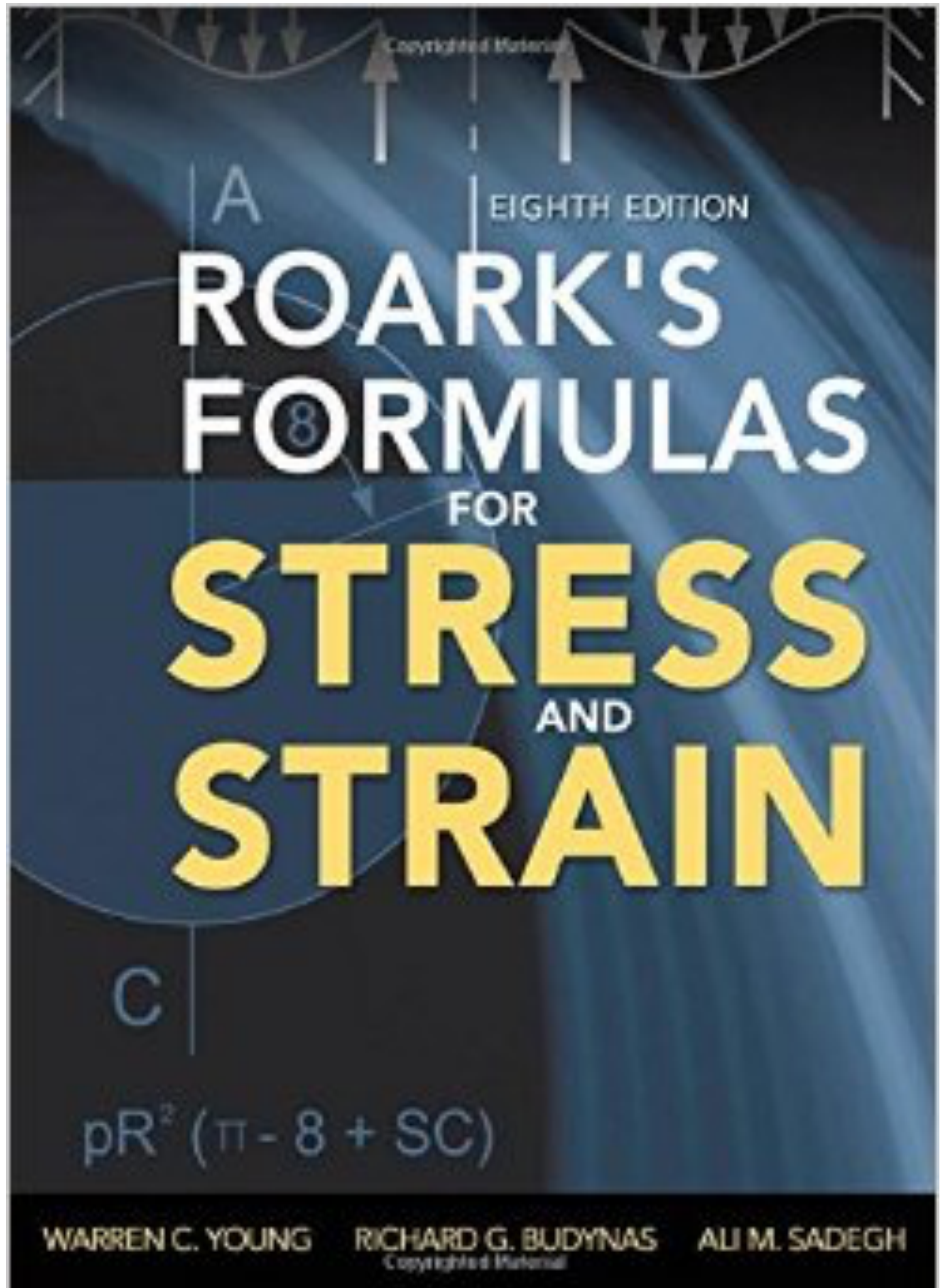


Image: amazon.com

Head geometry greatly influences the design and material choices

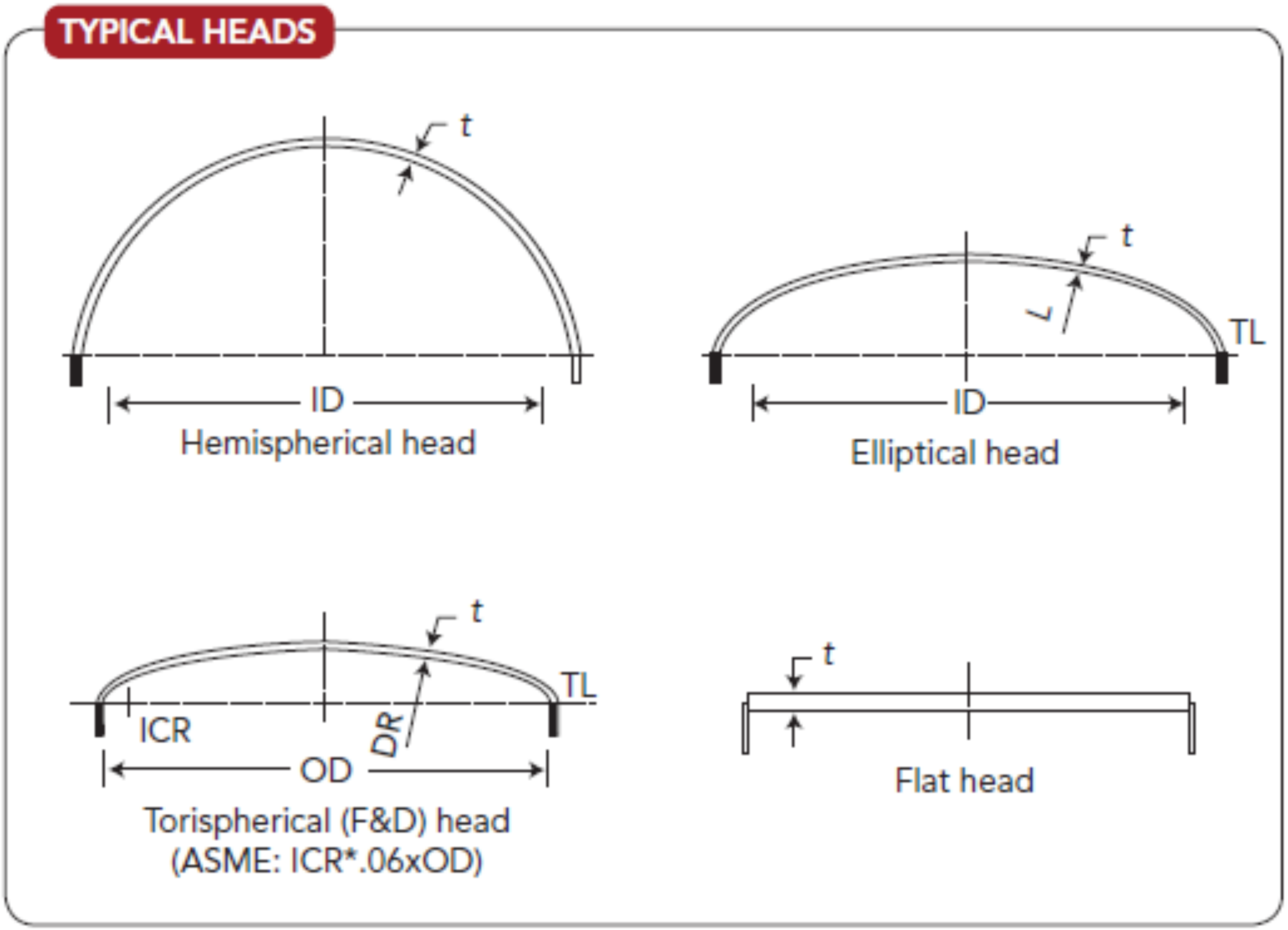


Figure 1. Curved heads predominate and avoid the pressure limitations of flat heads.

Image: boardmaninc.com

Checkout the Applied Science YouTube channel

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Gas cylinders very dangerous pressure vessels

https://youtu.be/FTWWnIfd46c

Image: youtube.com

Always consider what really is a pressure vessel and if it could ever encounter strange conditions

Allow provisions for venting a vessel

https://youtu.be/E5pljUJ6b1k

Image: youtube.com

Always have a safety blow out device

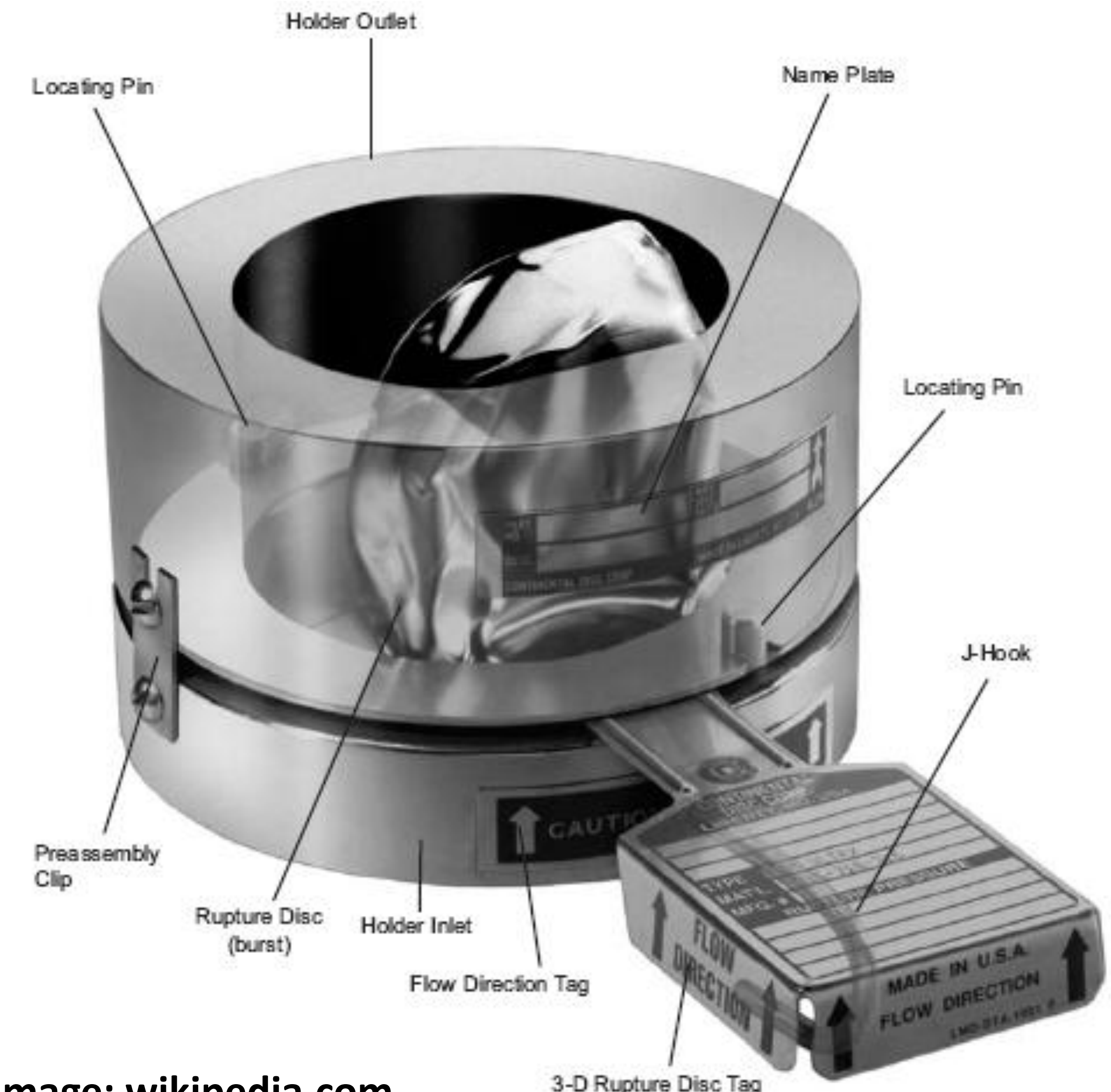


Image: wikipedia.com

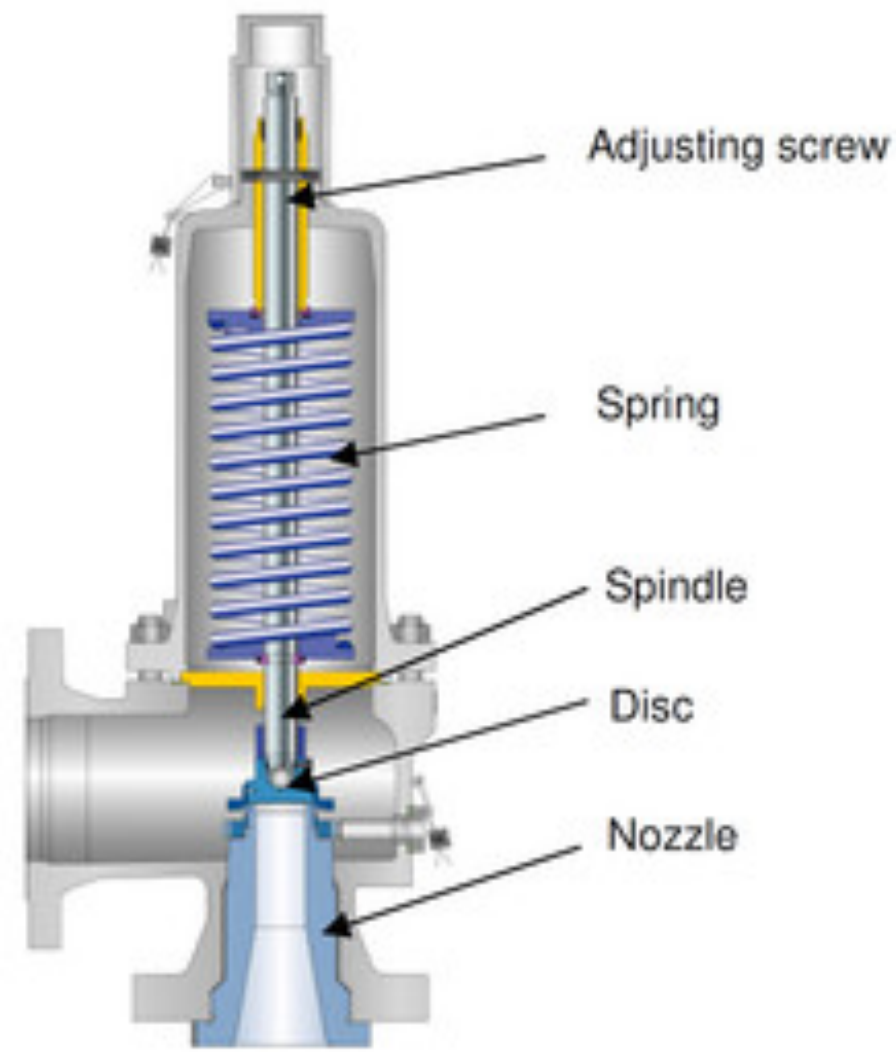


Image: leser.com

Design for 3-4 times the expected maximum pressure

$$\text{Factor of Safety} = \frac{\text{yield stress}}{\text{working stress}}$$

$$\text{Margin of Safety} = \frac{\text{Failure Load}}{\text{Design Load}} - 1$$

$$\text{Margin of Safety} = \text{Factor of Safety} - 1$$

Design Safety Factor = [Provided as requirement]

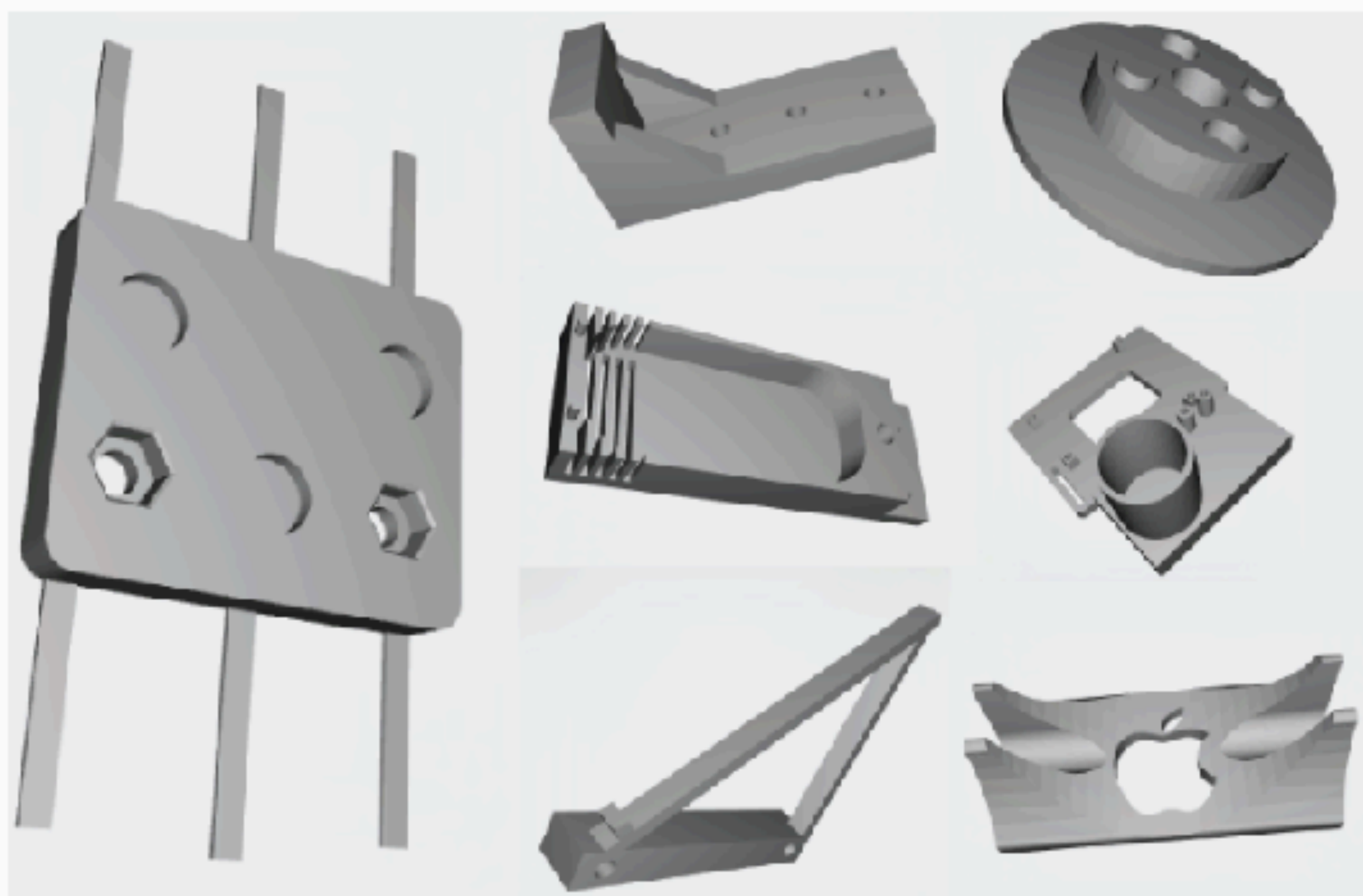
$$\text{Margin of Safety} = \frac{\text{Failure Load}}{\text{Design Load} \times \text{Design Safety Factor}} - 1$$

$$\text{Margin of Safety} = \frac{\text{Realized Factor of Safety}}{\text{Design Safety Factor}} - 1$$

Assignment: 3D Printing Activity

In this activity you will design and print a 3D part. You may take an existing CAD file from a repository such as Thingiverse, GrabCAD, etc. and modify it to suit your purpose (must be a non-trivial change) or create your own design. You can make your design in your preferred CAD tool, a few great choices are OnShape, OpenSCAD, FreeCAD, AutoDeskInventor , and SketchUp These can be simple brackets and parts or very complex structures. Be sure to make something that actually can be 3D printed though - remember the design concerns we discussed in class. A few examples of CAD files designed for 3D printing are shown below.

Many universities, public libraries, and maker spaces have 3D printers that you can use for little or no cost. Penn State operates the Maker Commons as a part of the library that allows students to print. There are also commercial service bureaus that will make your print on professional grade machines and ship it to your door. Of these, Shapeways seems to have the largest variety of materials and services. Often service bureaus and library services can get very busy, so make sure you allow enough time for manufacturing and shipping!



DUE: 10/13/16

Activity: Pressure Vessel Design

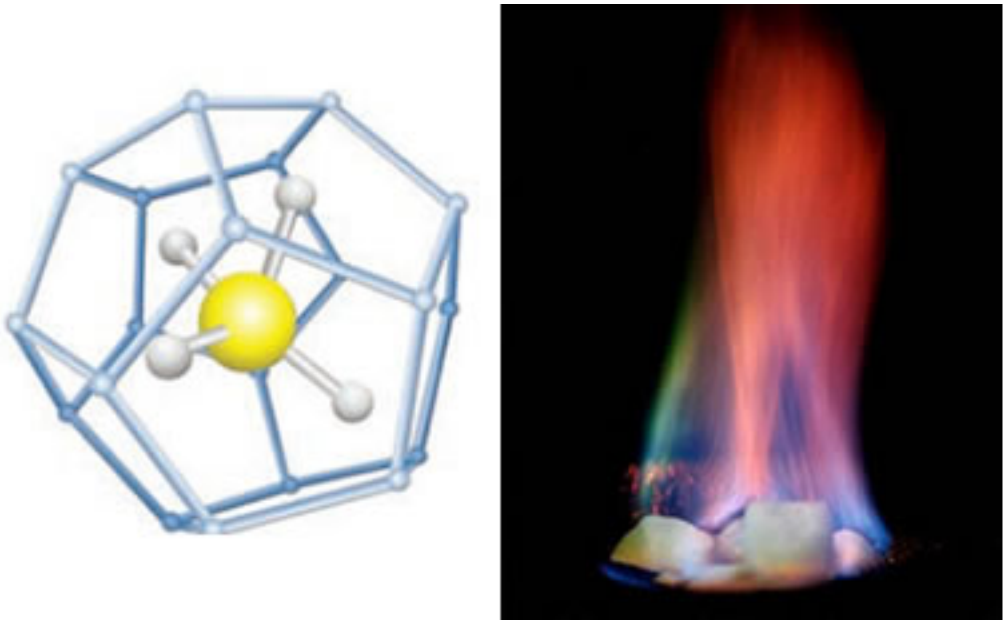


Image: geology.com

Image: telegraph.co.uk

Image: rdmag.com

Image: ps.uci.edu

Activity: Pressure Vessel Design

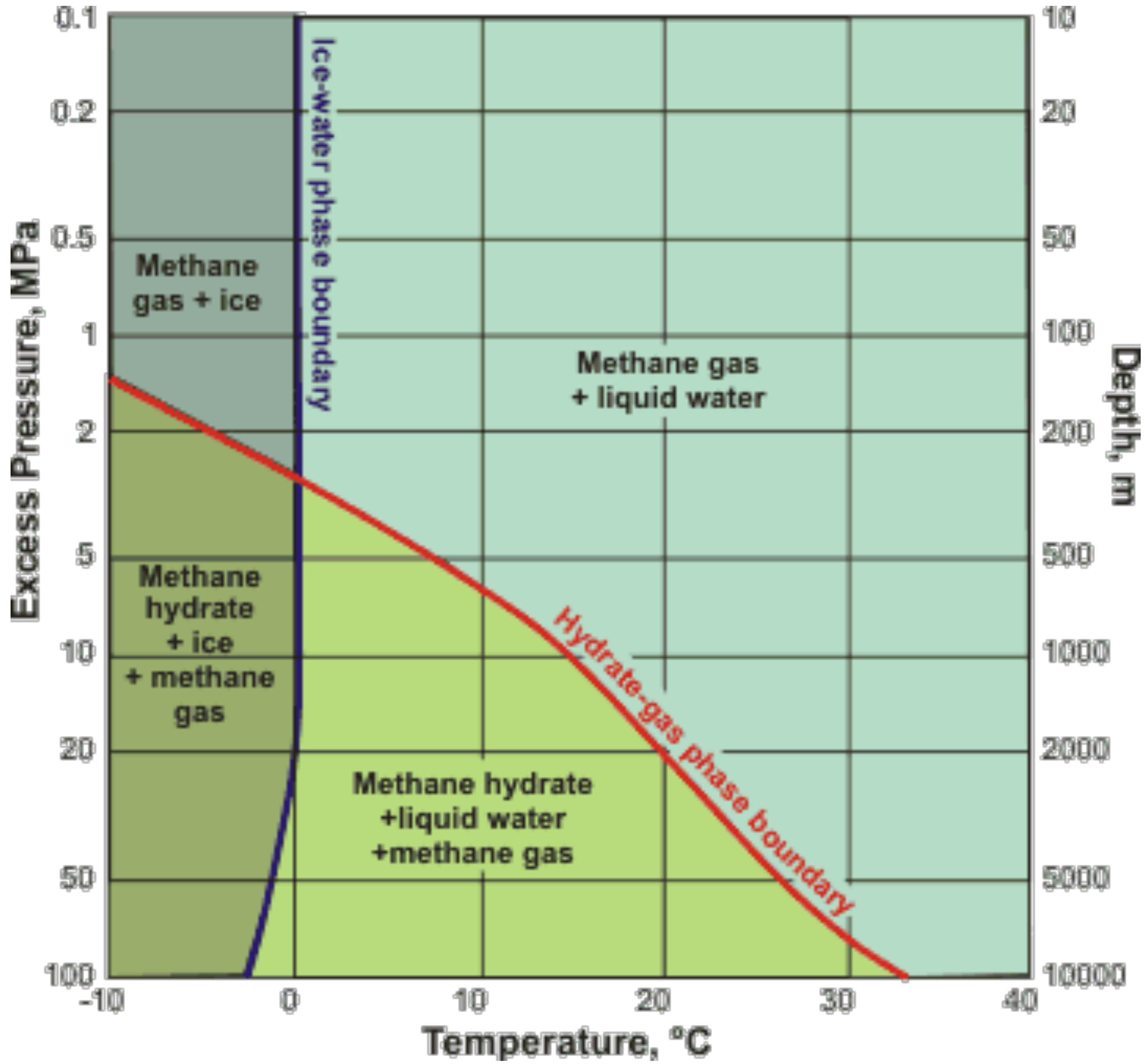


Image: http://www1.lsbu.ac.uk/water/clathrate_hydrates.html