ASM MATERIALS OLYMPICS

McMaster University | ENGINEERING Materials Science & Engineering

DomesDay Competition

For the Materials Olympics, your team's main challenge will be to construct a dome that can withstand the greatest amount of compressive load. Teams are required to construct a dome at their local high schools to bring to McMaster on February 21, 2025.

Competition Rules

1) Students should lead all aspects of materials selection and design.
2) Any assembly that requires a specialized skill that the team does not possess may be outsourced. However, this choice must be referenced during the presentation to the judges.

Build/Geometric Requirements

1) Dome must fit within the negative space formed by a flat surface. The inner dome gauge (outside diameter of 140 mm) and the outer dome gauge (inside diameter of 200 mm).
2) Dome must not exceed 2.0 kg.
3) No element of the dome may exceed 10 mm in thickness.
4) Continuous dome bases are prohibited. Dome bases must not protrude into the area occupied by the inner dome gauge.
5) Domes should be an open lattice-like structure (no unbroken hemispherical surfaces). The use of large or flat plate-like components (eg. Holding the bottom and/or top of the dome) is not allowed.
6) Glitter and other decorations are prohibited due to complexities with testing.
7) See Appendix A below for details.

Note: This is a modification of the official ASM International Geodesic Dome Design Competition, DomesDay. The official competition can be found here: https://www.asminternational.org/students/domesday-competition/

Judging Criteria

Design Judging (100 points): Judges will assign a score based on a combination of the presentation and the question/answer period. Teams will be given up to 7 minutes to present to judges. This presentation should discuss the material selected, manufacturing processes, challenges encountered, description of costs and budgeting and other details. Teams are expected to present on a poster. This poster is meant to be a visual aid meant to guide your presentation.

There should be 4 sections:

1) Introduction.
2) Justification of your dome design. Visual depictions paired with calculations will validate your design.
3) Manufacturing: Depict the manufacturing process as visually as possible.
4) Conclusion.

Structural Integrity (100 points): Domes will be judged on how much compressive load it can bear before fracturing. Domes will be tested on a MTS C43.504 electromechanical load frame with a maximum compressive load capacity of 50 kN at a rate between 15-25 mm/min.

Start Condition: The moment the upper platen, moving downwards, contacts the dome.
End Conditions:

1. Dome catastrophic failure. Complete mechanical failure of the dome.
2. Load frame overload. The load frame exceeds the maximum rated load of 50 kN.
3. Nominal end condition. The upper platen is within 50 mm of the lower platen.

100 points are allocated to the peak load sustained by the dome, normalized by dome mass squared.
Note: Peak load is the maximum load value recorded.

Appendix A

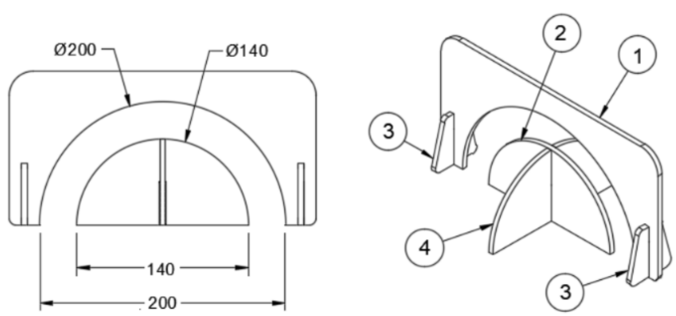
Dome Gauges

The inner dome gauge and outer dome gauges are designed to be reproduced by the student teams for their own use in inspecting their dome. The gauges are designed to be cut from standard sized sheets goods, 3/16 inch thick or 5 mm thick. To facilitate this, .dxf files of the gauge components are available for download which may be used to fabricate the gauges with equipment such as a laser cutter. If the student team does not have access to analogous materials or methods, .pdf* drawings of the gauge components, at a 1:1 scale, are available for download. These may be used as templates to cut the gauges from cardboard or a similarly accessible material. It's recommended that students inspect a known dimension of their gauges, e.g., the width of the gauge, to confirm that their manufacturing equipment or printer has faithfully reproduced the intended geometry of the gauges.

Note: Student teams are encouraged to avoid designing their domes close to the limits of the allowable geometry. For example, a dome designed to be 200 mm in diameter may actually be 201 mm in diameter accounting for manufacturing imprecision. This dome would fail inspection.

Note: While the gap between the dome gauges is greater than 10 mm, the dome must still not exceed 10 mm in thickness in any one location.

*If printing the .pdf drawings, select the "actual size" option in the printer dialogue box to ensure measurement on the printout are correct.



PARTS LIST		
ITEM	QTY	PART NUMBER
1	1	OUTER GAUGE
2	1	INNER GAUGE TOP HALF
3	2	OUTER GAUGE SUPPORT
4	1	INNER GAUGE BOTTOM HALF

Figure 1. (Left) A front view of the dome inner and outer gauges fully assembled and together, with critical dimensions noted. (Center) Isometric view of the inner and outer dome gauges fully assembled and together. (Right) Parts list describing each gauge component, corresponding to the center isometric view. Units are in [mm].

Dome Thickness Inspection

A set of lock-joint transfer calipers, pictured below, will be calibrated such that the distance between the measurement points is 10 mm. These calipers will be passed over the dome, with one measurement point inside the dome and one outside it. The calipers must be able to pass over any and all elements of the dome in at least one direction and orientation. Teams are encouraged to either (1) attain a similar measurement tool to inspect their dome or (2) build one using cut-outs from a rigid material. To facilitate this, a set of to-scale .pdf drawings* and .dxf files are available for download which can be used by student teams to manufacture their own set of calipers as necessary.

*If printing the .pdf drawings, select the "actual size" option in the printer dialogue box to ensure measurement on the printout are correct.

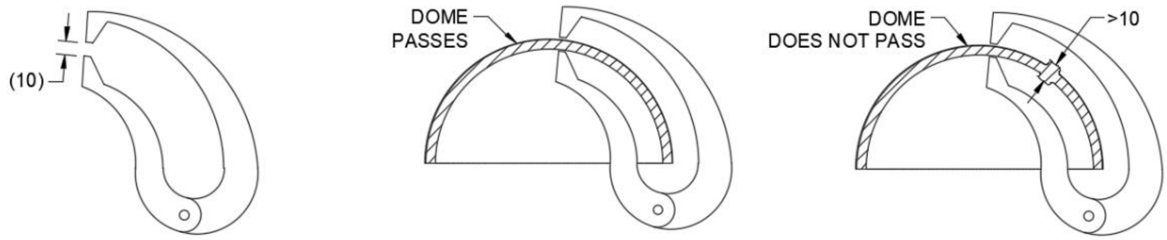


Figure 2. Drawing of lock-joint transfer calipers, set to 10 mm distance between probing points. One example of a dome cross-section which does pass, and one of a dome which does not pass are shown.