



2025 ChemE Cube™ Competition Rules

Document Revision History

Version (Date)	Comment
1.0 (January 2025)	Initial release of 2025 competition rules

2025 ChemE Cube Competition Rules

2025 ChemE Cube Competition Powered by RAPID® | ExxonMobil Quick Start Guide

1. Get up-to-speed on Modular Chemical Process Intensification and Direct Air Capture concepts:

- Many RAPID and AIChE eLearning courses and webinars are free to AIChE student members and will be useful in this competition. [A full list](#) is available, but it is recommended that all teams review the following resources:
 - i. 1-hour RAPID webinar [“Design, Application & Economics of Process Intensification”](#)
 - ii. 1-hour RAPID webinar [“Carbon Capture, Transport and Sequestration”](#)
 - iii. [2019 AIChE Student Design Competition Problem Statement](#) (Modular Distributed Ammonia Synthesis)
 - *Note: this file is a resource only to help demonstrate the benefits to modular processes, particularly the design consideration and references section. No elements of the competition problem are required for this competition.*
- **Review the following documents** (all found at [ChemE Cube Competition Powered by RAPID | ExxonMobil | AIChE](#))
- 2025 ChemE Cube Competition Rules (this document)
- 2025 ChemE Cube Problem Statement
- 2025 ChemE Cube Rubrics
 - i. Virtual Qualifying Presentation
 - ii. The Ad & Poster
 - iii. The Pitch
 - iv. The Run
- 2025 ChemE Cube Safety Program
- [AIChE Code of Ethics](#)
- [AIChE Code of Conduct](#)

2. Check out the 2025 ChemE Cube Informational Webinar Recording for more context.

- The 2025 ChemE Cube Competition Informational Webinar took place on February 4th at 3 PM EST. RAPID staff reviewed competition details and experts from ExxonMobil reviewed Direct Air Capture technology.
- Link to webinar:

3. Sign up for the Virtual Qualifying Event

- [Sign your team up](#) for a virtual qualifying presentation time slot, no later than March 31.
- Link to schedule:

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Date	Checklist of Important Dates and Deadlines for the 2025 Competition
January 2025	2025 Competition Rules & Problem Statement Launched
Sign up no later than March 31, 2025	<p><u>Sign Up for Virtual Qualifying Presentation Time</u> Sign your team up for a virtual qualifying presentation time slot no later than March 31. (Hint: the sooner you sign up, the more likely you are to get your preferred time). Link to schedule: https://calendly.com/keitj/cheme-cube-2025-virtual-qualifying-presentation</p>
April 14-25, 2025	<p><u>Virtual Qualifying Presentations</u> To qualify to compete at the 2025 ChemE Cube Competition, you will present your team's design to a panel of judges via Zoom. The top teams will be selected to compete at the 2025 ChemE Cube Competition in-person.</p>
May 2, 2025	Teams are notified no later than May 2, 2025 if they qualify and will compete in the 2025 ChemE Cube Competition in Boston, MA, USA.
May 9, 2025	Qualifying teams confirm their intended participation at the on-site competition.
August 19, 2025, 2pm-3pm ET	<p><u>2025 Competition Prep Call</u> The teams who qualify to compete at the 2025 ChemE Cube Competition will be required to participate in a Competition Prep Call.</p>
Friday, October 3, 2025, 5:00pm PST	Deadline for Engineering Design Package (EDP), submit to ChemECube@aiiche.org .
Friday, October 24, 2025, 5:00pm PST	Deadline for The Ad, submit to ChemECube@aiiche.org .
TBD	Deadline to Order/Ship Chemical to Site.
Sunday - Monday, November 2-3, 2025 5 th Annual ChemE Cube Competition, Boston, MA	<p>The 5th Annual ChemE Cube Competition will take place at the 2025 AIChE Annual Student Conference in Boston, MA.</p> <p>Bring all items to the on-site competition:</p> <ul style="list-style-type: none"> - Poster - The Pitch presentation materials (send to ChemE Cube team electronically and 5 hardcopies for judges) - ChemE Cube - Appropriate personal protective equipment (PPE) for all team members

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1) What is ChemE Cube?

ChemE Cube is an annual student competition, launched in 2021 and hosted by the [RAPID Manufacturing Institute](#), where undergraduate university teams design, build, and demonstrate a 1 cubic foot mini plant that solves a real-world problem in the chemical process industries. Teams compete on the basis of the cube's performance, merits of the technical approach, and the business case.

2) ChemE Cube Objectives

This program seeks to provide students in engineering and related disciplines with the opportunity to participate in an innovative, team-oriented, hands-on design project to manufacture a chemical process that fits in a 1-foot cube. Students will be expected to:

- a) Solve real-world problems by designing a process using creative chemical engineering solutions.
- b) Demonstrate the ability to safely build and operate a complete chemical process (i.e. reaction and/or separation) at a small scale using advanced manufacturing and intensified processing technology.
- c) Calculate and clearly communicate the ways in which industry could “number-up” the process to meet required product demand and pitch the product’s business case to a panel of industry judges.

3) ChemE Cube Core Values

Teams should demonstrate a commitment to these core values:

- Teamwork
- Creativity & Innovation
- Sustainable Development
- Diversity & Inclusion

4) ChemE Cube Rules of Conduct

Teams should review AIChE’s Code of Conduct and Code of Ethics and act consistent with the two during the competition, including team meetings at respective universities, in online communication, and at the onsite competition.

- a) [AIChE Code of Conduct](#)
- b) [AIChE Code of Ethics](#)

5) Number of Students per Team

There is no limit to the number of students who may participate on a ChemE Cube team. It is encouraged that teams seek members outside of the chemical engineering major to increase diversity in skill sets. The team must designate up to 5 students to participate, in-person, in The Cube portion of the competition for safety reasons. Only 2 team members will be

6) Qualifying for the ChemE Cube Competition

To qualify for the in-person portion of the ChemE Cube competition, teams will present a Virtual Qualifying Presentation to panel of judges representing RAPID staff, representatives from sponsor companies, volunteers, etc. The judges will have sufficient technical background to adequately and fairly

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judge team's designs. To ensure consistency across scores, RAPID staff will attend each team's virtual qualifying presentation.

- a) Each team who wishes to participate in ChemE Cube will present (via Zoom) a design presentation.
- b) To sign up to participate, each team will sign up for a 30-minute time slot:
<https://calendly.com/d/cqxx-3g5-vxp/cheme-cube-2025-virtual-qualifying-presentation>
- c) Each team's presentation should last no more than 20 minutes, with 10 minutes reserved for Q&A from judges.
- d) Judges will score teams using the Virtual Qualifying Presentation found at [2025 ChemE Cube Competition Powered by RAPID | ExxonMobil | AIChE](#).
- e) RAPID will use the overall scores to determine the top teams who will be invited to advance to the in-person competition in November 2025.
- f) Once notified, teams must confirm their intended participation by the defined deadline in order to advance to the next stage of the competition.

7) ChemE Cube Competition Format

The In-Person ChemE Cube competition will take place at the Annual Student Conference at the site of the AIChE Annual Meeting in November 2025.

- a) The ChemE Cube Competition has four main elements: **The Ad, The Pitch, The Poster, and The Run.**
 - i) **The Ad:** Teams will prepare a 1-minute 'ad' or video prior to the competition that highlights the team's product and value proposition (like a commercial would). This video will be judged prior to the competition and the team that scores the highest on this element of the competition gets to choose the order in which they run their cube, a unique advantage on-site.
 - ii) **The Pitch:** Students will have twenty minutes to pitch their process to a panel of industry members. This pitch is expected to include elements that a start-up company formed to commercialize your cube technology would present to a group of angel investors, such as an IP and Patent plan, understanding of the market, competitive advantage, financing required to bring the technology to market, and value proposition to the customer. Ten minutes will be allotted to the presentation and ten minutes for Q&A.
 - iii) **The Poster: Students** will have 10-15 minutes to present their poster to a group of three judges. The poster is more of a technical overview of the cube and is expected to include elements of a poster presented at a scientific conference.
 - iv) **The Run:** During the competition, each team of 5 students will run their 1-ft cube in a head-to-head arena against another team. Cubes will be judged and scored by measurable criteria made available in the annual problem statement. Criteria might include things like cube weight, cost, energy consumption, throughput, waste generation, and product purity.

8) ChemE Cube Competition Awards

The ChemE Cube Competition associated awards are:

- a) First place award: \$1,000 USD, a trophy and individual medals
- b) Second place award: \$500 USD, a trophy and individual medals
- c) Third place award: \$250 USD, a trophy and individual medals
- d) Honorary awards:

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- i) Outside-the-Cube Award – An award to honor a team that had the most innovative and original cube design or cube components (chosen by Poster judges)
- ii) Entrepreneur Award – An award to recognize the team that receives the most mock investment dollars during The Pitch.
- iii) RAPID Award – An award to recognize the best implementation of Modular Chemical Process Intensification (MCPI) concepts (chosen by RAPID staff)

9) Scoring

- a) See detailed scoring rubrics for the specific problem statement
- b) See Table 1 for general scoring criteria and point values for the Virtual Qualifying Presentation
- c) See Table 2 for general scoring criteria, mechanisms, and point values for each portion of the ChemE Cube competition.

Table 1: Overview of Scoring and Judging Criteria for Virtual Qualifying Presentation

Scoring Category	General Criteria	Point Value
Cube Design & Safety Considerations	See ChemE Cube Virtual Qualifying Rubric at www2.aiche.org/chemecube2025	120
Value Proposition		60
Total		180

Table 2: Overview of Scoring and Judging Criteria for ChemE Cube Competition

Scoring Category	General Criteria	Point Value
Cube Demonstration	See ChemE Cube Run Rubric at www2.aiche.org/chemecube2025	600
The Ad	See ChemE Cube Ad Rubric at www2.aiche.org/chemecube2025	100
The Poster	See ChemE Cube Poster Rubric at www2.aiche.org/chemecube2025	100
The Pitch	See ChemE Cube Pitch Rubric at www2.aiche.org/chemecube2025	200
Total		1,000

10) Safety Inspection Rules

- a) Prior to the competition, as stated in the *Checklist of Important Dates and Deadlines*, the teams must submit an Engineering Documentation Package (EDP) to ChemE Cube officials by the date listed to be considered for the competition moving forward.

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- b) During the pre-run inspection, an audit team will inspect each ChemE Cube to ensure that all of the safety requirements have been met and that the cube will operate without risk to the operators, competition staff and spectators.
- c) If the audit team deems the cube safe to operate, then the cube will be given permission to compete.
- d) This permission can be revoked during the competition if teams fail to adhere to the rules and procedures outlined in the Competition Safety Rules.

11) ChemE Cube Ad

a) Technical Requirements

- i) Length: 1 minute
- ii) Video File Format: .MP4, .MOV, .M4V
- iii) Resolution: Full HD 1920 x 1080 (1080p) or higher
- iv) Aspect Ratio: 16:9 landscape

b) Content Requirements

- i) Include the intro provided by RAPID (does not count toward your total 1 minute).
- ii) Credits at the end should recognize everyone who contributed to the video, especially if they were outside of your team.
- iii) No copyrighted material allowed without permission. Make sure to use only materials that are appropriately licensed for reuse, such as freely usable or Creative Commons licensed creative works, royalty-free music, or music licensed for your team use. Be sure to give proper attribution to the creator where necessary. Any unlicensed use of copyrighted material will disqualify the team from this portion of the competition.
 - (1) Tip: A good resource for royalty-free music is <https://incompetech.com/>
- iv) You should receive consent from anyone appearing in your video. If there are individuals under the age of 18 that appear in your video, you are required to get parental consent.

c) Elements of Video Judging Rubric

- i) See rubric released with the problem statement for specific scoring requirements. Generally, videos will be judged according to the following criteria:
 - (1) Clearly and concisely communicating unique or innovative elements used in the cube.
 - (2) Clearly and concisely communicate the impact potential of the technology.
 - (3) Quality of visuals.
 - (4) Overall engagement level.

12) ChemE Cube Poster

a) Team Members

- i) The poster session and judging will take place during an allotted 20-minute time slot as part of the competition. At least one team member must be present during judging to answer questions from the judges.

b) Elements of Poster Judging Rubric

- i) See rubric released with the problem statement for specific scoring requirements. Generally, posters will be judged according to the following criteria:
- ii) Quality of the poster organization/aesthetic and presentation of the poster content by team members
- iii) Design creativity and unique features of the cube
- iv) Demonstration of knowledge of cube design, safety, results, and business case by all team members, and ability by team members to answer questions posed by the judges

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13) Cube Demonstration Session Rules

a) Professional Protective Equipment

- i) In areas where there are chemicals present; all personnel must have the following PPE.
 - (1) Lab Coat
 - (2) Goggles
 - (3) Gloves
 - (4) Dust Masks
- (a) For those who are pouring solid sorbents into their cube.

b) Showcase of Design, “The Run”

- i) The 2025 competition will focus solely on the performance of each team's individual cube.
- ii) An area where The Run occurs will be designated and clearly labeled as “The Arena.”
- iii) Anyone in The Arena must be authorized to enter by the competition staff and wear appropriate PPE.
- iv) Each team will have two separate runs as dictated by the problem statement during which they will process the challenge input and generate product. Student teams will be given a set amount of time between runs to make any necessary modifications to their cube.
- v) Both attempts will be considered in scoring.
- vi) During each run, the team must not interact with their cube in any way after startup procedures are complete.

c) “The Pit” Area

- i) A pit area where the teams will work on and/or troubleshoot their cubes will be designated and clearly labeled.
- ii) Anyone in this is required to wear proper PPE.
- iii) Students will be allowed to enter The Pit and work on their cube only when allowed by competition staff.
- iv) Students will be allowed to prepare and safely operate their cubes in The Pit area prior to the runs.

d) Scoring Logistics

- i) Each cube will have two separate runs as dictated by the problem statement during which they will process the challenge input and generate product. Student teams will be given a set amount of time between runs to make any necessary modifications to their cube.
- ii) Both attempts will be considered in scoring.
- iii) If one team fails to show up in the arena, or their cube fails during startup, this run is forfeited, and no points will be awarded.

e) Starting Area Procedure

- i) Two teams of no more than 5 student representatives each will bring their cubes, including any necessary consumables, to The Arena.
- ii) Upon entering The Arena, each team will weigh their cube fully loaded with their capture material of choice.
- iii) When the judge signals the start of the run, the teams may begin startup procedures for their cube.
- iv) Competition staff will record each team’s power consumption, product flow rate, product purity, and any other performance criteria specified in the problem statement.

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- v) Once a pre-determined amount of product has been produced or time has passed (as specified in the problem statement), the teams will be signaled to begin shutdown procedures. This will signal the end of a run.

f) Run Order Logistics

- i) Each run takes place over 15 minutes and includes time for setup, start-up, run time, and shutdown. The exact timing of each element is defined in the Annual Problem Statement.
- ii) Team competition order is determined from The Ad's scoring and coordinated with teams before arrival.
- iii) Five (5) minutes before the start of the run, the first two teams will be called to the arena.
- iv) Once the teams have arrived, the signal to begin loading of reactants will be given.
- v) A countdown is initiated for the teams to begin startup of their cubes.
- vi) Prior to the start of the run, teams will be given start-up time in The Arena to purge or prime their cubes.

g) Reaction Mechanism

- i) This competition's objective is for students to demonstrate the ability to perform and control a chemical or physical transformation (e.g., reaction or separation) in a continuous process.

h) System Design

- i) Cubes must have a significant and demonstrable student design and fabrication component, particularly with respect to the cube's controller hardware, custom manufactured components, and any controls programs.
- ii) **All cube components must be securely attached within the cube's frame** before the start of the competition.
- iii) The use of exposed wiring, such as alligator clips are prohibited. Cubes must use *female* banana plug socket interfaces. All wiring should be properly insulated.
- iv) Cubes must use 12V. Cubes may not exceed 10A or 120 watts.
- v) Teams must use PVC tubing with 1/8 inch I.D. and 1/4 inch O.D.
- vi) Any catalysts, adsorbents, or the like must be preloaded before the competition.
- vii) Any chemicals (e.g., reagents and catalysts) must be declared in the EDP and used in accordance with the Competition Safety Rules.
- viii) Cubes must be the result of intellectual contributions by the students. **Any cubes designed partially or entirely by a design firm or faculty advisors are prohibited.**
 - (1) Faculty and graduate students can only act as sounding boards to student queries. The faculty cannot be idea generators for the project. Use of the Socratic method is encouraged for faculty advisors.
- ix) **Autonomous operation.** The cube must be autonomous and not require user interaction during the run (not including startup and shutdown periods). Students are only permitted to set system parameters in The Pit before moving to The Arena.
- x) **Ease of use.** The cube must startup in no more than five (5) simple tasks. Examples of simple tasks include priming a pump, pushing a button, loading a solid in a simple container, etc. Written instructions on startup must be free of jargon and included in your EDP.
- xi) Teams will be asked to provide a copy of their complete controller software programs (e.g. code used to run pumps and controls) in their EDP.
- xii) Cubes must include appropriate machine guards, shields and secondary containment in accordance with Competition Safety Rules.

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i) Size of the Cube

- i) All components of the cube must fit into a cube of outer dimensions no larger than 1 ft ×1 ft ×1 ft.

j) Capital Cost of the Cube

- i) The cost of the all-cube components and the chemicals must not exceed \$2,500 USD.
- ii) The use of reselling and third-party sites (eBay, AliExpress, AliBaba, Temu, etc.) are prohibited. We encourage the use of reputable vendors (McMaster-Carr, Grainger, Home Depot, Lowes', etc.). Ordering from Amazon is allowed.
 - (1) An invoice/receipt must be provided as proof to show where materials were ordered from.
- iii) McMaster-Carr prices must be used when calculating the capital cost of the cube.
- iv) Basic household chemicals that can be found over the counter can be bought and priced as normal.
- v) There is a \$200 overcharge for any part that is 3D printed or machined in house, no matter the size.
 - (1) The price of materials will be determined based on the amount of material used.
- vi) The labor hours and fabrication equipment usage fees donated by university machine shops and other personnel will not be included in the capital cost of the cube but will be considered in the judgement of resourcefulness.

k) Changes to Cube from Previous Years

- i) The competition problem statement will change on an annual or biennial basis.
- ii) The cube's frame can be reused from year to year as long as the manufacturing method, cost, materials of construction, and any other relevant information is included in the EDP and capital cost of the new cube.
- iii) Reuse of any internals from a previous cube must be tested at any new process conditions and shown to be chemically compatible with any new chemicals.
- iv) Returning teams are not allowed to use a previous design and must display an appreciable change.

14) Team Member Status and Conduct

- a) All team members must be active AIChE members and a minimum of five (5) students must be registered for the Annual Student Conference.
- b) There is no restriction on requesting assistance on cube safety – teams may request safety assistance from their faculty advisor, other faculty members, other universities, and professional practitioners in industry and elsewhere.
- c) All questions posed by rules and safety judges at the safety inspection and poster session must be answered by the undergraduate student team members. The ability to explain cube design, operation, safety and/or rules compliance is the responsibility of the undergraduate students.
- d) The students working on the project must sign a statement saying they have read, understand, and abided by the rules. This statement must be included in the EDP.

15) Winning Team and Awards

- a) The overall winning team is the team that scores the highest total score taken as the sum of the three elements of the competition (see Scoring section above). There is a maximum of 1,000 points.
- b) In the case of a tie, the judges will vote to break the tie with each judge receiving one vote.

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16) Onsite Safety Judges and Rules Coordinators

If there is any uncertainty on an issue of safety or other judging criteria, please contact chemecube@aiiche.org. The decisions of the onsite rules and safety judges are final. In case of any discrepancy between these rules and the safety rules, the safety rules prevail.

17) Eligibility

Teams will consist of undergraduate students enrolled at host university along with a faculty advisor. There are no restrictions on the degree programs for student team members, and multidisciplinary teams are encouraged. There is no limit to the total number of students permitted in a team.

18) Forfeiting

Should a team forfeit the competition after confirming participation for any reason, no team from that represented university may participate in the following year's competition.

19) Funding

While the ChemE Cube staff are always looking for opportunities to acquire external funding to help teams offset direct costs, RAPID does not guarantee any funding support to teams. Teams should be prepared to finance all costs (build materials, shipping the cube to the competition, team travel costs, registration to the Annual Student Conference, etc.) associated with ChemE Cube whether through support of their university, seeking funding through local businesses, etc. Teams may display sponsors logos or names as part of their cube design.

20) Intellectual Property Rights

By participating in the ChemE Cube competition, student teams are encouraged to develop and commercialize modular processes. However, student teams should be aware that there are risks in sharing unprotected ideas.

Neither RAPID nor the competition's sponsors claim any ownership of intellectual property developed by student teams participating in the ChemE Cube competition and shall not be held responsible for any misuse of IP.

Student teams are encouraged to review their university's intellectual property policies and are responsible for managing risks associated with sharing unprotected intellectual information.