



Emerging Technology Series

SAE AEROCONNECT CHALLENGE™ 2021 CHALLENGE RULESET

Revision A | Published June 15, 2020



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Part A. SAE AEROCONNECT CHALLENGE™ OPERATIONS

A.1 CHALLENGE OVERVIEW

Through the SAE AeroConnect Challenge™ universities will think critically about emerging technology issues relevant to the connected aircraft industry. Teams of university students will design and develop, conceptually, an Urban Air Mobility System in response to a Florida based theme park request for proposal for upgrade to current mobility. Immersed in the SAE International's AeroTech conference, universities will present their solution in various ways including a technical design presentation and a showcase opportunity on SAE International's AeroTech show floor.

The SAE AeroConnect Challenge™ is a student engineering design competition in the SAE Emerging Technology Series, which provides an opportunity for students to think critically about current and future emerging technologies in the mobility engineering industry. Each program within the SAE Emerging Technology Series challenges universities to create a team of multi-disciplinary engineers to collaborate, design, present, and defend conceptual designs to industry professionals.

A.2 CHALLENGE EDUCATIONAL OBJECTIVES

The formal education objectives of SAE AeroConnect Challenge™ include:

- Participants will demonstrate the ability to think critically about current and future emerging technology issues relevant to Urban Air Mobility.
- Participants will demonstrate the ability to research and define based on a proposal for a new theme park experience.
- Participants will demonstrate an ability to design a technically capable and affordable Urban Air Mobility System to meet the needs of the theme park and their mass populations.
- Participants will demonstrate the ability to communicate technical information using the SAE International Technical Paper format.
- Participants will demonstrate the ability to create a Failure Mode Effects Analysis (FMEA).
- Participants will demonstrate the ability to use a Preliminary Design Review Presentation to present and defend in-depth conceptual designs.
- Participants will demonstrate the ability to communicate their solution to industry professionals at their own SAE AeroTech Floor Showcase Booth.
- Participants will demonstrate the ability to work on a multi-disciplinary team to solve a real-world industry problem outside of the classroom.

Additionally, SAE AeroConnect Challenge™ participants will receive these benefits.

- Participants will receive the opportunity to submit resumes to SAE AeroConnect Challenge™ sponsors on the Sponsor Portal on www.saeaeroconnectchallenge.com.
- Participants will receive a Student Pass to attend 2021 SAE AeroTech.
- Participants will receive admission to participate in the Meet the Sponsors reception at 2021 SAE AeroTech.

- Participants will receive access to select SAE International's Technical Standards at no cost.

A.3 ORGANIZING COMMITTEE AUTHORITY

Ambiguities or questions concerning the meaning or intent of these rules will be resolved by the Organizing Committee as appropriate. All team members, faculty advisors and other university representatives are required to cooperate with, and follow all instructions from challenge organizers, officials and judges.

A.4 OFFICIAL ANNOUNCEMENTS & INFORMATION

It is the university's responsibility to be familiar with all official communication and rule interpretations released by the SAE AeroConnect Challenge™ Rules Committee. SAE AeroConnect Challenge™ information and announcements will be provided to students in these formats:

- Competitor Email Newsletters
- [Challenge Newsfeed](#)
- [SAE AeroConnect Challenge™ App](#)

A.5 CHALLENGE DATE & LOCATION

The 2021 SAE AeroConnect Challenge™ will be held on March 9-11, 2021 as part of [2021 SAE AeroTech®](#) in Orlando, Florida.

A.6 CHALLENGE REGISTRATION

Teams intending to participate in the 2021 SAE AeroConnect Challenge™ must register their teams online per the registration schedule shown below. The \$1,500 registration fee is non-refundable and the registration fee must be paid or proof of payment initiation must be submitted to collegiatecompetitions@sae.org within 48 business hours of registration. Each university may register up to 2 teams, however separate entry fees are required for each team participating.

Registration will open at www.sae.org at October 1, 2020 10:00 AM ET
Registration will close at www.sae.org at November 1, 2020 11:59 PM ET

For additional information regarding how to register for the 2021 SAE AeroConnect Challenge™, visit www.saeaeroconnectchallenge.com/go/resources.

A.7 WAITLIST REGISTRATION

Once an event reaches capacity, additional teams attempting to register will be placed on a waitlist. The waitlist is capped at 10 available spaces and will close on the same day as registration closes. Once a registration slot opens, an SAE International Staff member will inform the individual who registered the team to the waitlist by email that a spot on the registered teams list has opened. Teams will have 24 business hours to accept or reject the position and an additional 48 business hours to have the registration payment completed or proof that payment has been initiated.

Waitlisted teams are required to submit all documents by the posted deadlines in order to be considered serious participants and any team that does not submit all documents will be removed from the waitlist.

A.8 WITHDRAWAL POLICY

Registered teams that find they will not be able to attend the competition are required to officially withdraw by emailing collegiatecompetitions@sae.org no later than (4) weeks before the challenge. Registration fees are NOT refundable or transferable.

A.9 CHALLENGE AWARDS

Monetary awards will be presented in the following categories:

- Technical Design Report
 - 1st Place - \$1,000
 - 2nd Place - \$500
 - 3rd Place - \$250
- Preliminary Design Review Presentation
 - 1st Place - \$1,000
 - 2nd Place - \$500
 - 3rd Place - \$250
- SAE AeroTech Floor Showcase Booth
 - 1st Place - \$1,000
 - 2nd Place - \$500
 - 3rd Place - \$250
- Overall
 - 1st Place - \$5,000
 - 2nd Place - \$3,000
 - 3rd Place - \$1,750

Part B. SAE AEROCONNECT CHALLENGE™ PARTICIPATION

B.1 UNDERSTANDING THE RULES

Teams, team members as individuals and faculty advisors are responsible for reading and understanding the rules of this challenge. Should universities have additional questions, they may utilize the Rules Q&A feature. More information on the Rules Q&A feature can be found at www.saeeroconnectchallenge.com/go/resources.

B.2 FACULTY ADVISOR REQUIREMENT

Each team is expected to have a Faculty Advisor appointed by the university. The Faculty Advisor is expected to accompany the team to the challenge and will be considered by challenge officials to be the official university representative. Faculty Advisors may advise their teams on general engineering and engineering project management theory but may not design any part of the Urban Air Mobility system nor directly participate in the development of any documentation or presentation.

B.3 INDIVIDUAL REGISTRATION REQUIREMENT

Individual registration will be required of all team members and faculty advisors by February 23, 2021 at the following websites:

- <https://www.sae.org/attend/student-events/aeroconnect-challenge>
 - Fast Track Roster
 - Newsletters
- www.saeeroconnectchallenge.com
 - Document Submissions
 - Sponsor Portal
 - Rules Q&A
 - Series Resources
 - <https://www.sae.org/attend/aerotech>
 - SAE AeroTech Event Registration

More information on the registration process for each site can be found at www.saeeroconnectchallenge.com/go/resources.

Additionally, all onsite participants, including students, faculty and volunteers, are required to sign a liability waiver in the form of a Fast Track Roster. Additional information on the Fast Track Roster process can be found at www.saeeroconnectchallenge.com/go/resources.

B.4 PARTICIPANT ELIGIBILITY AND TEAM LIMITS

Eligibility is limited to undergraduate and graduate students from an accredited university or college. Teams are limited to 10 participants and 1-2 Faculty Advisors. Universities can register up to 2 separate teams.

B.5 PARTICIPANT SOCIETY MEMBERSHIP REQUIREMENT

Team members must be members of SAE International. Students can join SAE online at: www.sae.org/students. Faculty that wish to be SAE members should choose the “Professional Membership” link and proceed to the series of questions. Please note all student participants must be SAE International members to participate in the event. It is not mandatory for faculty to join as a member, but they must be on the team roster on sae.org. More information on affiliating to the team roster as a non-member Faculty Advisor can be found at www.saeconnectchallenge.com/go/resources.

B.6 PARTICIPANT AGE REQUIREMENT

Team members must be at least eighteen (18) years of age at the time of participation on the team.

B.7 PARTICIPANT MEDICAL INSURANCE REQUIREMENT

Individual medical insurance coverage is required and is the sole responsibility of the participant.

B.8 PARTICIPANT RULES OF CONDUCT

Team members and Faculty Advisors will be held to the highest standard of conduct and must abide by their University’s own code of conduct extending that to this challenge. It is recognized that this event is an engineering educational experience. In the heat of competition, emotions peak and disputes arise. Our officials are trained volunteers and maximum human effort will be made to settle problems in a reasonable, timely, and professional manner.

B.9 ALCOHOL AND ILLEGAL MATERIAL

Alcohol, illegal drugs, weapons or other illegal material are prohibited on the event site during the challenge. This rule will be in effect during the entire challenge. Any violation of this rule by a team member will cause the expulsion of the entire team. This applies to both team members and faculty advisors. Any use of drugs or alcohol by an underage individual will be reported to the local authorities.

Part C. SAE AEROCONNECT CHALLENGE™ 2021 MISSION

C.1 2021 CHALLENGE MISSION DETAILS

A Florida Theme Park is requesting proposals for a new people mover system for installation at their resort in Orlando, FL. The new guest transportation system is intended to serve as a technological refresh to existing mass transit systems (e.g., ferries, monorail and transit buses) in the resort and should make use of developments in Urban Air Mobility technologies, while still providing an entertaining, themed attraction for guests. The following are the primary objectives of the new transportation system:

- **Safety:** Guest safety is paramount. The transit system must provide enough redundancy such that the guests feel safe and protected.
- **Reliability:** The transit system must be able to support continuous operation from park open to close, 8:00 AM to Midnight, (with 1 hour of additional use for arrivals and departures to the resort complex). Downtime for maintenance leads to frustrated guests.
- **Comfort:** The interior should be climate controlled, ventilated in accordance with mass transit standards SAE AIR4766 - Air Quality for Commercial Aircraft Cabins and ample seating should be available to support throughput.
- **Throughput:** The theme park estimates upwards of 30,000 – 50,000 guests each per day. Everyone who visits the park uses some form of Mass Transit - the system must be able to support at least 10% of that daily population moving between a specified park to park option or a park to resort option.
- **Entertainment:** An on-board park information & entertainment system should be available providing key updates about the park. On-board wireless internet should also be supported. In traditional fashion, each of the transit vehicles should be fashioned to represent park themes - e.g., a futuristic / retro-futuristic motif, a fairy tale motif, etc.
- **Technology:** The experience must demonstrate the latest in autonomous transport technologies including waypoint navigation (travel to predetermined air transit stations throughout the resort), traffic / collision avoidance and on-board Wi-Fi to support guests' use of the park app.

For the purposes of this solicitation, an “Urban Air Mobility” vehicle is defined as a small aircraft capable of repeated vertical takeoff and landing operations, operating autonomously in confined airspace, and carrying up to 20 people and associated light cargo.

Additional Requirements:

1. The transit system shall be carbon-neutral; making use of renewable alternative energy means where possible.
2. The experience shall contain sufficient ride vehicles to meet throughput requirements while factoring in charging/refueling, and vehicles out of service for scheduled/unscheduled maintenance.
3. Efforts should be made to reduce ride vehicle noise wherever possible. 75 dB at 30 meters (100 feet) shall be used as a goal.

4. The ride vehicle must be FAA certified as a Transport-Category aircraft per 14 CFR Part 25.
5. The ride vehicle will take off and land within the park, but may transit elsewhere within the various other properties during the experience. The vehicle shall not exit the airspace directly above the property and shall not exceed 120 meters (400 feet) above ground level at any point.
6. The transit system is autonomous with standard safety measures to watch for guests entering / exiting the transport, the use of safety harnesses, etc.
7. All vehicles must maintain persistent communication with the ride operator, providing regular position, altitude, airspeed, and general systems status (i.e. nominal/off-nominal/state of charge/emergencies).
8. No single failure shall result in loss-of-mission (i.e. emergency landing). Following any single failure, the vehicle shall be capable of completing the ride, unloading passengers, and autonomously returning to a maintenance facility.
9. No dual failure shall result in loss of vehicle. An emergency landing with a dual failure is acceptable - the vehicle does not need to return to the origination point.
10. The vehicle shall have at a minimum triplex redundancy of critical flight, navigation and communication systems.
11. Interiors must have enough luggage / stowage space for a single carry-on or equivalent piece per every guest (example a stroller/wheelchair).
12. Teams must incorporate SAE Standard AS8037 Rev. D (available on SAE MOBILUS for teams) which establishes minimum performance standards for new equipment position lights into their conceptual design system.

Teams are challenged to design and present a technically capable and affordable Urban Air Mobility based attraction to meet the requirements of the specified theme park Request for Proposal (RFP). The RFP response shall include a Technical Design Report covering all aspects of the system, a Preliminary Design Review (PDR) presentation, and a Failure Mode, Effects, and Criticality Analysis (FMECA) supporting the loss-of-mission and loss-of-aircraft requirements.

Units: Standard units for this challenge shall be as follows:

- **Distance: Kilometers (km)**
- **Speed: Kilometers per hour (kph)**
- **Altitude: Meters (m)**

Aerospace and Entertainment Industry stakeholders will evaluate the team's transportation system concept, design, and presentation for technical merit, innovation, and entertainment potential.

Part D. SAE AEROCONNECT CHALLENGE™ EVALUATIONS

D.1 SCORING MATRIX

EVALUATION METHOD	MAX POINTS	DEADLINE
Technical Design Report	400	02/01/2021
Failure Mode Effects Analysis (FMEA)	100	02/01/2021
Preliminary Design Review Presentation	300	Onsite
SAE AeroTech Floor Showcase Booth	200	Onsite

D.2 DOCUMENT SUBMISSION PROCESS

All required submissions are to be submitted on www.saeconnectchallenge.com by the posted deadline. Additional information on the document submission process can be found at www.saeconnectchallenge.com/go/resources.

Part E. TECHNICAL DESIGN REPORT

E.1 OVERVIEW

The objective of the Technical Design Report is to convey how the Urban Air Mobility System is the most suited design to accomplish the intended objective. The Technical Design Report should explain the team's thought processes and engineering philosophy that drove them to their conclusions.

The Technical Design Report should contain a brief description of the Urban Air Mobility System with a review of a team's design objectives, system concepts, and a discussion of any important design features. The team should note or describe the application of analysis and testing techniques.

E.2 DOCUMENT SUBMISSION

The Technical Design Report must be submitted electronically in Adobe Acrobat Format (PDF) at www.saeeroconnectchallenge.com. The document must be a single file (text, drawings and optional content are all inclusive). The maximum size for the file is 10 MB.

E.3 FORMAT

The Technical Design Report shall not exceed fifteen (15) pages, including a cover page with team name, team number, and school name and team member names. If the design report exceeds fifteen (15) pages, the judges will only score the first fifteen (15) pages. All pages must be either 8 ½" x 11" or A4 size.

The Technical Design Report shall be formatted as a [SAE Technical Paper](#). In the event of conflicting requirements, this Technical Design Report rule supersedes the SAE Technical Paper Formatting (i.e. total report length).

E.4 EVALUATION

The total points available for the Technical Design Report evaluation will be valued according to the Scoring Matrix. The Technical Design Report will be scored based on such categories as:

- How does the proposed Urban Air Mobility System achieve the stated objective?
- How clearly does the design achieve the stated objective?
- How comprehensively is the design verified using computer aided drafting, analysis, simulation, and testing?
- How thoroughly are manufacturability, serviceability, and system integration addressed?

Additional information related to evaluating the Technical Design Report is available at www.saeeroconnectchallenge.com/go/resources.

Part F. FAILURE MODE EFFECTS ANALYSIS (FMEA)

F.1 OVERVIEW

The objective of the Failure Mode Effects Analysis (FMEA) is to describe all the potential failure modes that can occur, the strategy that is used to detect these failures and the tests that have been conducted to prove that the detection strategy works.

F.2 DOCUMENT SUBMISSION

The FMEA must be submitted electronically in Microsoft Excel (XLSX) format at www.saeaeroconnectchallenge.com. The maximum size for the file is 15 MB.

F.3 FORMAT

An FMEA template is available at www.saeaeroconnectchallenge.com/go/resources.

F.4 EVALUATION

The total points available for the FMEA will be valued according to the Scoring Matrix. The FMEA will be scored on a Pass/Fail basis.

Additional information related to evaluating the FMEA is available at www.saeaeroconnectchallenge.com/go/resources.

Part G. PRELIMINARY DESIGN REVIEW PRESENTATION

G.1 OVERVIEW

The objective of the Preliminary Design Review Presentation is to evaluate the engineering effort that went into the design of the Urban Air Mobility System and how well the team can communicate how their design best achieves the objective.

G.2 FORMAT

One or more team members may make the Preliminary Design Review Presentation to the judges. Following the presentation there will be time for clarification questions from the judges. Only the judges are permitted to ask questions. Any team member on the presentation floor may answer the questions even if that member did not speak during the presentation itself.

It is required that teams bring a laptop computer to show documentation or the engineering they have completed. The presentation area will include one monitor and one power outlet. Teams should be prepared to connect to the monitor with their own HDMI cable.

The Presentation Format will be as follows:

- 5 Minutes Presentation Setup
- 25 Minutes Technical Presentation
- 10 Minutes Question & Answer Sessions
- 5 Minutes Presentation Tear Down

G.3 EVALUATION

The total points available for the Preliminary Design Review Presentation evaluation will be valued according to the Scoring Matrix. The Preliminary Design Review Presentation will be scored based on such categories as:

- The technical content of the presentation
- The organization of the presentation
- The effectiveness of the visual aids
- The speaker's delivery
- The team's responses to the judges' questions

Additional information related to evaluating the Preliminary Design Review Presentation is available at www.saeaeroconnectchallenge.com/go/resources.

Part H. SAE AEROTECH FLOOR SHOWCASE BOOTH

H.1 OVERVIEW

The objective of the SAE AeroTech Floor Showcase Booth is to evaluate the ability of the university to communicate their solution to a broader audience.

The SAE AeroTech Floor Showcase Booth will be evaluated by industry representatives who will engage the university and ask questions. These judges will not identify themselves as judges. Universities should be prepared to engage all visitors.

H.2 FORMAT

Displays should not extend beyond the booth space (8'x8'). One 8' table and one power cord will be available at each booth for use by the university. Because of the convention center rules, no additional power lines can be used. No additional monitors will be provided.

Teams should plan accordingly to staff their booth while another portion of their team is presenting the Preliminary Design Review Presentation.

H.3 EVALUATION

The total points available for the SAE AeroTech Floor Showcase Booth evaluation will be valued according to the Scoring Matrix. The SAE AeroTech Floor Showcase Booth will be scored based on such categories as:

- The incorporation of technical content
- The effectiveness of visual aids
- The professionalism of booth attendants
- The first impression of the overall booth space
- The interactivity of the overall space

Additional information related to evaluating the SAE AeroTech Floor Showcase Booth is available at www.saeaeroconnectchallenge.com/go/resources.

Part I. SAE STANDARDS AVAILABLE TO TEAMS

I.1 ACCESSING SAE STANDARDS AVAILABLE TO TEAMS

All teams that participate in the SAE Collegiate Design Series and SAE Emerging Technology Series can access select SAE Standards at no cost. Additional information on accessing SAE Standards can be found at www.saeconnectchallenge.com/go/resources.

I.2 LIST OF SAE STANDARDS AVAILABLE TO TEAMS

General

- J1739 – Potential Failure Mode and Effects Analysis in Design (Design FMEA) Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA) and Potential Failure Mode and Effects Analysis for Machinery (Machinery FMEA)

AeroConnect Challenge™

- SAE AIR4845 - FMECA Process in the Concurrent Engineering Environment
- SAE AS8037™ - Minimum Performance Standard for Aircraft Position Lights

AutoDrive Challenge™

- J3016 – Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems
- J3018 - Guidelines for Safe On-Road Testing of SAE Level 3, 4, and 5 Prototype Automated Driving Systems (ADS)
- J3063 - Active Safety Systems Terms & Definitions

Baja SAE

- J586 - Stop Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width
- J759 - Lighting Identification Code
- J994 - Alarm - Backup – Electric Laboratory Tests
- J1741 - Discriminating Back-Up Alarm Standard
- J98 – Personal Protection for General Purpose Industrial Machines – Standard
- J183 – Engine Oil Performance and Engine Service Classification - Standard
- J306 – Automotive Gear Lubricant Viscosity Classification - Standard
- J429 – Mechanical and Material Requirements for Externally Threaded Fasteners – Standard
- J512 – Automotive Tube Fittings - Standard
- J517 – Hydraulic Hose - Standard
- J1166 – Sound Measurement – Off-Road Self-Propelled Work Machines Operator-Work Cycle
- J1194 – Rollover Protective Structures (ROPS) for Wheeled Agricultural Tractors
- J1362 – Graphical Symbols for Operator Controls and Displays on Off-Road Self-Propelled Work Machines - Standard
- J1614 – Wiring Distribution Systems for Construction, Agricultural and Off-Road Work Machines

- J1703 - Motor Vehicle Brake Fluid - Standard
- J2030 - Heavy Duty Electrical Connector Performance Standard
- J2402 - Road Vehicles - Symbols for Controls, Indicators and Tell-Tales - Standard

SAE Clean Snowmobile Challenge

- J192 - Maximum Exterior Sound Level for Snowmobiles
- J1161 - Sound Measurement - Off-Road Self-Propelled Work Machines Operator-Work Cycle
- J44 - Service Brake System Performance Requirements - Snowmobiles - Recommended Practice
- J45 - Brake System Test Procedure - Snowmobiles - Recommended Practice
- J68 - Tests for Snowmobile Switching Devices and Components - Recommended Practice
- J89 - Dynamic Cushioning Performance Criteria for Snowmobile Seats - Recommended Practice
- J92 - Snowmobile Throttle Control Systems - Recommended Practice
- J192 - Maximum Exterior Sound Level for Snowmobiles - Recommended Practice
- J288 - Snowmobile Fuel Tanks - Recommended Practice
- J1161 - Operational Sound Level Measurement Procedure for Snowmobiles - Recommended Practice
- J1222 - Speed Control Assurance for Snowmobiles - Recommended Practice
- J1279 - Snowmobile Drive Mechanisms - Recommended Practice
- J1282 - Snowmobile Brake Control Systems - Recommended Practice
- J2567 - Measurement of Exhaust Sound Levels of Stationary Snowmobiles - Recommended Practice

Formula SAE Hybrid

- J1318 - Gaseous Discharge Warning Lamp for Authorized Emergency, Maintenance and Service Vehicles
- J1673 - High Voltage Automotive Wiring Assembly Design
- J1772 - SAE Electric Vehicle and Plug in Hybrid Conductive Charge Coupler

Formula SAE

- SAE 4130 steel is referenced but no specific standard is identified
- SAE Grade 5 bolts are required but no specific standard is identified
- J183 - Engine Oil Performance and Engine Service Classification - Standard
- J306 - Automotive Gear Lubricant Viscosity Classification - Standard
- J429 - Mechanical and Material Requirements for Externally Threaded Fasteners - Standard
- J452 - General Information - Chemical Compositions, Mechanical and Physical Properties of SAE
- Aluminum Casting Alloys - Information Report
- J512 - Automotive Tube Fittings - Standard
- J517 - Hydraulic Hose - Standard
- J637 - Automotive V-Belt Drives - Recommended Practice
- J829 - Fuel Tank Filler Cap and Cap Retainer

- J1153 - Hydraulic Cylinders for Motor Vehicle Brakes - Test Procedure
- J1154 - Hydraulic Master Cylinders for Motor Vehicle Brakes - Performance Requirements - Standard
- J1703 - Motor Vehicle Brake Fluid - Standard
- J2045 - Performance Requirements for Fuel System Tubing Assemblies - Standard
- J2053 - Brake Master Cylinder Plastic Reservoir Assembly for Road Vehicles - Standard

SAE Supermileage

- J586 - Stop Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width