Emerging Technology Series

SAE AEROCONNECT CHALLENGE™ 2020 CHALLENGE RULESET

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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 identify a real-world connected aircraft problem and develop a UAV system to solve their identified problem. Immersed in the SAE International's AeroTech Americas conference, universities will present their solution in various ways including a technical design presentation and on the SAE International's AeroTech Americas show floor.

The SAE AeroConnect Challenge™ is the inaugural 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 connected aircraft.
- Participants will demonstrate the ability to research and define a problem statement currently experienced in the connected aircraft industry.
- Participants will demonstrate an ability to design a technically capable and affordable UAV system to meet the needs of the mission and stated requirements.
- 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 Americas 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 2020 SAE AeroTech Americas.
- Participants will receive admission to participate in the Meet the Sponsors reception at 2020 SAE AeroTech Americas.
- 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 responsibly 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 2020 SAE AeroConnect Challenge™ will be held on March 17-19, 2020 as part of 2020 SAE AeroTech® Americas in Pasadena, CA.

A.6 CHALLENGE REGISTRATION

Teams intending to participate in the 2020 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 01, 2019 10:00 AM ET
Registration will close at www.sae.org at December 2, 2019 11:59 PM ET

For additional information regarding how to register for the 2020 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 Americas 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.saeaeroconnectchallenge.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 UAV 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 March 02, 2020 at the following websites:

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

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

B.4 PARTICIPANT ELIGIBILITY AND TEAM LIMITS

Eligibility is limited to undergraduate and graduate students from an accredited university or college in the United States or Canada. 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.saeaeroconnectchallenge.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 of alcohol by an underage individual will be reported to the local authorities.

Part C. SAE AEROCONNECT CHALLENGE™ 2020 MISSION

C.1 2020 CHALLENGE MISSION DETAILS

Wildfires are expected to once again impact California in 2020, and local authorities are looking for new rapidly deployable Unmanned Aerial Vehicle (UAV) systems to support the fire-fighting mission. The primary missions of the UAV system shall be:

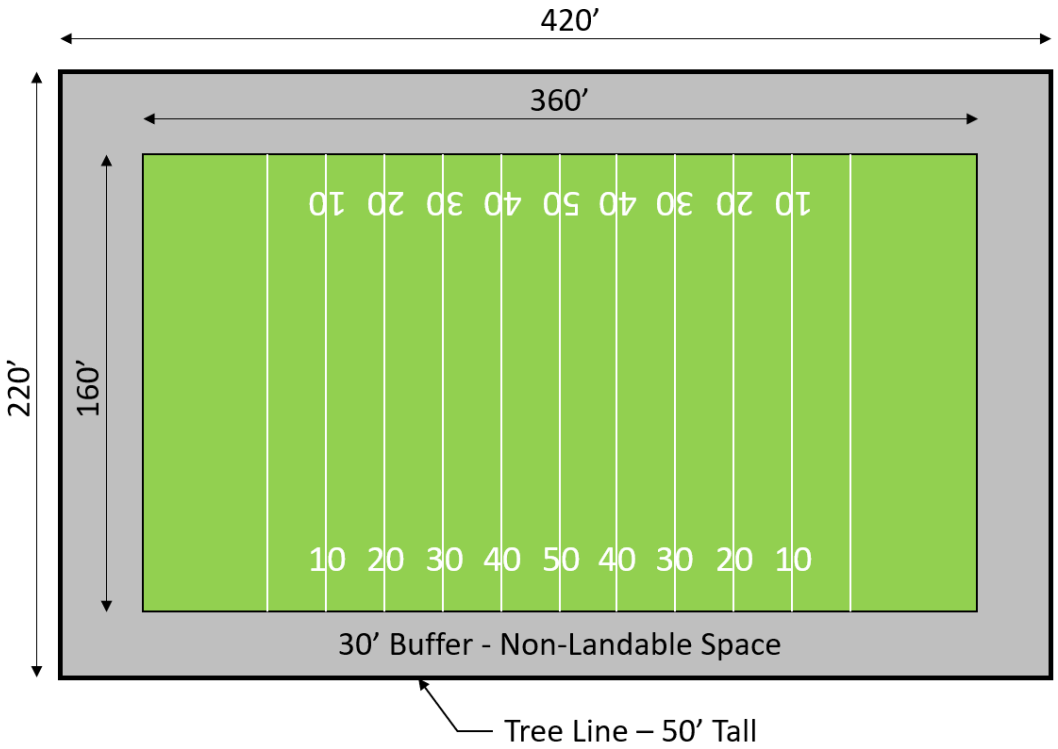
- **Fire Detection, Imaging, and Tracking**: The UAV system shall be capable of monitoring an area for new fires, provide imagery of on-going fires, and tracking of fire progression.

- **Fire Suppression Aircraft Routing**: Once a fire system is identified, the UAV system shall be capable of generating optimal routes for fire suppression aircraft into and out of the fire zone and disseminating those routes back to the ground station. Routes should ensure aircraft separation for ingress and egress of the fire suppression aircraft, as well as separation from any UAV traffic.

- **Persistent Communications Node**: Communication within a fire zone is critical, and lives have been lost due to communication failure. Standard Land Mobile Radios (LMR) work on Line-of-Sight, which can be a challenge in a mountainous fire zone. The UAV system shall serve as a persistent communications relay for LMRs in the VHF and UHF frequency ranges.

Additional Requirements:

- The entire UAV system shall pack into a single, standard 53-foot semi-truck trailer. Assume interior dimensions of:
  Length: 52’6”
  Width: 99”
  Height: 110”
- The UAV system shall be fully mission capable within 2 hours of arrival at the fire zone command station.
- The UAVs shall be fully autonomous, requiring only general initial navigational guidance to the fire from the operator. (e.g. GPS coordinate of the fire)
- The UAV shall use pump-gasoline (87-91 Octane) or battery power for propulsion to permit rapid and continuous operation.
- The UAV shall support a mission radius from launch and recovery site to the fire zone of at least 50 nautical miles.
- The UAV shall be capable of launch and recovery operations from a standard American Football field (with field goal posts removed), with a tree line 30 feet away in all directions made up of 50-foot trees. The 30 feet between the field and the tree line is not useable for takeoff and landing roll. Assume dimensions as shown:



- The UAV system shall be capable of being on-station over the fire zone continuously for an indeterminate length of time. (i.e. UAV endurance vs. Number of UAVs).
- The UAV shall be capable of operations at altitudes of at least 15,000 feet MSL and launch & recovery operations at altitudes of at least 7,000 feet.
- The UAV shall support ADS-B In and Out, and be capable of autonomous traffic avoidance.
- No single failure in the UAV system shall cause a loss-of-mission.
- No dual failure in the UAV system shall cause a loss-of-aircraft.

Teams are challenged to design and present a technically capable and affordable UAV system to meet the needs of the mission. For the purposes of this challenge, "UAV system" shall be defined as: Two or more UAVs, any required Ground Elements including launch & recovery element, ground support equipment, and transportation for the system.

Part D. SAE AEROCONNECT CHALLENGE™ EVALUATIONS

D.1 SCORING MATRIX

EVALUATION METHOD	MAX POINTS	DEADLINE
Technical Design Report	400	02/01/2020
Failure Mode Effects Analysis (FMEA)	100	02/01/2020
Preliminary Design Review Presentation	300	Onsite
SAE AeroTech Americas Floor Showcase Booth	200	Onsite

D.2 DOCUMENT SUBMISSION PROCESS

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

D.3 LATE SUBMISSION PENALTY

Late submission or failure to submit any report by the deadline will be penalized 20 points per day. Your team will be notified before or on the 4th day of no submission that we have not received your documents and after the 5th day your team's registration will be canceled, and no refund will be given.

D.4 AUTOMATIC WITHDRAWAL POLICY

Teams are required to submit several documents prior to the challenge that judges use to evaluate the team during the challenge. When these documents are not submitted, judges cannot properly assess the team.

If documents are received more than five (5) days late, the documents will be classified as "Not Submitted" and your team will be automatically withdrawn and therefore unable to attend the onsite challenge.

D.5 TIE BREAKERS

Ties for the any scored evaluation will be broken using teams' overall points total.

Part E. TECHNICAL DESIGN REPORT

E.1 OVERVIEW

The objective of the Technical Design Report is to convey how the UAV system is the most suited design to accomplish the intended mission. 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 UAV 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.saeaeroconnectchallenge.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 UAS system achieve the stated mission?
- How clearly does the design achieve the stated mission?
- 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.saeaeroconnectchallenge.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 (XLXS) 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 UAV system and how well the team can communicate how their design best achieves the mission.

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 AMERICAS FLOOR SHOWCASE BOOTH

H.1 OVERVIEW

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

The SAE AeroTech Americas 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 Americas Floor Showcase Booth evaluation will be valued according to the Scoring Matrix. The SAE AeroTech Americas 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 Americas 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.saeaeroconnectchallenge.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

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