Social Responsibility Report	April 17, 2020
Concept Design Report	April 30, 2020
Final Team Roster/Fast Track Roster	May 30, 2020

Article C4: Competition Document Penalties

DP.4.1 Late Submission Penalties

Documents or submissions that are uploaded after the deadline, or are submitted largely incomplete within the deadline, will receive a point penalty per day, based on the time difference between the deadline and the actual date and time of receipt or upload, subject to official discretion.

The applicable point penalties are shown below.

Document	Deadline	Penalties
Year 3 Safety Updates	January 30, 2020	-1 points per day
Autonomous Vehicle Safety Assessment Part 2	February 1, 2020	-1 points per day
Social Responsibility Report	April 17, 2020	-5 points per day
Concept Design Report	April 30, 2020	-5 points per day

Static Events

Article D1: Concept Design Report Year 3

CDR.1.1 Concept Design Report Objective

The concept of the design report is to evaluate the engineering effort that went into the design of the vehicle and how the engineering meets the intent of the autonomous market both in terms of vehicle performance and overall value. The intended audience for the report and presentation are professional engineers from the AutoDrive Challenge™ sponsor companies.

Teams will be required to submit a written concept design report before each year's competition and participate in an oral presentation at each year's competition (see Article 2 for presentation details). The format of the concept design report and review was the same, with growing complexity, for Years 1 and 2. For Year 3, the format has changed to focus on a few specific topics of your design as well as let your team discuss innovative features of your vehicle that are especially well done.

For Year 3, consider what your team has learned and what has changed in your design over the past 2 years. All Teams took away learnings from the Year 1 and Year 2 Competition that will have an influence on Year 3 designs. In your team's Concept Design

Report, explain how your design (both physical sensor suite and software algorithms) has changed to bring your vehicle to its current Year 3 implementation.

In addition to learnings over the competition years, a majority of the report for Year 3 will focus on 5 Innovative Concepts of your Team's Vehicle. Three (3) concepts have been chosen for the teams and two (2) concepts are up to the discretion of your team. Choose an innovative concept or topic that your team has implemented above and beyond the rules of the competition and that your team is the proudest of. Submit your two innovative topics by **January 31st, 2020** to receive approval from the rules committee. Teams are welcome to submit their topics for approval earlier. Approval is to ensure your team has chosen topics which align with the intent of the report.

CDR.1.2 Concept Design Report Contents

The judges will evaluate the Concept Design Report based on the Design Judging Score Sheet found at http://www.autodrivechallenge.com.

1. Abstract
2. Introduction
    a. Introduce your vehicle and what has changed between Years 1, 2 and 3.
    b. Briefly introduce the 5 Innovative Concepts that will be discussed in detail later in the report
3. Concept 1 - Navigation
    a. Explain how your team's vehicle will perform the required navigation in Year 3. Given an address and/or POI, how does your vehicle determine a route? Given a road blockage, how does your vehicle re-route? Were the HERE Maps utilized in your system? If so, explain how they were used.
    b. Include helpful test results and figures to support the discussion
4. Concept 2 – Loss of GPS
    a. If your vehicle loses its GPS, how will it react in order to keep SAE standard Level 4 Autonomy? Describe in detail how your system detects the loss, and the fall back strategy when GPS is not present, and how this aligns with the SAE Level 4 Autonomy safety strategy.
    b. Include helpful test results and figures to support the discussion
5. Concept 3 – RADAR Utilization
    a. How did you integrate RADAR into your system? What is it used for in your team's perception strategy? If you did not use RADAR, please explain why it was not used.
    b. Include helpful test results and figures to support the discussion
6. Concept 4 – Teams Choice
    a. Choose an innovative concept that your team has implemented in your vehicle
    b. Include helpful test results and figures to support the discussion
7. Concept 5 – Teams Choice
    a. Choose an innovative concept that your team has implemented in your vehicle
    b. Include helpful test results and figures to support the discussion
8. Patents, Papers and Conferences

a. List of all patents, papers and conferences written and attended by the Team throughout all 3 years of the competition

9. Conclusion
10. References

CDR.1.3 Concept Design Report Format

The Concept Design Report must not exceed twenty-five (25) pages:

- 5 Pages for Introduction, Year 1 to Year 3 vehicle design changes, conclusion, Patent/Papers/Conferences and references
- 4 Pages per Concept

All Concept Design Reports should be put into SAE Technical Paper Formatting. See website for format. In the event of conflicting requirements, this Concept Design Report Article supersedes the SAE Technical Paper Formatting (for example, total report length).

Article D2: Concept Design Event Year 3

The onsite concept design event for Year 3 will be a twist on the well-known show Shark Tank. For the AutoDrive Challenge™, this will be known as "Innovation Tank"! Each team will choose one of the innovative concepts from their Concept Design Report and sell it to the judges.

For the presentation, each team will sell their innovation to the judges. Scoring will be based on the team's presentation skills, marketing scheme feasibility, innovative-ness, and technical feasibility. Teams do not need to provide an overall cost of their innovation as no actual selling or purchasing will be taking place amongst the teams and the judges.

CDE.2.1 Judging Criteria

Judges may or may not have read each team's Concept Design Reports.

Team's will be graded not only on the content of the presentation but also on the quality of the content's delivery.

90% of the Team's Score will be an average of all judges scores (judging score sheets found in CDE.2.2).

10% of the Team's Score will be based on each judge's willingness to "partner" with each team. Each judge will be able to choose 4 teams and the teams chosen by the most judges will receive the most points. The 4 teams chosen are up to the judge's discretion of what they feel are the most innovative concepts.

CDE.2.2 Score Sheet

The Design Judging Score Sheets are available at http://www.autodrivechallenge.com.

The organizing committee strongly urges all teams to read and study the score sheets and all other documents related to design judging that are available on the website.

CDE.2.3 Support Material

Teams are encouraged to bring with them to the Concept Design Event any of the following:

- Photographs
- Drawings

- Plans
- Data collections
- Computer results
- Charts
- Example components
- Other materials that they believe are needed to support the presentation of the vehicle and the discussion of their innovative concept
- Marketing materials

All Teams will be required to use the LCD Projector and large Screen provided by the Transportation Research Conference Center in the presentation room.

.

CDE.2.4 Judging Procedures - Onsite

- Teams will have up to 15 Minutes to present their innovations, followed by a 15 minute question and answer time with the judging panel.
- The presentation itself will not be interrupted by questions.
- Teams can select up to 6 student members (maximum of 2 graduate students and the rest undergraduate students) of the team to present
- Undergraduate students must give at least fifty percent of the presentation.
- Faculty and the GM Mentor are not permitted to present during the design event or answer questions for the team.
- Teams will have 10 minutes prior to their presentation to set up their extra materials and get their vehicle ready for display and presentation. Teams will be presenting in a partitioned off area with their vehicle. Official schedule, location and times will be available to teams in the student handbook released prior to the event.
- There will be up to 10 judges grading each presentation. These judges will be volunteers from sponsor companies and be from various backgrounds in the Autonomous Vehicle industry.

CDE 2.6 Judging Process

Competition judges will observe and score the quality of student teams' responses to the challenge (paper and presentation). Judges will evaluate the performance of the participants per the standards and criteria provided. All decisions by judges are final and not subject to critique, challenge or reconsideration under any circumstances.
Participants are not allowed to approach judges to solicit feedback or comments outside of what is provided by the competition process under any circumstances. Violation of this rule could result in being disqualified from the competition. A judge may abstain from input or voting on a team or otherwise disqualify himself or herself if he or she feels his or her participation in the round of competition reflects a conflict of interest due to prior relationship (e.g., employment, academic, familial) with individual team's members or if participation will create an appearance of impropriety.

Article D3: Social Responsibility Report Year 3

Year 1 AutoDrive Challenge™ asked teams to examine "the case for developing autonomous driving technologies through the three critical aspects of sustainability (economic, environmental and social) and present the case for a "shared value" definition of Corporate Social Responsibility (CSR) within a "new mobility ecosystem". Each team examined how it should respond to concerns over autonomous driving passenger vehicles from the three aspects of sustainability: economic, environmental, and social. Teams tackled this theme by considering how to pitch its involvement and acceptance of autonomous vehicle design and discussed main points of how the technology would save lives by reducing human error.

Year 2 AutoDrive Challenge™ asked teams to advance Year 1's theme with continued focus upon safety and public (social) opinion of "growing public concern over the benefits of this emerging technology"…and address how "some argue that "driverless cars" pose critical moral dilemmas that need to be addressed prior to advancing technology in this area". Many teams looked at the very public autonomous accident(s) that occurred and then pointed how the OEM's design and operational mistakes resulted in a dangerous and deadly situation.

These Social Responsibility assignments addressed internal components of autonomous vehicles for awareness, safety and acceptance. Teams haven't reviewed the roots of Social Responsibility, how it is promoted, and how it is sustained given the complexity of melding industrial, technological, and societal goals. And after these three goals are considered, where does academia fit and how does it keep up? Who will lead, who will follow, and who will footprint the ever-changing development of our new autonomous society?

During the early 1900s, automobile manufacturers in the US and worldwide were introducing vehicles and parts, but they were specializing their products to service only their own designs. Henry Ford's cars could only use Ford parts, etc. With his encouragement, major OEMs began to join trade groups and these trade groups worked together to standardize measurements within the vehicle, thereby standardizing the parts so a bolt made for one manufacturer's vehicle could also be used in a competitor's vehicle. The development of standard parts allowed invention to spread and advance for the betterment of humanity as technology was shared.

SAE's vision: "SAE is the leader in connecting and educating mobility professionals to enable safe, clean and accessible mobility solutions" (SAE Website) and through engagement with industrial, technological, and societal leaders continues to champion efforts to bridge the existing gap for academia. Through our consistency with working toward mobility solutions, SAE's reputation of creating operational and safety standards ensure its vision is safeguarded.

The AutoDrive Challenge™ team was approached in 2018 by the Office of Disability Employment Policy, (ODEP), a focus group dedicated to promoting inclusion and acceptance of improving employment opportunities for individuals who otherwise are hindered due to access or transport to and from work.

Through discussion the AutoDrive Challenge™ team learned that in usual circumstance, technology is launched and then accessibility is considered. As an example, the smart phone was distributed and then the makers found ways for blind or physically disabled individuals to use voice command. The AutoDrive Challenge™ competition is a first chance to consider accessibility before industry launches to the masses.

Year 3 AutoDrive Challenge™ Social Responsibility is asking teams to help SAE bridge the academia gap in a partnership with ODEP and write a 10-15-page standard for autonomous mobility that includes accessibility. Teams are tasked to research, analyze and standardize their best practice autonomous vehicle design that provides a safe and operationally user-friendly environment for the general public which includes disabled citizens.

SRR.2.3 Research Paper Process

1. Team members will receive a presentation at Kick Off regarding SAE Standards Writing.
2. Teams will review The Department of Justice's 2010 ADA Standards for Accessible Design. This review is for the construction of buildings, walkways, and otherwise Civil planning and its reference will help teams understand how existing policies and practices are determined and promoted (written).
3. Teams will log into Mobilus and review one or two existing mobility standards as a reference to SAE format, language, and purpose for standard promotion. A suggested standard to review is J1495 Surface Vehicle Standard: Test Procedure for Battery Flame Retardant Venting Systems. This standard was Published in 2013 and is currently being revised to reflect current needs, and its length, format and style match the requirements for the Year 3 assignment.
4. Combining the ADA Standards for Accessible Design, and SAE standard publication style, teams will choose at least one (and no more than three) disability challenges to address emotional, physical, or physiological categories to mobility and autonomous vehicle options. Ride sharing or personal vehicle are specific transportation methods to explore.
5. Teams will utilize ODEP's website https://www.dol.gov/odep/ as its main statistical reference as well as the DOJ's ADA Standards publication referenced above to develop a working standard not yet published.

SRR.3.3 Research Paper Requirements

1. Concept design will be an original proposal using reasonable and logical critical and strategic thinking. (In short, there is no seek and find answer. Teams will need to use processes that consider what is, what will be, and what plausibly can infiltrate the autonomous vehicle culture for all.)
2. Teams will consider the economical and societal implications of the standard. (As an example, if ride sharing is chosen, and an accessible component is added, how will that impact riders who are not considered disabled? How will the adaptation impact cost?)
3. The paper's design will include no more than 30% illustration, graph, or other visuals.
4. The paper will include in-text citations and a Works Cited page in MLA format.

SRR.3.4 Judging Process

Competition judges will observe and score the quality of student teams' responses to the challenge (paper and presentation). Judges will evaluate the performance of the participants per the standards and criteria provided.

All decisions by judges are final and not subject to critique, challenge or reconsideration under any circumstances. Participants are not allowed to approach judges to solicit feedback or comments outside of what is provided by the competition process under any circumstances. Violation of this rule could result in being disqualified from the competition. A judge may abstain from input or voting on a team or otherwise disqualify himself or herself if he or she feels his or her participation in the round of competition reflects a conflict of interest due to prior relationship (e.g., employment, academic, familial) with individual team's members or if participation will create an appearance of impropriety.

SRR.3.5 Violation of Rules

The rules of ethics and academic integrity apply, meaning that plagiarism, using faculty in the writing of papers or presentations, and theft of other team's ideas will be considered a violation and the team eliminated from the competition. All sources for information, data, research and reports must be cited using MLA or AMA style of writing, format and citations. Any violation of these rules either intentionally or unintentionally will result in an appropriate sanction that includes assessment of a penalty, disqualification from the competition and/or the return of prize money. The imposition of sanctions is within the sole discretion of the Organizing Committee and is not subject to discussion, debate or challenge.

Article D4: Social Responsibility Event Year 3

SRE.4.1 Social Responsibility Presentation Format

- Each team can structure the presentation based on their own needs and style but a formal presentation document (PowerPoint) is required.
- Up to 4 team members form the presentation group and will give the presentation to the judging panel (maximum of 2 graduate students and the rest undergraduate students) of the team to present during the presentation.
- All team members who are part of the presentation group must be in the presentation area when the presentation starts and must be introduced and identified to the judges.
- Team members who a part of this are "presentation group" may answer the judge's questions even if they did not speak during the presentation itself.
- Presentations are limited to a maximum of thirty (30) minutes. The judges will stop any presentation exceeding thirty minutes. The presentation itself will not be interrupted by questions.
- Immediately following the presentation there will be a question and answer session of up to ten (10) minutes. Only judges may ask questions. Only team members who part of are the "presentation group" may answer the judges' questions.

SRE.4.2 Evaluation Criteria

Presentations will be evaluated on content, organization, visual aids, delivery and the team's response to the judges' questions. The Social Responsibility Presentation Events total score is based on the average of the judges' scores.

SRE.4.3 Judging Process

Competition judges will observe and score the quality of student teams' responses to the challenge (paper and presentation). Judges will evaluate the performance of the participants per the standards and criteria provided. All decisions by judges are final and not subject to critique, challenge or reconsideration under any circumstances. Participants are not allowed to approach judges to solicit feedback or comments outside of what is provided by the competition process under any circumstances. Violation of this rule could result in being disqualified from the

competition. A judge may abstain from input or voting on a team or otherwise disqualify himself or herself if he or she feels his or her participation in the round of competition reflects a conflict of interest due to prior relationship (e.g., employment, academic, familial) with individual team's members or if participation will create an appearance of impropriety.

Article D5: MathWorks Simulation Challenge Year 3 – 50 Points

MathWorks will be compiling a separate Simulation Challenges document detailing this year's Simulation Challenge to be released by October 2019 and will be hosting a Workshop at SAE Headquarters in November 2019 for further detail.

Technical Inspection

Article E1: Vehicle Requirements & Restrictions

TI.1.1 Technical Inspection

The following requirements and restrictions will be enforced through technical inspection. Noncompliance must be corrected, and the vehicle re-inspected before the vehicle can operate under power.

TI.1.2 Modifications and Repairs

Once the vehicle is approved to compete in the dynamic events with all technical stickers, the ONLY modifications permitted to the vehicle are those done during or after their practice period(s) and before their scored runs.

The vehicle must maintain all required specifications throughout the competition as approved by their technical inspection passing. If any changes are made after practice periods an official competition Technical Inspector must approve and note these edits on the team's technical inspection sheet before they run their scored Challenges.

Once the vehicle is approved for competition, any damage to the vehicle that requires repair, (e.g. crash damage, electrical or mechanical damage, will void the Technical Inspection Approval. Upon the completion of the repair and before re-entering into any dynamic competition, the vehicle MUST be re-submitted to Technical Inspection for re-approval.

Article E2: AutoDrive Challenge™ Technical Inspection Pre-Competition Trainings & Documents

The AutoDrive Challenge™ Organizing Committee will offer the following pre-competition trainings for all those working on the vehicle or driving/operating the vehicle during planned workshops throughout the year.

RRAM.2.1 Roof Rack Mounting Design Pre-Check Form

Each team will need to submit a Roof Rack Mounting Design Pre-Check Form to show their antenna placement and design for the scoring team to be able to determine if this set up is an approved configuration for the

OXTS installation of scoring equipment in your team's vehicle. Scoring antenna mounting requirements are listed in your Series Resources for download. The form can be downloaded from your series resources and uploaded in the approved space on www.autodrivechallenge.com

HV.2.2 High Voltage System Safety Training

All AutoDrive Challenge™ team members who will be working with the GM vehicle shall complete the GM High Voltage System Safety Training. Initial training will be provided at Milford Proving Ground.

DT.2.3 Driver Training

All AutoDrive Challenge™ Safety Drivers and operators who will be working on the Bolt EV shall complete the following training:

1. Emergency Stop (E-Stop) Button Operation.
2. Vehicle Level Hazard Training – Vehicle Safety Drivers will be trained via experiences of worst-case actuator malfunctions and the expected methods for maintaining safe control of the vehicle.

ONLY trained Safety Drivers shall drive the vehicle. A list of trained Safety Drivers shall be maintained by respective schools.

Article E3: Systems Safety & Technical Reports (Year 3)

SSTR.3.1 Procedure

The goal throughout the competition is to ensure autonomous vehicle safety within a closed course competitive environment. This goal is accomplished two-fold:

1) "Design for Safety" AutoDrive Challenge™ teams shall understand the real risks autonomous technology introduces and how to reduce these risks in a systematic way.

Year 1) Goal is met through an introduction to functional systems safety principles through a Safety Concept, a Preliminary Hazard Analysis (that defines hazards and safety goals), and an Interface Analysis. Teams are expected to revisit and revise these analyses each year.

Year 2) Goal is met through providing requirements traceability to safety goals and through analysis of the system design through a DFMEA and Software Safety Analysis.

Year 3) Goal is met through formally defining the Operational Design Domain (ODD), Object, Event, Detection & Response (OEDR), and addressing Safety of the Intended Functionality (SOTIF).

2) "Formally Documenting Safety" AutoDrive Challenge™ teams shall be exposed to real world processes and deliverables through the compliance to the GM Development Vehicle Usage Level (DVUL) process and by creating a student version of the NHSTA Voluntary Safety Self-Assessment (VSSA) for Autonomous Vehicles

Year 1) Goal is met through drive logs, safety inspections, and maintaining DVUL 1 compliance

Year 2) Goal is met through working towards VSSA work products (AutoDrive Challenge™ Autonomous Vehicle Safety

Assessment- Part 1) and working towards DVUL2-MM certification

Year 3) Goal is met through completing the VSSA work products (AutoDrive Challenge™ Autonomous Vehicle Safety Assessment- Part 2)

Teams should become informed about the NHSTA Voluntary Safety Self-Assessment (VSSA) Report under the Federal Automated Vehicle Policy 2.0. < https://www.nhtsa.gov/document/automated-driving-systems-20-voluntary-guidance> and become familiar with public reports that have been released by existing AV companies (such as GM's report found here: < https://www.gm.com/content/dam/gm/en_us/english/selfdriving/gmsafetyreport.pdf >. Under the Federal Automated Vehicles Policy 2.0 producers of automated vehicles are requested to submit a VSSA. Aligning AutoDrive Challenge™ with the VSSA provides an opportunity for the teams to create meaningful deliverables that are established by federal entities.

The Student Version VSSA will ask for reporting on 7 safety topics. (omitting 6 areas from the VSSA guidance that are not applicable to a student competition and adding one additional area). The Student Version VSSA will be known as the AutoDrive Challenge™ Autonomous Vehicle Safety Assessment. Year 3 deliverables are bolded in the accompanying text.

AutoDrive Challenge™ Autonomous Vehicle Safety Assessment referencing the FAVP2.0 shall include the following elements:

- **System Safety (Required Updates for Year 3)**
- Fallback (minimal risk condition) [MRC] (Year 2)
- Human Machine Interface [HMI] (Year 2)
- **Operational Design Domain [ODD] (Year 3)**
- **Object and Event Detection and Response [OEDR] (Year 3)**
- **Validation Methods (Year 3)**
- **Sufficiency of Autonomous Safety (Year 3)**

Note: the following sections in the FAVP2.0 are not required: Data Recording, Vehicle Cyber Security, Crashworthiness, Post-Crash ADS Behavior, Consumer Education and Training, Federal, State, and Local Laws (defined by challenge rules). In place of removed sections add additional area: Sufficiency of Autonomous Safety Proposal (Year 3) address the question "when an autonomous vehicle is safe enough to pull out the safety driver?"

TD.3.2 Technical Document Deliverables for Year 3

TD.3.2.1 Systems Safety Year 3 Updates (20pts)

AutoDrive Challenge™ teams are required to provide updates to their existing Systems Safety Concept Report, and Preliminary Hazard Analysis (PHA). The Year 3 updates should have particular interest in the area of 'Safety of the Intended Functionality' [See ISO/PAS 21448]. Teams shall analytically examine what has been done via design and test to minimize the risk of failures stemming from 1) technological limitations (ie. FOV

limitations, limitations during weather, exiting the ODD, etc), 2) system definition shortcomings (ie. algorithm makes an incorrect determination even when all the inputs are correct because of incomplete consideration of the particular use case, or algorithm has not been designed to consider this particular use case, etc.), and 3) reasonably foreseeable misuse (ie. overconfidence). Teams are asked to define requirements together with qualitative and quantitative criteria for satisfying the SOTIF. A formal analysis method is requested. One method to consider is the Systems Theoretic Process Analysis (STPA). Teams are not required to use this analysis approach but should if a suitable alternate method is not found. https://psas.scripts.mit.edu/home/get_file.php?name=STPA_handbook.pdf

https://www.iso.org/standard/70939.html

VSA.3.2.4 AutoDrive Challenge™ Autonomous Vehicle Safety Assessment (30pts)

Building off of work completed during the Year 2 challenge, AutoDrive Challenge™ teams shall complete the Autonomous Vehicle Safety Assessment. The Assessment will include the sections created in Year 2

Part 1: Completed Under Year 2 rules included 4 sections:

1. Introductory material
2. Systems safety
3. Fallback strategy
4. Human-Machine Interface strategy.

- **The introductory material** set the stage highlighting a focus on safety and understanding and appreciation of the risks and benefits of autonomous technology as well as the teams' safety goals. *Update only if safety goals were added or modified.*
- **The Systems Safety** analyses completed and how that creates a safer vehicle. *Update with any relevant additional analyses. Update with SOTIF considerations.*
- **The Fallback** (Minimal Risk Condition) Strategy section shall define states of minimal risk and implementation strategy when/if encountering faults. *No updates from year 2 expected unless desired by team.*
- **The Human-Machine Interface** (HMI) Strategy shall define strategy for HMI leveraging previously completed work (i.e. mode switch, driver takeover, etc.). *No updates from year 2 expected unless desired by team.*
- Expected updates to these sections are worth a combined 10pts

Part 2 To Be Completed Under Year 3 includes 4 New Sections:

5. Operational Design Domain [ODD] (Year 3)
6. Object and Event Detection and Response [OEDR] (Year 3)

7. Validation Methods (Year 3)
8. Sufficiency of Autonomous Safety (Year 3)

- **Operational Design Domain [ODD]** Utilizing a domain taxonomy define where and under what conditions the vehicle is authorized to operate under. (5 pts)
- **Object, Event Detection and Response [OEDR]** Provide a definition of objects and expected events within the ODD and how the vehicle, through behaviors, must identify these objects and events and provide a safe response. Utilize a consistent taxonomy. (5 pts)
- **Validation Methods** Provide a discussion on validation methods, such as bench test, simulation, and full vehicle tests. How they are selected and how they correspond to requirements, traceability strategy, and how validation serves to ensure safe operation of the vehicle. (5 pts)
- **Sufficiency of Autonomous Safety** This section must present a response to the question of when would an autonomous vehicle (LIV+ SAEJ3016) be considered sufficiently safe to operate without a driver. The response should consider design, analysis, as well as quantitative and qualitative verification and validation criteria. (5 pts)

- These eight sections shall be combined into a single visually appealing document. (5 pts overall document)

Article E4: AutoDrive Challenge™ Development Vehicle Usage Level (DVUL - Safety Requirement)

The Chevy Bolt EV donated to teams will be a Level 1 DVUL. For Year 3 Competition, AutoDrive Challenge™ teams are expected to maintain DVUL 1 criteria to be part of the competition and target DVUL2 - Manual Mode (MM) certification (DVUL2-MM is optional if teams benefit).

DVUL.4.1 DVUL Level 1 Definition (Vehicle Status at Delivery to Teams)

DVUL Level 1 vehicle rating allows usage on Controlled, Closed Course Usage Only by approved and trained Safety Drivers. This level allows a limited, highly knowledgeable set of trained drivers to operate the vehicle on a controlled, closed course, such as an access-controlled parking lot.

The following Vehicle Control System functions are required to maintain DVUL Level 1 rating:

1. Self-Remediation by the system under certain hazardous failure conditions (Production validated), braking, steering, and propulsion control systems shall not be modified from delivered condition to the teams.
2. Driver Secured Remediation via E-Stop (or other AutoDrive Challenge™ approved back-up means) with verified capability to place the vehicle in a safe state when any hazardous failure conditions occur.
3. During automated driving operation, the vehicle speed shall be limited to 25 MPH, this will be the as delivered limit of the vehicle.

4. Verify that the vehicle contains a placard, which is very visible to the driver that contains detailed information on the state of the vehicle, what to do in case a hazard occurs and who to contact. A placard will be provided as an appendix to these rules.

DVUL.4.2 DVUL Level 2-Manual Mode Definition

DVUL 2-Manual Mode (MM) is optional for year 3. If you have obtained DVUL 2-MM in year 2 no action is required for year 3 unless changes were made to the year 2 applicable work products.

DVUL 2-MM grants limited public road usage in manual mode by trained and approved drivers (as well as closed controlled course in AV and Manual Mode). *Note that Autonomous mode shall only be enabled on a closed course regardless of DVUL level. For DVUL 2-MM teams are required to meet requirements per the table below before being issued the DVUL 2-MM placard.*

Public road usage is expected for transporting the vehicle to a test site or to collect data. The driver cannot be responsible for any other task beyond driving (for example driver cannot operate a laptop, log data, etc.).

Driving off property is expected to be minimized, and teams must have plated and insured their vehicle based on their vehicle donation agreement document.

Activity	Deliverable
Safety Logs	Safety log for all driving operations (manual and autonomous)
Technical Inspection Check List	Mentor completed technical inspection list
Safety Analyses	Demonstration of plan for Year 3 Completion of deadlines and documents
Approved Driver Training List	List of approved drivers (licensed and trained)
Operating Routes	Map with routes of where vehicles will be driven identifying safety critical signs (such as traffic lights, speed limits, stop signs, school zones, etc.)
Autonomous Mode Isolation Switch Design and Usage Testing	Provide design schematics for isolation of autonomous commands to actuators either by physically disconnecting (from chassis bus / high speed bus) or by providing two inhibits, such as 1) insert and turn switch key, 2) depress switch. Provide a comprehensive test strategy that is approved by GM Safety to validate switch. A lockage/keyed switch is recommended.
Public Road Usage Checklist	New checklist which must include items such as: notifying faculty advisor of when off property usage will take place, description of route, who will be driving and who else is in the car and their function, test start and stop time, miles driven, issues encountered, what to do in case of an emergency (call 911)

The completed DVUL-Level 2 Manual Mode packet (the above chart deliverables) should be uploaded to the http://www.autodrivechallenge.com in the upload slot for this document in PDF form. Once submitted there will a two-week review process and a decision on the driving will be issued back to the team on the website. If accepted, then you will receive a sticker for validation and approval on the vehicle.

DVUL.4.3 Vehicle Usage Modes

Vehicle shall have a physical mode switch to allow usage in 1 of 2 distinct modes: (1) Manual Mode and (2) Autonomous Mode. Manual Mode shall be the default mode following full power down/up of the vehicle (by stopping and restarting vehicle through master Stop/Start switch in instrument panel) and re-entering the Autonomous Mode shall require a physical switch selection in addition to other control system initialization following restart. Physical switch selection and necessary operation is a key vehicle inspection item.

Manual Mode

Manual Mode is the default conventional driving mode with inherent safety and driving properties identical to the base production vehicle. The Manual Mode operation shall be as near to production configuration (as provided by GM) as possible. Manual Mode will be verified upon completion of all vehicle preparation steps and prior to first approval to drive GM-provided vehicle. The expectation is that any restart of the vehicle will put the vehicle in Manual mode and that Manual Mode configuration will remain unchanged such that DVUL2-MM usage by authorized drivers is always available to team members.

In Manual Mode, control system commanding or active assist of any actuator or other vehicle controls shall NOT be allowed. Teams shall demonstrate sufficient isolation of automated actuator controls in their design while in Manual Mode to ensure no unintended commands at any time. Drivers in Manual Mode shall keep hands on the wheel at all times and provide human control like any conventional vehicle. As such, all driver information or alerts required to drive the vehicle safely and per all applicable laws shall be functional.

Autonomous Mode

Autonomous Mode is the mode used for the AutoDrive Challenge™ Competition events and will be a driver-supervised fully automated driving mode with a human driver monitoring but not interfering with automation. The human monitor shall be able to intervene to control the vehicle at any time through takeover of either brake, steering, or propulsion. Driver supervision by trained human monitor is a significant enabler for safe evaluation of unproven automated vehicle control systems on closed or local road networks. Once activated, the Autonomous mode shall meet all automation and human monitor requirements stated in these rules. The expectation is that Manual Mode is initially verified and will not change even as significant changes occur in the Autonomous controls system.

Article E5: AutoDrive Challenge™ Technical Inspection Testing & Verification

TI.5.1 Pre-Driving Inspection Check List – (Download Technical Inspection Checklist for Explanation of Each Area)

1. Documentation
   a. DVUL Level Placard
   b. Approved Driver List (and verification of Driver's License for each competition driver) **All safety drivers must be present at inspection**
2. Exterior Light Operation
   a. Brake Lights

   b. Front Lamps
   c. Rear Lamps
   d. Left & Right Turn Signals
   e. Hazard Lights
   f. Blue Autonomous Warning Light (See Section TI.4.3)
3. Drivability
   a. Battery Level/Range
   b. Telltales/Messages
   c. Interior Displays
   d. Tires
4. Sensors & Visibility
   a. Vision Sensor Set(s)
   b. Hood
   c. Trunk
5. Occupant Safety
   a. E-Stop
   b. Restraints
   c. Doors
   d. Seats
   e. In-vehicle equipment
6. Braking System
   a. Brake Pedal
   b. Park Brake
7. Steering System
   a. Steering Wheel
8. Software
   a. Software Version
   b. Controller (Brakes)
   c. Controller (Steering)
   d. Controller (Propulsion)
9. Other
   a. Vehicle Damage
   b. Under Hood
   c. Up to date logbook from testing (printed version)
   d. A Fire Extinguisher
      Should be rigidly clamped/secured inside of the vehicle.
      Should be easily accessible in the event you need to assist another vehicle

TI.5.2 Driving Test Inspection

1. Three people will be in the vehicle:
   a. a Safety Driver
   b. one additional team member
   c. an official Technical Inspector
2. Proper E-Stop usage will be shown during a short drive to ensure proper safety driver reaction. ALL drivers who will be participating in the competition

must have taken the proper Driver Training at General Motors Proving Grounds, Milford, MI.

3. Teams will be asked to enter into autonomous mode, demonstrate that the Blue Autonomous Warning Lights activate automatically when autonomous mode is engaged. Then teams will be asked to disengage through their preferred method of takeover (braking or steering) and demonstrate that the vehicle is now in manual mode and the Blue Autonomous Warning lights automatically deactivate.

TI.5.3 Blue Autonomous Warning Light

The first light shall be on the exterior of the vehicle, mounted to the roof. The exterior blue light serves as a warning to others around the vehicle that Autonomous Mode is active. **The light must be visible in daylight conditions by an observer on all sides of the vehicle and from at least 200 Feet away**. Teams should select their own mounting design strategy. Teams must design into their autonomous control system the ability control the light. It is required that the control system turn on the light when entering Autonomous Mode and turn off the light when exiting Autonomous Mode for any reason, including when the Safety Driver performs a manual take over. **This functionality will be tested during Tech Inspection and if it does not automatically function in this manner it will need to be resolved before passing Tech Inspection and continuing in the Year 3 Competition**. As an example, teams may choose an exterior light similar to this:
https://www.amazon.com/MATCC-Emergency-Magnetic-Warning-Cigarette/dp/B01L94RC9W/ref=sr_1_9?ie=UTF8&qid=1489073844&sr=8-9&keywords=blue+strobe+light
The second light shall be on the interior of the vehicle, mounted on the dashboard. The interior blue light serves as an indicator to judges and passengers that autonomous mode is active. The light must be visible from any seat in the vehicle. The interior light should be turned on and off in sync with the exterior light.
As an example, teams may choose an interior light similar to this:
https://www.amazon.com/Alpinetech-Metal-Indicator-Pilot-Custom/dp/B00GNQXLQ0/ref=sr_1_13?ie=UTF8&qid=1490129247&sr=8-13&keywords=blue+led+indicator+light
The functionality of both lights will be checked during the Driving Test Inspection as described in section TI.4.2

NOTE: Teams must design to allow for 3 persons to fit in the car:

- A safety driver,
- 1 other team passenger
- An official during the challenges.
- Build envelope is one foot off the bumpers and one foot past the side view mirrors. Space for a judging DAC will be marked and cannot be encroached on.

Dynamic Event & Procedures

Article F1: Overview

AutoDrive Challenge™ Year 3 will have one Dynamic Challenge consisting of 3 Routes. The objective of this challenge is to portray a ride sharing vehicle (your autonomous Chevy Bolt EV) that must navigate a series of address points and perform pseudo "drop off" and "pickup" operations. The Year 3 Dynamic Challenge will be a culmination of components from both Year 1, Year 2. This Dynamic Challenge will be a much longer drive scenario than the past two years. The address points will be pre-determined and mapped by HERE for the purposes of the competition.

Article F2: Year 3 Dynamic Challenge Procedures and Definitions

Teams will be given two days of practice in which they will each have 30-minute blocks of time twice a day (4 total sessions over the two days) to run practice routes using addresses to navigate. Objects will be located throughout the two practice days to gain practice and testing on both dynamic and static objects, traffic signals, and traffic signs.

Following 2 days of practice will be 3 scored days for the total dynamic points. Each of the scored days will have 30 minutes non-scored practice in the morning using the same address points as the scored afternoon but will not contain dynamic/static objects, controlled traffic lights, blocked roads, or signs in the correct placement that will be present in the afternoon scored route. The afternoon scored Route will have a 20-minute time limit.

Teams are encouraged to keep a continuous path of travel in autonomous mode throughout the entire route, but if you cannot complete a segment within the route you will forfeit any potential points you could have earned for the remainder of that segment. Teams who cannot complete a segment will manually drive to the next address within the route to re-engage autonomous mode continuing that route.

Dynamic Day 1– Morning Route 1 - 30 minutes non-scored practice

Afternoon Route 1 - 30-minute non-scored practice

Dynamic Day 2 – Morning Route 2 - 30 minutes non-scored practice

Afternoon Route 2 - 30-minute non-scored practice

Dynamic Day 3 – Morning Route 3 - 30 minutes non-scored practice

Afternoon Route 3 – 20-minute scored run for 180 points

Dynamic Day 4 – Morning Route 4 - 30 minutes non-scored practice

Afternoon Route 4 – 20-minute scored run for 180 points

Dynamic Day 5 – Morning Route 5 - 30 minutes non-scored practice

Afternoon Route 5 – 20-minute scored run for 260 points

The below is a list of high-level objectives that teams should expect to see in the Year 3 Dynamic Challenge. The full breakdown of metrics will be provided to teams in a supplementary document in your series resources to provide the breakdown of each dynamic route scoring. Including items such as drive quality metrics and individual object breakdowns.

- Teams will be expected to stay in autonomous mode throughout the entire length of the challenge.
- Teams will encounter a completely closed road and must avoid construction to re-route and navigate to the next address

- Teams may not perform U-Turns.
- Teams will encounter traffic signals that will require your vehicle to deal with red, yellow, and green light configurations including flashing (red) and directional arrows.
- Teams will encounter paved roads that may have minimal or no markings and may need to rely on the HERE map for navigation of those areas.
- Teams will encounter a cul-de-sac that does not have markings but will be in your HERE Map.
- Teams will encounter both white and yellow lines, dashed and solid.
- Teams will need to be able to arrive at an address, stop and shift into park for a minimum of 5 seconds then continue the route to the next address.
- Teams will encounter stop signs with and without limit lines and will be required to stop within a certain distance specified in the metrics.
- Teams will encounter both static and dynamic objects throughout the challenge and will have to react appropriately.
- Teams will encounter traffic control signs and will be required to react appropriately.
- Teams will encounter intersections both controlled and uncontrolled.
- Teams will encounter crosswalks with and without pedestrians present. If a pedestrian is at a crosswalk you must react appropriately by waiting for the pedestrian clear roadway before proceeding.

The larger driving challenge will have several different parts. The definitions include **Route**, **Segment**, and **Checkpoint.**

Route – The Year 3 competition will include 1 driving challenge with 3 scored routes of address points that connect to form an optimal route using your HERE mapping data. Routes will be given to teams at least 30 days prior to competition.

Segment– between each address points within the longer route will be segments that connect each address point to another. Routes will contain up to 4 segments made up of up to 5 addresses. One Segment can be made up of several streets and turns between addresses

Checkpoint – Checkpoints are obstacles or traffic controls encountered within each segment. These checkpoints are opportunities for teams to accumulate points.

Did Not Start (DNS)

Teams will receive a DNS for any segment that they do not autonomously cross the segment start. A DNS is given when your team does not attempt to autonomously drive a segment within the route.

Did Not Finish (DNF)

Exceeding the Challenge Time Limit

Teams will have a maximum of 20 minutes to complete the scored challenge each day. Timing begins once the Green Staging light is illuminated by the scoring officials at the Starting line of the Challenge. The Challenge timer will stop once the vehicle reaches the Finish line of the final segment of the route within the challenge. Any points earned up to that point are kept. Exceeding the challenge time limit ends your route attempt for that day.

Collisions

Colliding with any object will be considered a Collision DNF for that segment. Any points earned up to that point are kept and the following segments can still be attempted after manually proceeding to the next address.

Off Course

An Off Course DNF occurs when the vehicle has all four (4) tires outside the course boundary indicated by yellow lines, solid white lines, or pavement edges. The vehicles that have gone off course must immediately be stopped and exit autonomous mode. Any points earned up to that point are kept and the following segments can still be attempted after manually proceeding to the next address.

Manual Overrides*

Any manual intervention by the Safety Driver or student passenger of the autonomous system will be considered a Manual Override DNF. This includes driver interventions with any of the following;

1. Power button
2. Accel pedal
3. Brake pedal
4. E-stop
5. Steering wheel
6. ETRS
7. Parking Brake

Most manual overrides will be scored based on CAN messaging signals for Year 3. A full list of messages/signals will be published in your Series Resources by Kick Off in October 2019.

Any points earned up to that point are kept and the following segments can still be attempted after manually proceeding to the next address.

.

Exceeding Speed Limit

The maximum vehicle speed limit is 25 mph. Exceeding this speed will result in a DNF. Any points earned up to that point are kept and the following segments can still be attempted after manually proceeding to the next address.

NOTE: Based on extenuating circumstances and investigation of a root cause(s), judges have the discretion to remediate the situation on any initially determined DNF if the situation arises. No protest can be made by teams on this issue and organizing authority will stand.

Starting Order

Starting order will determined by the organizing committee and posted in the Student Handbook prior to competition. The organizer will determine the allowable windows for each run and retains the right to adjust for weather or technical delays. Teams that have not run by the close of the event will receive 0 points for the Challenge.

Starting

Staging lights will be used to indicate the approval to begin. Once approval to begin is given, the teams are to activate Autonomous Mode for the vehicle to start. Timing begins once you are given the Green light from the staging lights regardless on if you cross the Challenge Start line. Once you arrive at the starting line no further driving or dynamic testing can be done (i.e. you cannot drive around to adjust your GPS at the starting line).

Article F3: Software and Calibration Changes

During the Dynamic Event days at any time software and calibration changes will be permitted.

Article F4: Vehicle Integrity and Disqualification

During the Dynamic Events, the mechanical integrity of the vehicle must be maintained during the challenge. Any vehicle condition that could compromise vehicle integrity or could compromise the track safety or pose a potential hazard to participants, spectators, and volunteers will be a valid reason for exclusion by the official until the problem is rectified.

Article F5: Access to Dynamic Event Areas

The organizing committee will specify areas of the event such as the waiting area for dynamic events where only team members wearing official dynamic passes (3 will be given at registration) may gain access and the number of tools that may be used in this area may be restricted. Please refer to the student handbook to understand the specific restrictions on this competition.

Article F6: Weather Conditions

The organizing committee reserves the right to alter the conduct and scoring of the competition based on weather conditions to maintain safety of the participants and volunteers at any given time.

Article F7: Flags & Timing Lights

Each dynamic event will use staging lights to start the route. Teams will pull up to the start line and receive a Green light to begin the route each day. Flags will only be used in an emergency and only RED which will halt all operations.

RED FLAG – Immediate stopping of all activity, and vehicles.

Scoring & Protests

Article I1: Official Scores

All official AutoDrive Challenge™ scores will be posted on the official webpage, and on the AutoDrive Challenge™ App.

Article J2: Protests

It is recognized that thousands of hours of work have gone into all aspects of the competition and teams are entitled to all the points they can earn. We also recognize that there can be differences in the interpretation of rules, the application of penalties and the understanding of procedures among volunteers and participants. The Organizing Committee will make every effort to fully review all questions and resolve problems and discrepancies.

P.1.1 Cause for Protest

A team may protest any rule interpretation, score or official action (unless specifically excluded from protest) which they feel has caused some actual, non-trivial, harm to their team, or has had a substantive effect on their score.

Teams may not protest rule interpretations, modifications, or actions that have not caused their own team any substantive damage. (i.e. on behalf of another team).

P.1.2 Protest Format and Forfeit

All protests must be filed in writing (form can be downloaded from www.autodrivechallenge.com) and presented to the SAE Competition Manager by the team's captain. The team captain must then meet with the Organizing Committee and verbally present the protest. The team captain may, at his or her discretion, bring one team faculty advisor and/or one other team member, but the team captain must present the protest and lead the discussion of any questions from the Organizing Committee.

To have a protest considered, a team must post bond of 25 points. These points will be subtracted from the team's overall score if the protest is rejected.

P.1.3 Protest Period

Protests concerning any aspect of the competition must be filed within the protest period which is one-half hour (30 minutes) after the posting of the scores of the event to which the protest relates.

P.1.4 Decision

The decision of the competition Organizing Committee regarding any protest is final.