ESF Template description

Society of Automotive Engineers of Japan, Inc.（JSAE）

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Introduction

➤ This document is an instruction manual for the ESF (Electric Systems Form) for the EV class of Formula SAE Japan (FSAEJ) organized by JSAE.

➤ The ESF is called a template in the FSAE Rules.
In FSAEJ, it is customary to refer to it as "form", "format" etc., but both are synonymous with "template" in the SAE Rules.

➤ This document is an explanation of how to write an ESF and is not about rule interpretation or design method.

What is Electric Systems Form (ESF)

ESF clearly documents the entire EV's electrical system

EV.2.1 Electrical System Form – ESF

EV.2.1.1 Each team must submit an Electrical System Form (ESF) with a clearly structured documentation of the entire vehicle electrical system (including control and Tractive System). Submission and approval of the ESF does not mean that the vehicle will automatically pass Electrical Technical Inspection with the described items / parts.

EV.2.1.2 The ESF may provide guidance or more details than the Formula SAE Rules.

EV.2.1.3 Use the format provided and submit the ESF as given in section DR - Document Requirements

ESF Approval ≠ Electrical Inspection Completed

Participation Rules, Article 16 Submission of EV-ESF

1. Aim of submission

The screening of electrical system design documents is emphasized as the most effective means of ensuring the safety of EV design, and enabling to proceed to Dynamic Events.

Scope of ESF (EV-class)

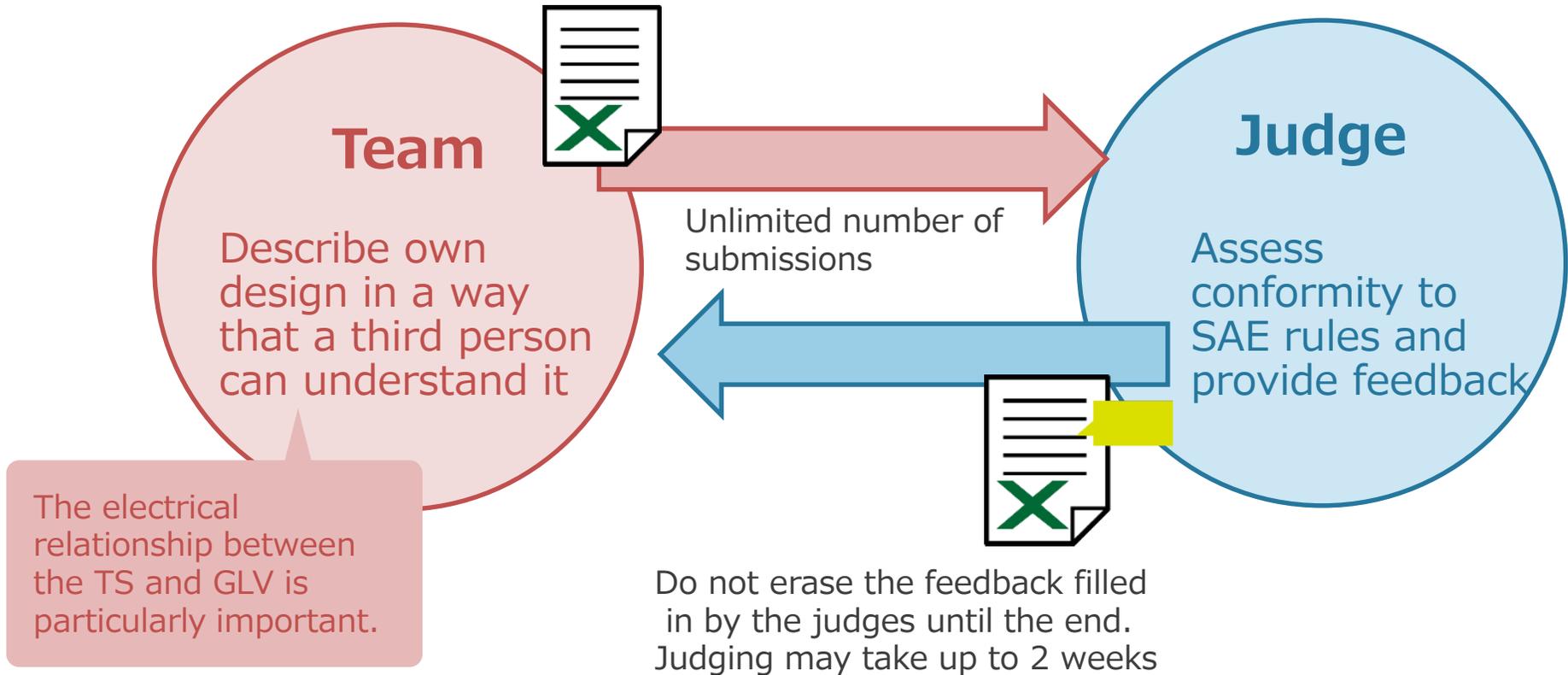The ESF allows a large number of Electric Inspection items to be confirmed in advance.

If the team is unable to complete the ESF, it may be difficult to complete the Electric Inspection during the competition.

		Electrical System	others
Static	Cost Event	◯	◯
	Design Event	◯	◯
	Presentation Event	△	△
Inspection	Mech Inspection		◯ Pre-confirmation by ESF
	Elec. Inspection (incl. rain test)	◯ Pre-confirmation by ESF	

Procedure

For the team, the ESF is the electrical design document for the entire vehicle system.

The ESF is used by the auditors themselves to check the compliance status of the electrical system rules.

Team

Describe own design in a way that a third person can understand it

The electrical relationship between the TS and GLV is particularly important.

Unlimited number of submissions

Judge

Assess conformity to SAE rules and provide feedback

Do not erase the feedback filled in by the judges until the end. Judging may take up to 2 weeks

Role as a design document in ESF

■ Get an objective view of your design
- Clarify design specifications and use the ESF as a blueprint
- Use it to debug the vehicle and validate its operation
- Update the ESF if the information in the ESF does not match the information in the vehicle.

■ Each person who reads the ESF understands the design details and shares information and knowledge.

■ Transfer vehicle technology to younger members
- The younger members understand the design concept/structure and make the design better.

Requests from judges

- **The judges are not familiar with your vehicle**
  The judge only receives information about the vehicle from the ESF. It is acceptable to use additional comments to supplement the description of the vehicle so that the judges understand that the vehicle meets the SAE Rule and is safe.

- **The judge knows the SAE Rule**
  It is not necessary to explain the content of the rule. Just quote the SAE Rule number.

- **Be aware of the judges' point of view**
  The judges will check the ESF in order of priority: (1) compliance with the rules, (2) safety, and (3) ability to perform dynamic judging. There are cases where additional explanations are requested regarding (2) and (3), but the ESF will be better if it is described from the judges' point of view in advance.

- **The ESF must be passed.**
  If the ESF is not passed, the number of items to be judged will be extremely large. Due to time constraints, it is very difficult to pass the vehicle inspection during the competition period.

- **No judge wants to fail your ESF**
  The judges want to support your team, so do your best to get a pass!

The following pages explain how to write the ESF

ESF-format major changes from 2023 to 2024

10_Other TSAL Location and TSAL Visibility are added

- Describe where is the TSAL mounted on the vehicle and visible from. Front, side, and rear view drawings should be attached.

How to describe "9_Procedure" collectively

- Include any information that needs to be verified prior to operation.

- The procedures should be numbered.

- The procedures are written so that a person unfamiliar with the vehicle (e.g., a new team member, judge, etc.) can work safely after reading the procedures.

  - Example of a point of view
    - What kind of action does the ESO supervise?
    - Is there anything to check before donning protective equipment?
    - What type of personal protective equipment should be worn correctly, etc.?
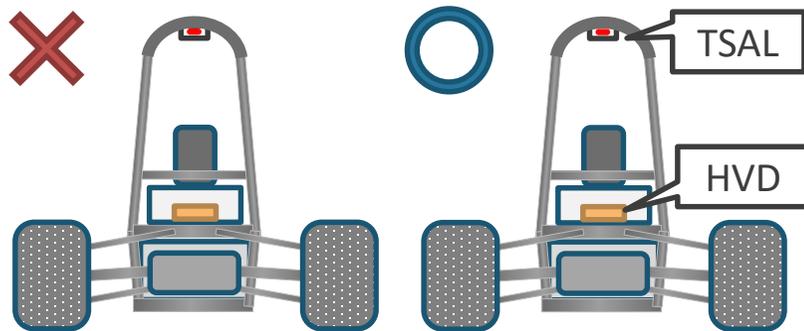
How to improve drawing and photo

Point of attention must be clearly indicated

Don't just insert a drawing and/or picture
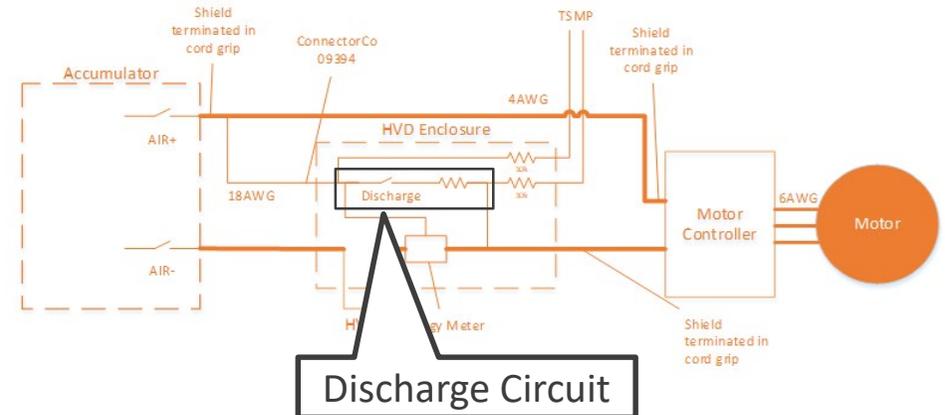Clearly indicate what you want the judges to see for better understanding

e.g. : TSAL and HVD location
    Be labeled with text for objective understanding

e.g. : Diagram
    Be labeled with text for more focus

Fill out "2_Datasheets" completely

If a particular cell is empty, the drop-down list does not work properly.

The example below shows,
if you filled in a Resistor's cell in the "2_Datasheets", a drop-down list of cell in another sheet is displayed. If you did not filled it, an empty drop-down list is displayed.

2_Datasheets

									OK
Resistors									
Manufacturer	Part Number	Voltage [V]	Resistance [Ω]	Power [W]	Power for 15 sec [W]	Heatsink [°C/W] (Enter "None" if no heatsink)	Datasheet	Location Used	
Tigers	100	600	500	5	15	None	test	TSMP	OK

5_PrechargeDischarge

TSMP		BLANK
Resistor		BLANK
# parallel	Tigers 100	BLANK
# series		BLANK
Resistance		#N/A
Cont power		#N/A
Voltage		#N/A

! Caution !
If you change the entry in the "2_Datasheets" reference after selecting it from the drop-down list, you must reselect it from the drop-down list again.

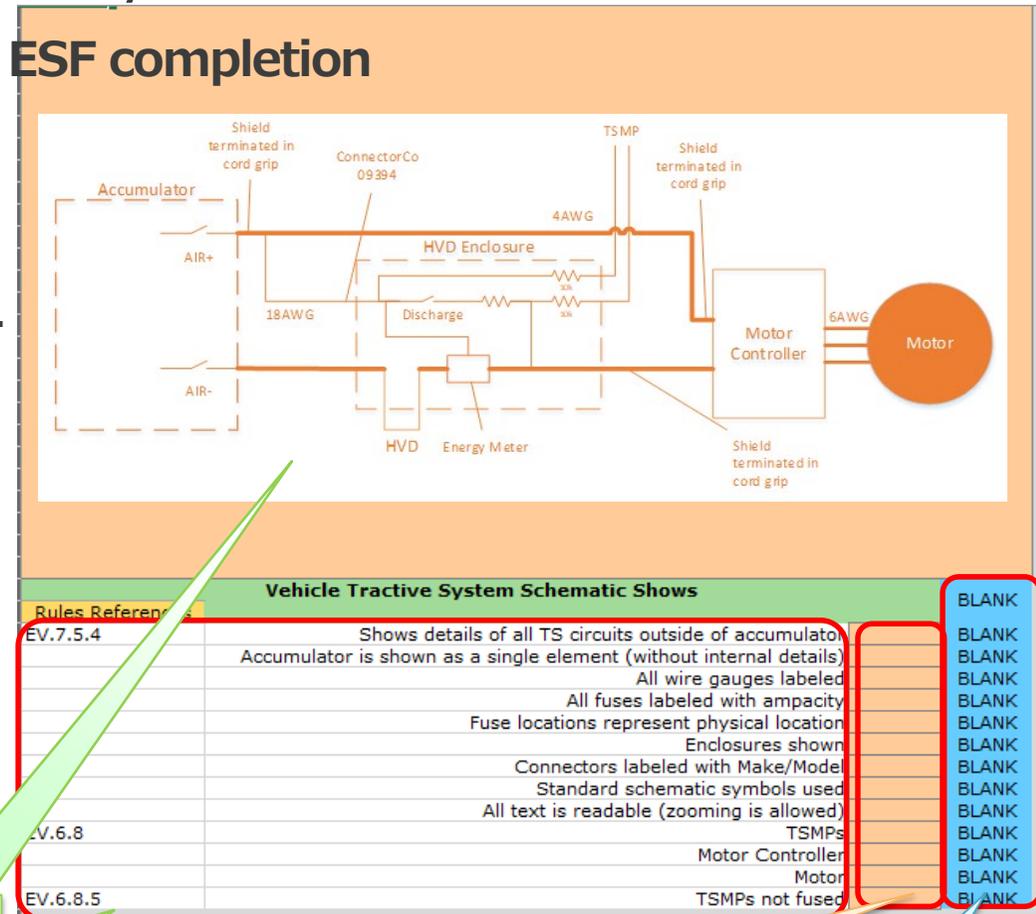Your changes will not be reflected automatically.

Cell entry and auto-judgment by Excel

Auto-judgment **"OK" does not mean ESF completion**

As shown in the figure on the right, when an entry is selected in an orange cell, an auto-judgment is displayed in a blue cell.

If there is a mismatch between the diagram and TRUE/FALSE, the blue cell is OK.
However, if the judge cannot find the listed item from the diagram, the ESF cannot pass this section.

Vehicle Tractive System Schematic Shows

Rules Reference			BLANK
EV.7.5.4	Shows details of all TS circuits outside of accumulator		BLANK
	Accumulator is shown as a single element (without internal details)		BLANK
	All wire gauges labeled		BLANK
	All fuses labeled with ampacity		BLANK
	Fuse locations represent physical location		BLANK
	Enclosures shown		BLANK
	Connectors labeled with Make/Model		BLANK
	Standard schematic symbols used		BLANK
	All text is readable (zooming is allowed)		BLANK
EV.6.8	TSMPs		BLANK
	Motor Controller		BLANK
	Motor		BLANK
EV.6.8.5	TSMPs not fused		BLANK

The diagram above should be filled with components on the list below at least.

Select TRUE/FALSE

Excel judges automatically

How to use "Additional Comments"

Auto-judgment **"WARNING" ≠ "ESF fail"**

- If a blue cell is marked "WARNING", the "Additional Comments" section should be filled in to describe the foreseeable reason for the "WARNING" and the basis for the design, etc.

- If the design is reasonable and meets the rules, this section may be qualified.
- If the blue cell is marked "BLANK" or "#N/A", the entry is missing and should be reviewed.

BLANK	#N/A	WARNING	OK
✗	✗	✗ ⭕	✗ ⭕
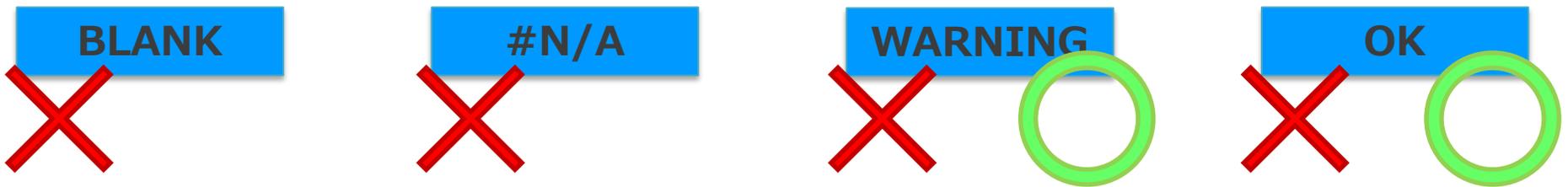
- To help the judges understand, use Additional Comments aggressively for the team's innovations, explanations of diagrams, etc.

    -Additional Comments sections are provided throughout for documentation of things which the team feels are not adequately documented in the provided fields. These are optional and do not need to be completed.

Diagram and drawing should be readable

Judges will enlarge ESF drawings for detailed review.

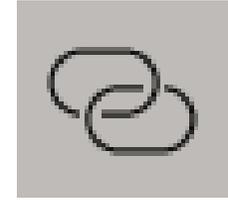■ "Instructions" on "1_Overview" about the ESF

-For sections which require an image or schematic, The image should be pasted and located over the specified area. Images should be pasted at a high resolution and then resized. This allows the reader to zoom into the image if more resolution is required.

■ e.g. Cell input

All text is readable (zooming is allowed) | TRUE | OK

**Use a diagram with an appropriate resolution
that allows for legible (=readable) text and symbols.**

How to desctibe "11_Appendix Datasheets"

- ■ "Instructions" on "1_Overview"

-Where datasheets are requested, a hyperlink to the datasheet from the manufacturer must be provided. Only when a link to the outside does not exist, a hyperlink to the datasheet in the "11_Appendix Datasheets" must be provided.

- ■ Hyperlink the Datasheet* field.
  Parts for which a Datasheet is being required should have a hyperlink to the information provided by the manufacturer.
  However, only when there is no external link, the necessary information should be pasted into "11_Appendix Datasheets" in the ESF, and a hyperlink (cell reference) should be set in the Excel book.

※ Datasheet : Component specifications
　　　　　　　　e.g. Specifications, instruction manuals, catalogs, and other documents

Torque Control Path Security Checks

## Signal transmission from APPS to Motor Controller

Torque Control Path Security Checks									BLANK	
Source Device	Destination Device	Communication	Redundant	Out Of Range	Correlation	Checksum	Timeout	Other		Additional Comments
APPS	①	②	③	③	③	③	③		BLANK	

1. The contents entered in "Destination Device" are entered in "Source Device" one line below.

2. Communication
   - Select the communication protocol from Analog or Digital

3. Redundant and Timeout
   - The security check from Source to Destination should be described.
   - If you cannot find the appropriate words, YES/NO is also acceptable.

Other Notes

➢ **Input character type**
Use single-byte alphanumeric characters. Incorrect input character types may result in incorrect calculations.
Japanese (double-byte characters) may be used for sentences such as "Additional Comment.

➢ **Number of characters to be entered**
Fill in as many characters as necessary in a cell, even if the input box is too small to write in.
If not all are shown in a cell, the auditor should expand the input box to check.

*Cell size cannot be changed.
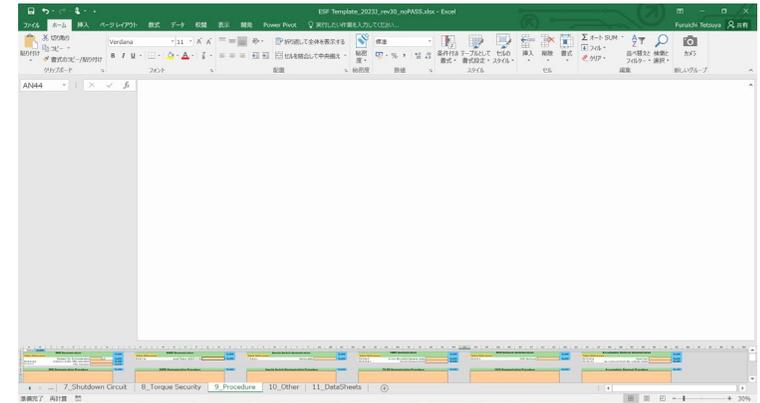
➢ **Review Comments**
 This entry is for judges' feedback only.

➢ **Alteration is prohibited.**
Do not edit anything except orange cells
(including "11_Appendix Datasheets" Worksheet).
Do not change it.

In Case of Trouble

➢ Understand what is required by the "formula" of the cell to avoid mistakes.
- The judgment formula automatically determines whether or not the input matches the specified conditions and whether or not there are any input errors.

➢ Understand all the Rules
- Read the official JSAE rules (Formula SAE® Rules 2024, Local Rules, Participation Rule) and other documents (Q&A, Design Guides, etc.) carefully.

Submission of EV-ESF (2024 FSAEJ Participation Rules, Article 16)

3. Initial Submission
- **If, at the time of initial submission, approximately 1/3 or more of the sections are found to be blank, or if the designated form is not used, the document shall be treated as not submitted.**
- Even in the case of an initial submission that has not been submitted, if the applicant submits the documents again within the initial submission deadline and the reviewer finds that the contents have been improved, the submission will be treated as an initial submission.
- **It is recommended to submit the documents well in advance of the deadline.**

4. Resubmission, and Final Resubmission
- If the first submission is not accepted, the applicant will be asked to resubmit.
- The second submission after the initial submission must be made by the "Second Submission Deadline".
- **Re-submission is possible after receiving feedback from the auditor and can be done any number of times without waiting for the deadline.** (Please note that the method of feedback is different from that of SES submission as stipulated in Article 14 above.)
- The order of passing the ESF and compliance with the resubmission deadlines will be one of the factors in determining the order in which EVs will be inspected at the competition.
- **Feedback from the judges may take up to 2 weeks.**
- The ESF feedback may not be provided to teams that are unable to participate in the EV and technical vehicle inspections.

How to communicate with the judge

The judge use the "memo" function of Excel (or the "comment" function in versions prior to Office365).
Do not delete the contents of any feedback* in the "Memo" ("Review Comments") without the judge's permission.

- The judge will note the feedback comments in the "Memo" and/or "Review Comments" in the format <Review(s)Judge>.
- Do not delete feedback remarks in the "memo" and/or "Review Comments" to preserve the history of previous reviews and prevent backtracking.
- The team's response to the judge's feedback should also indicate <Review(s) Team Writer>.

e.g.

*feedback in the "memo"