



# Technology Innovation Forum for Agricultural Nurturing

An Engineering Students' competition for Agricultural solutions

## RULE BOOK

(Rev 1.1, 20<sup>th</sup> Sep 2022)

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## A. Part A: ADMINISTRATIVE REGULATIONS

### A.1 General information

The Rules for SAEINDIA-OFFHIGHWAY BOARD- TIFAN (Technology Innovation for Agricultural Nurturing) 2023 events conducted in India are comprised of the TIFAN Official Rule 2023, hereinafter referred to as can be downloaded from the participants from the SAEINDIA TIFAN website <http://saeindia.org/tifan/>.

### A.2 Functions and roles

#### A.2.1 Organizing Authority:

The SAEINDIA OFFHIGHWAY BOARD (SAEI-OHB) that organizes the TIFAN event and all the personnel acting on its behalf.

#### A.2.2 Team:

The group of individual students with a team name and one Machine that team has developed and that has been accepted for entry to the TIFAN competition.

#### A.2.3 Participant:

Student member of the participating team.

#### A.2.4 Team Captain:

A Participant from the team that has been appointed on the event registration document as a single focal point for his/her team towards the Organizing Authority.

#### A.2.5 Technical Head:

The person appointed by the Organizing Authority, who is responsible to manage and sanction all static as well as field technical activities of TIFAN competition.

#### A.2.6 Field Marshall:

A person appointed by the Organizing Authority to act on their behalf, to ensure on field safety and observe on-field rule compliance.

#### A.2.7 Convener:

A person appointed by the Organizing Authority, who is responsible to ensure the conduct of the TIFAN competition.

#### A.2.8 Organizing Committee:

A team comprising the members comprised of members, from various supporting agencies, organizations institutions etc. and acting as honorary working board for planning, execution and supporting this TIFAN event

#### A.2.9 Steering Committee:

An advisory committee usually made up of high-level stakeholders and/or experts from various supporting agencies, organizations institutions etc. who provide guidance and direction on key issues such as policy and objectives, budgetary control, marketing strategy, resource allocation, and decisions involving large expenditures.

### A.3 Overview of Competition

#### A.3.1 Competition Objective:

The SAEI-OHF TIFAN competition, challenges teams of undergraduate engineering students to conceive, design, fabricate, develop, and compete with self-propelled or implement based farm machinery, in an event with field demonstration. This engineering event gives teams the maximum design flexibility and the freedom to express their creativity and imaginations, however there are very few restrictions on the overall machine design as explained in this rule book.

#### A.3.2 TIFAN 2023 Theme:

The TIFAN 2023 competition is designed to evolve around the theme of challenges in Vegetable Transplanting and thereby the theme chosen for this year is “Automated Multi Vegetable Transplanter”. For Chili, Brinjal, tomato saplings. Teams are expected to conceive, design, and develop and demonstrate a working level prototype of farm machine at the specified venue with the laid down criteria and requirements laid down in this rule book. The very design objectives of this competition are as below.

- i. The teams are to assume that they work for a design firm that is designing, fabricating, testing, and demonstrating a prototype of self-propelled or tractor mounted implement type automated Multi vegetable transplanter for a new and emerging market.
- ii. The Machine should have good performance in terms of productivity, coverage, fuel economy, damage to crop, cleanliness of crop, operator comfort, handling, and operating speeds, braking and safe to the operator as well as bystander. It should be sufficiently durable to successfully complete all the events described in the TIFAN competition rules.
- iii. Once the Machine has been completed and tested, your design firm will attempt to “sell” the design to a fictitious “company” that is considering the production of Automated Multi Vegetable Transplanter.
- iv. Each design will be judged and evaluated against other competing designs to determine the best overall Transplanter.
- v. Good Engineering Practices: Machines entered to TIFAN competitions are expected to be designed and fabricated in accordance with good engineering practices by the engineering students and without professional help.
- vi. Team which is participating more than a year and qualified for final event will be called as old team
- vii. Teams are also encouraged to explore addition of features, enabling the machine’s utility for transplanting Chili, Brinjal, tomato saplings.
- viii. Team may also upgrade the machine to be used as prime mover enhancing the “kW/ha” farm power, which is one of the missions of TIFAN competition. (e.g., Pump set for field or for irrigation purpose)



#### A.3.3 Open Registration:

TIFAN Competition have open registration policies and accept registrations by student teams representing universities duly recognized by UGC/AICTE/ICAR which have a SAEINDIA Collegiate Chapter/club.

#### A.3.4 Official announcement and competition information

Teams are required to read the articles posted on the SAE India homepage ([www.saeindia.org](http://www.saeindia.org)) published by TIFAN Organizing Committee. Teams must also be familiar with all official announcements concerning the competitions and rule interpretations released by the TIFAN Organizing Committee.

#### A.3.5 Official language:

The official language of the TIFAN competition is English. Document submissions, presentations and discussions in English are acceptable at all parts of the competitions.

### A.4 TIFAN Competition and Organizing Authority

#### A.4.1 Rules Authority & Validity

The rules for the competition are issued under the authority of TIFAN Organizing Committee and are valid for the calendar year of the competition. Ambiguities or questions concerning the meaning or intent of these rules will be resolved by the TIFAN Organizing Committee and the organizing committee decisions will be final in such cases.

#### A.4.2 Rule's compliance

By entering the TIFAN competition, the team, members of the team as individuals, faculty advisors and the University agree to comply with and be bound by, these rules and all rule interpretations or procedures issued or announced by SAEINDIA, the TIFAN Organizing committee and the other organizing bodies.

The Organizing Authority reserve the right to rescind machine approval upon further or more detailed checks. The Organizing Authority must be notified of any modifications to the machine after inspection. Non-compliance with the rulebook will lead to Machine disqualification.

#### A.4.3 Understanding the Rules

Teams are responsible for reading and understanding the rules in their entirety for the competition in which they are participating. The section and paragraph headings in these rules are provided to facilitate reading: they do not fully explain all the paragraph contents.

#### A.4.4 Loopholes

It is virtually impossible for a set of rules to be so comprehensive that it covers all possible questions about the machine's design parameters or the conduct of the competition. Please keep in mind that safety remains paramount during TIFAN competition, so any perceived loopholes should be resolved in the direction of increased safety/ concept of the competition. All teams should comply and adhere to all government rules and regulations applicable.

#### A.4.5 Participating in the competition

Registered teams, team members as individuals, faculty advisors and other representatives of a registered university/institute who are present on-site at a competition are "participating in the competition" from the time they arrive at the event site until they depart the site at the end of the competition or earlier by withdrawing.

#### A.4.6 Violations of the Intent

The violations of the intent of a rule will be considered a violation of the rule itself. Questions about the intent or meaning of a rule may be addressed to TIFAN Organizing Committee or Technical Inspectors.

#### A.4.7 Right to Impound

SAEINDIA and TIFAN Organizing Committee reserves the right to impound any onsite registered machines at any time during a competition for inspection and examination by the Organizing Authority, officials, and technical Inspectors.

#### A.4.8 General Authority

SAEINDIA and TIFAN organizing committee reserve the right to revise the schedule of any competition and/or interpret or modify the competition rules at any time and in any manner that is, in their sole judgement, required for the efficient operation of the TIFAN event.

#### A.4.9 Restriction on machine use

Teams are cautioned that the machine designed in compliance with the TIFAN rules are intended for competition operation only at the official TIFAN competition and students are refrained to operate such prototype at competition site only. TIFAN organizing committee will not be responsible for any in appropriate usage of this machine. Tractor Operator should hold tractor driving license during the test.

### A.5 Individual Participation requirements

#### A.5.1 Eligibility Limits

Eligibility is limited to undergraduate students to ensure that this is an engineering design competition. Team members must be enrolled as degree seeking undergraduate in the college or university of the team with which they are participating. Team members who have already graduated prior to the competition are NOT eligible to participate.

ID card For Student: Valid College ID card is required as a proof to ensure that Participant is an engineering student at a university/college.

Members, for participation, mix of male and female team members are welcomed. A team with all female members is also encouraged to participate.

TEAM MAIL ID: Each team is required to have their unique mail ID for communication with TIFAN. The mail id shall be created in the following format only

[TIFAN23teamname@gmail.com](mailto:TIFAN23teamname@gmail.com)

Any query or communication other than this email id will not be entertained.

Note: Any communication done by personal email ID of any team member or faculty advisor will not be entertained once team has been registered.

Every team must have a representative preferably team captain or vice-captain while communicating with TIFAN organizing committee, to prevent any kind of miss communication.

Team representative should communicate through registered team Email ID only.

#### A.5.2 Society Membership

Team members must be members of SAE or SAE affiliate society. Proof of membership, such as membership card, is required at the competition. Note: Students can join SAEINDIA online at: <http://www.saeindia.org>

#### A.5.3 Age

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

#### A.5.4 Driver's License

Team members who will operate a competition machine/vehicle at any time during a competition must hold a valid and appropriate government issued driver's license (expected type is LMV or tractor). This will be required onsite for proof.

Driver Restriction: Driver must be from the same participating team. Any professional driver from outside is not allowed to ride the machine during the competition.

#### A.5.5 Liability Waiver

All on-site participants, including students, faculty, and volunteers, are required to sign a liability waiver upon registering on-site during the time of registration for the event.

Indemnity form: Every team including faculty advisors must fill indemnity in the format sent and submit the same at the registration counter before entering the event site.

#### A.5.6 Insurance

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

#### A.5.7 Individual Registration Requirement

All participating team members and faculty advisors must register themselves at the competition site along with appropriate ID proof, SAE membership Card and Letter from College in college letter Head.

#### A.5.8 Team Composition

Total number of members in team need to be minimum 15 and maximum 25. It is advised to have a good mix of final year students with earlier year students as well.

Each team can also have one non-student member from farming background or farmer and consider his inputs while design and development of the competition machine. This member should be different than the assigned faculty advisor for the team. Appropriate evidence of inputs and interactions of this member must be clearly reflected. There will be an assessment of regional agronomy knowledge/farm machinery know-how and cultivation practices during the presentation events for each team. Physical presence is optional for this member, no mandatory SAE membership required for this member.

NOTE: Teams are advised to take proper care while forming the team and refrain from further modification later. Any change in team composition i.e., addition of new members or deletion of old members is NOT ALLOWED after registration. Any exceptional cases like death, natural calamity etc. could be dealt with separately. For such cases, a letter of declaration shall be provided from the Institution Head / Principal on institution letter head. Backing-out or withdrawal of any member from the team, due to any reason other than exceptional ones mentioned above, is NOT allowed and entire team will be responsible for consequences, if any, arises due to this.

If you are not an SAE member, go to [www.sae.org](http://www.sae.org) and select the "Join SAE/Membership Renewal" link under "Quick links", and then select the "Join SAE" link in the top right column. Students will need to select the "Student Membership" link and then follow the series of questions that are asked. Faculty members who wish to become SAE members should choose the "Professional Membership" link. Please note all student participants must be SAE members to participate in the events; this is not mandatory for faculty advisors.

Team name: The meaningful and inspirational team name is required to distinguish the team in the competition.

Team logo: An attractive team logo (not downloaded from the internet) is required from Participating team. Teams are required to use their team logo in Reports, on their vehicle and Videos.

## A.6 Faculty Advisor

### A.6.1 Faculty Advisor Status

Each team is expected to have a Faculty Advisor appointed by the institute/college. The faculty advisor is expected to accompany the team to the competition and will be considered by competition officials to be the official institute/college representative.

### A.6.2 Responsibilities

Faculty Advisors are expected to advise their teams on general engineering and engineering project management theory.

### A.6.3 Limitations

Faculty advisors should neither design any part of the machine nor should directly participate in the development of any documentation or presentation. Faculty Advisors should not neither fabricate nor should assemble any components nor should assist in the preparation, maintenance, testing or operation of the machine.

Faculty Advisors are not allowed to participate during technical inspection, design evaluation, cost, marketing, and sales presentations. The team captain or other designated members of the team must do all the presenting although faculty advisors may silently observe.

In brief –Faculty Advisors should not design, build, or repair any part of the machine.

## A.7 Eligibility machine prototype

### A.7.1 Student Developed machine

Machines entered TIFAN competitions must be conceived, designed, fabricated, and maintained by the student team members without direct involvement from professional engineers, automotive engineers, machinists, or related professionals. Proof of manufacturing location will be essentially required to be furnished by the teams on-site upon being so asked for by the TIFAN organizing committee.

The machine used for multiple year:

Universities/Colleges/Industries may enter the same vehicle for multiple years but must document substantial improvements and/or upgrades to the vehicle as used In The previous year's competition, provided they fulfill the requirements of the TIFAN theme of that year. There should be specific mention about following aspects on improvement with respect to earlier machine in competition.

- i. Productivity
- ii. Innovation
- iii. Performance
- iv. Cost of Operation

Any team who is participating repeatedly under the same theme, if unable to present their uniqueness in the newer design will attract penalty in the evaluation by judges. Team can always choose to design new machine form, in case they wish to participate, without using the same machine architecture of previous events.

There is no direct entry in the field events for the previous year participating and the team will have to pass through all the evaluation stages as that of for other teams.

### A.7.2 Information Resource

The student team may use any literature or knowledge related to Automated Multi Vegetable Transplanter design and information from professionals or from academics as long as the information is given as a discussion of alternatives with their pros and cons. due citation for the source is to be provided wherever such information is used or referred.

### A.7.3 Professional Assistance

Professionals may not make design decisions or drawings and the Faculty Advisor may be required to sign a statement of compliance with this restriction.

Each team need to give an undertaking signed by the Head of Department (HoD) mentioning the manufacturing done in-house using workshop facilities. Also, teams need to submit a list of facilities / equipment in operating condition with the college facilities which will be used to fabricate & assemble the machine as per design presented in Virtual TIFAN event.

During the actual manufacturing and fabrication process, the video clips that cover students working in college facility need to be taken and written in a CD, to be furnished anytime throughout the course of project. The clip is required to cover each of the manufacturing processes carried out in college.

It is the intent of the TIFAN competition to provide direct hands-on experience to the students. Therefore, students should perform all fabrication tasks. The Fabrication should be done on-campus using in-house facilities of college / university.

All work done outside the Campus need to be informed to the TIFAN organizing Committee and prior approval acquired for the same. Appropriate documentation with consent and approval from Faculty and HOD, to maintain for using facilities outside of campus.

Machines, which have been professionally fabricated, may be penalized up to 400 points or even disqualified from the competition. The decision of the TIFAN organizing committee in this regard will be final. The registration fee would NOT be refunded in any case.

Machines fabricated from previously published designs are ineligible to compete. Machines which have been professionally fabricated may be disqualified from the competition and may will not be allowed in the competition if a team does not have access to machine Shop facilities, they can use support of professional fabrication shop with declaration by faculty advisor.

Any outsourcing must be reflected in cost reporting, with supporting receipts or invoices from your outsourced vendor.

## A.8 Registration

### A.8.1 General information

Registration for TIFAN competitions held in 2023 must be completed by submitting the on-line google registration form or appropriate method as communicated to teams mentioning all the details correctly. Online registration must be done by either (a) team captain who need to be an SAEINDIA member or (b) the official faculty advisor.

Note: It typically may take at least 5 working days between the time you complete an on-line SAEINDIA membership application, and our system recognizes you as eligible to register your team.

After sending the online registration form along with the payment details a copy of the registration form attested by Head of Department or Principal of the respective University/College must be mailed to [tifan@saeindia.org](mailto:tifan@saeindia.org) within 5 working days after submitting the google form.

Note: If there is need of change in Team Captain/Faculty Advisor/Team member, team need to send an application with the details and signature of Previous Team captain /Faculty Advisor and current Team Leader/Faculty Advisor through Team Mail Id.

Changing of such team structure is allowed maximum till Virtual Tifan event only, any change after that is not permissible. There could be drop possible but additional members are not allowed to the team.

#### A.8.2 Entries per college/University

Registration for TIFAN competition allows a more than one machine per college / institute location, provided each team fulfills all requirements of this rule book. All team members from team should have valid SAE membership throughout TIFAN event dates till completion.

#### A.8.3 Registration limits

TIFAN 2023 competition, the registration limit will be posted on the <http://saeindia.org/tifan/>. The registration will close as soon as the registration limit is reached. We strongly advise teams to register as soon as registration opens. (First come First Serve Basis). There are no exceptions to this registration policy.

#### A.8.4 Registration Dates

Teams must register for TIFAN competition between following dates:

Last day for registration is 30<sup>th</sup> September 2022

Last day for registration with late fees is 07<sup>th</sup> October 2022

#### A.8.5 Registration Fees

Registration fees must be paid by each participating team by the deadlines Registration fees are not refundable and may not be transferred to a subsequent year's competition. Any change will be notified and will be declared on official web site.

For the TIFAN2023, the registration fees are to be paid in phased manner as below

Format -->	(At identified location)
Qualifying Round	₹ 7000+GST
Final Round	₹ 5000+GST
Late registration fee	₹ 1000

Table 1. Fees Structure

#### Mode of Payment:

Mode of transfer: Online transfer, Direct Bank Deposit or Demand Draft (DD) (DD shall be drawn in favor of TIFAN SAEINDIA, Payable at Chennai)

Account Name: TIFAN SAEINDIA

Acc. No. 1550101083972

IFSC Code: CNRB0001550

Bank: Canara Bank

Payable At: Chennai

\*Students are requested to upload the photo of payment details during completing the registration form.

Demand draft should be sent by courier to below address. Mention "TIFAN 2023 Registration" on the envelop  
SAEINDIA | No 1/17Ceebros Arcade, 3rd Cross, Kasturba Nagar, Adyar, Chennai - 600020

#### Registration Fees confirmation:

Registration fees will be confirmed within 48 hrs. Of payment. If the payment day is followed by a Bank Holiday, then confirmation will be done before the end of the day.

#### Registration fee deadline and refund:

Registration fees must be paid to the SAEINDIA by/before the deadlines. Registration fees are not refundable and will not be transferred to a subsequent year's competition.

#### A.8.6 Withdrawals

Registered teams, unable to attend the competition are requested to officially withdraw by notifying to the Organizing Committee at least one Month before the virtual event. All communication in these regards needs to be sent to [tifan@saeindia.org](mailto:tifan@saeindia.org). Registration fees are not refundable and will not be transferred to a subsequent year's competition

#### A.8.7 On-site Reporting

All team members and faculty advisors must complete the on-site reporting procedures after they arrive at the competition site. All the site reporting credentials and/or other identification issued by the Organizing Authority properly worn before the machine prototype can be unloaded or worked upon in any manner.

#### A.8.8 Machine prototype Shipping

Machine prototype shipments by commercial carrier must comply with the local laws and regulations of location from which, and to which, the machine is being Sent. Teams are advised to consult with their transporter to make sure their shipment fully complies with all relevant documentation and shipping requirements.

Shipments must be sent with the participating team name listed as the receiving party.

Neither the TIFAN organizing Committee, nor the competition sites can be listed as the receiving party for your machine. Your team should be available to receive and unloading/loading of the machine

### A.9 Rule book related Questions

#### A.9.1 General

By submitting a question to TIFAN, you and your team agree that both your question and the Committee's answer can be reproduced and distributed by TIFAN, in both complete and edited versions, in any medium or format anywhere in the world.

#### A.9.2 Question Types

TIFAN Organizing Committee will answer questions that are not already answered in the rules or FAQs or that require new or novel rule interpretations. The committee will not respond to questions that are already answered in the rules. For example, if a rule specifies a minimum dimension for a part the committee will not answer questions asking if a smaller dimension can be used.

#### A.9.3 Question Format

All rules' questions must include (1) the full name and email address of the student submitting the question, (2) the name of the university/college, no abbreviations, (3) Clear and crisp short description of the question. The attachment, if any along with the question must not exceed 2MB size

#### A.9.4 Question Submission

The teams can send their technical queries and doubts to the official Email ID [tifan@saeindia.org](mailto:tifan@saeindia.org) for the clarification on any rule.

#### A.9.5 Question Documentation

Teams submitting questions are required to bring copies of the questions and answers with them to technical inspection.

#### A.9.6 Response Time

Please allow a minimum of two (2) weeks for a response. Organizing Committee will respond as quickly as possible, however responses to questions presenting new issues, or of unusual complexity, may take more than two weeks.

#### A.9.7 Event Related Questions

Questions pertaining to the operation and schedules of TIFAN competition should be emailed to [tifan@saeindia.org](mailto:tifan@saeindia.org)

#### A.10 Protest

It is recognized that thousands of hours of work have gone into building a machine and that 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. The TIFAN Organizing committee and SAEINDIA staff will make every effort to fully review all questions and resolve problems and discrepancies quickly and equitably

##### A.10.1 Preliminary Review - Required

If a team has a question about scoring, judging, policies, or any official action it must be brought to the Organizing Authority's attention for an informal preliminary review before a protest can be filed.

##### A.10.2 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 or actions that have not caused them any substantive damage.

##### A.10.3 Protest Format and Forfeit

All protests must be filed in writing and presented to the Organizing Authority by the team captain. To have a protest considered, a team must post a twenty-five (25) point protest bond which will be forfeited if their protest is rejected. The Organizing Authority, judges or volunteers will not review any video footage as part of the protest.

##### A.10.4 Protest Period

Protests concerning any aspect of the competition must be filed within half an hour (30 minutes) of the end of the event to which the protest relates.

##### A.10.5 Decision

The decision of the competition protest committee / Organizing Authority regarding any protest is final.

##### A.10.6 Penalties

Non-compliance with the competition rules will result in a formal warning, invalidation of the best overall attempt or disqualification of the Team, depending on the severity of the breach. The Organizing Authority will exclude, disqualify, or otherwise penalize any Participant who, in the judgement of the Technical Head, has gained an unfair advantage because of any breach of the Official Rules, hindrance of other Participants, departure from the normal course, or any act or omission capable of misrepresenting performance.

#### A.11 Driving Knowledge Test

- Only the registered Driver and the Reserve Driver will be authorized to drive the Machine prototype.



- Drivers may be questioned about their knowledge of the driving rules during inspection. The TIFAN Organizing Committee reserve the right to deny field access to Drivers with insufficient knowledge of the Rules.

- Driving on-field

In the interest of safety, it is important that Drivers learn and apply smooth and predictable driving techniques, e.g., thinking well ahead, avoiding sudden directional changes, and being fully aware of other Machines around them.

- It is mandatory for the driver to attend “ Briefing “before any event during the competition.

It is expected all team should not drive the completion machine on public road, any violation of found of this rule will make the team eligible to disqualify the team from the competition. It will be sole responsibility of the Team for any issue arising out of violation of traffic rules or driving in public road and TIFAN organizing Committee does not have any responsibility for such issues.

- Team driver shall always wear safety PPE kit (helmet, goggle, safety shoe and gloves) while handling the machine.

## B. PART B: TECHNICAL REQUIREMENTS AND REGULATIONS

### B.1 Qualifying Round

The SAEINDIA TIFAN Qualifying Round is a filtration criterion, through which all the registered teams are scrutinized for their knowledge and capability to participate successfully in the field /main event. This round acts as a pre-qualifier to participation in the main event TIFAN 2023. Depending upon guidelines and competent approvals, the Organizing Committee will decide the main event (Final Round) to be conducted and will be communicated in due course of time.

The various objectives of the Qualifying Round TIFAN 2023 Event are as follows:

1. To acquaint the teams completely with the objectives of the formation of SAEINDIA TIFAN competition and its multi-fold objectives.
2. The teams are required to familiarize themselves with the rule book and technical guidelines and limits for the design of the machine for the main event TIFAN 2023.
3. To conceive and design the complete layout of the farm machine for TIFAN 2023 in CAD (Computer Aided Design) tool. The machine design should be complete in all respects to the extent of being considered ready-to-manufacturing.
4. Timeline for Qualifying round will be communicated in due course of time.
5. The Qualifying Round for TIFAN2023 will be conducted through Digital platforms only.
6. There is no requirement for any team mates to be together. Digital platforms such as Microsoft Teams, Google meet, WebEx, etc. will be utilized to conduct this competition. The exact details of the same will be communicated. Student teams are encouraged to get acquainted with these tools to have smooth execution of Qualifying Round.

Teams need to submit the presentations / reports in the template provided by TIFAN OC and in given timelines for respective rounds of evaluations. Late entries will have penalty.

The design presented during the event shall be considered as final and the team shall be considered to proceed towards fabrication activity using the same design. If any teams have made some changes to the final machine, depending upon the quantum of changes teams may be penalized in terms of score. If the fabricated machine does not resemble the correlation with the virtual round design presentation, the team needs to prepare a design deviation report and justify the reasons. The following are the suggested but not exhaustive items to be present for the virtual event. Each team needs to follow the guidelines on no of slides, font size, ppt template etc.

- Overall technical machine specifications
- Machine frame/Chassis design
- Design of soil opening mechanism
- Design of Sapling pick up
- Design of transplanting mechanism
- Design of soil covering device
- Design of Power transmission systems
  - Planting and travel speed synchronization
- Additional Sapling holder
- Predicted Machine Cost and Weight analysis
- Project Management plan
- Risk assessment and action plan to mitigate it (DFMEA aka. Design Failure Modes And Effects Analysis)
- Design Validation plan
- Team Composition- Allocation of roles and responsibilities to each team member

- Plan on manufacturing of the prototype (in-house /outsource)
- Machine utility enhancement for additional farm operations/crops/prime mover

Based on the performance in the Qualifying Round, the teams would be selected for participation in the main event. The selection would be purely based on merit and evaluation by the panel of judges.

- Note: The Qualifying Round is a pre-qualifier, thus, no scores or awards would be issued to any of the teams, only list of qualifying teams will be published on SAE INDIA website or TIFAN face book page.

### Written Test (part of Qualifying Round)

An objective based written test based upon the Off Highway equipment /farm machinery design may be conducted, if deemed to be necessary. The details of the same shall be communicated in due course.

### Reporting to Qualifying Round

The date, venue, team slots etc. will be communicated to all registered teams, Teams are required to report for the online evaluation before time to avoid inconveniences. Only 5 team members are permitted for the online meeting. Teams should follow the guidelines issued for the Online evaluation from time to time.

All your presentation will be available with the coordinators of Online evaluation for presenting during event.

*TIFAN ORGANIZATION TEAM (OC Team) RESERVES THE RIGHT TO CONFISCATE ANY ELECTRONIC DEVICE WHICH CAN BREACH THE CONFIDENTIALITY OF THE VIRTUAL TIFAN EVENT. TEAMS FOUND GUILTY OF ANY MISCONDUCT WILL BE DISQUALIFIED FROM THE EVENT.*

## B.2 Basic Design considerations

The general design consideration for the theme of “Automated Multi Vegetable Transplanter”, could employ the following machine operation principles with no manual intervention. This information is just to aid teams in determining their scope, however each team is free to make and choose their own design of system if the ultimate objectives of the TIFAN competition are met.



*Fig. 1 Design Consideration Layout*

### B.2.1 Machine sub-systems

The machine should be as simple in construction as feasible and easy to operate. In general, the machine for the given theme can comprise of the following major systems to consider, however teams can produce other mechanisms as well to accomplish the given objective of TIFAN competition.

### I. Raised Bed Formation:

Bed formation would be done ahead of planting through a land preparation implement by the students as per the guidelines mentioned in the section B.3.1 or asked by evaluation committee at the time of trials. Land preparation/bed formation implement would be provided by Tifan committee in field. Designed (machine that will be evaluated in competition) planting machine or implement should be able to plant the saplings in those raised bed field or even in flat land (without raised bed). Machine should be able to adjust the ground clearance as per the bed height considered.

### II. Pickup Sapling – Pick-up System:

The main function of this system is to pick up sapling cup form tray or buckets without any manual intervention. The pickup systems can be one or multiple depending upon the machine row configuration.

Following are the suggested design considerations involved in this system. However, this list is not exhaustive, every team has its freedom to design and use any system that performs the intended function.

- Proper selection of cupping shape and geometry
- Selection of appropriate sapling
- Selection of proper tray/rack angle to take assistance of gravity
- Provision of speed change to adjust spacing variation requirements
- Choosing optimum machine travel speed to make best use of machine power and efficiency of systems

### III. Hold and Convey - conveying system:

The main function of conveyor is to convey the saplings picked from trays/buckets to digging system. Conveyor unit/system is used. The system should be designed that it holds the saplings at predetermined spacing and then passes to the other end of digging unit.

Following are the suggested design considerations involved in this system. However, this list is not exhaustive, every team has its freedom to design and use any system that performs the intended function.

- Convey of maximum no of saplings, with no or minimum damage.
- Proper picking of saplings from tray/bucket and thus ensuring smooth transfer.
- Channelize the pickup saplings towards digging system.
- Choose an appropriate type of conveyer belt like a slat type belt, flat belt, metal rod with chains etc.
- Proper angle of the system to enable material movement
- Speed of conveyer and liner speed of travel of material
- No. of Saplings flow rate
- Power consumption for conveying unit
- Diameter and spacing of conveyer belts
- No damage to saplings

#### IV. Dig a hole in soil:

A digging system consists of breaking the compact surface of earth to a certain depth and loosening the soil mass, to enable the roots of the crops to penetrate and spread into the soil.

Following are the suggested design considerations involved in this system. However, this list is not exhaustive, every team has its freedom to design and use any system that performs the intended function.

- Proper selection of blade shape and geometry
- Selection of appropriate blade material.
- Selection of proper rack angle.
- Throat clearance calculations
- Draft Calculations for the given soil
- Provision of depth change to adjust draft variation requirements
- Choosing optimum machine travel speed to make best use of machine power and efficiency of system

#### V. Drop the sapling:

Sapling with cups must be dropped into the holes dug by the machine. The team should try to avoid any damage to the saplings in this overall process.

#### VI. Cover the soil:

Machine should have the ability to cover up the soil such that the sapling is rooted well. Making sure that the roots are not visible, and plants are not shaken due to wind flow.

#### VII. Auxiliary Items:

Students are required to at least have 4 mandatory sapling trays to hold the saplings. Number of sapling requirements would depend based on productivity and sapling type chosen by the teams. Teams are asked to at least carry 20% extra saplings all the time on the machine/implement for any loss of sapling during the field/dynamic evaluation.

### B.3 General Design Requirements

#### B.3.1 Machine Configuration

- I. The farm machine must be of 4-wheel type and need to have at least 2 drive wheels as specified in this rule book. Machines proposals of 2 and 3-wheeler designs are not acceptable for TIFAN 2023 theme.
- II. Any machine which is merely modified using a readymade power tiller from market with just addition of 2 extra wheels to make it 4-wheeler configuration for participating in competition will not be accepted if appropriate design of steering system and related subsystems is not done available. Such machines will be disqualified from competition during static evaluation itself and no claim will be entertained for such deviations.
- III. The machine (Self-propelled) must use only the designated prime mover (Diesel Engine) specified in this rule book. Usage of any other engine (Power requirements) will liable team to disqualify from competition. This rule is intended to have one single basis of power for

comparing all competition machines. (Students to make a note of different engine requirements for Self-propelled Vs. attachment style designs based on their chosen style design)

IV. The machine can be designed to carry one person to operate it in field or it can be of walk behind type operated by one person.

V. Automated Multi Vegetable Transplanter Machine Dimensions

1. Track(tread) width: 1200- up to 1800 mm
2. Overall Length\*: 2800 mm

\*Overall length is considered including implement if it is mounted on three points attached to the main chassis of machine. No trailed or semi trailed machines which do not utilize power from engine are allowed as attachment. Attachments which are powered by PTO driven by engine are acceptable.

3. Overall, Height: 2000 mm max. without structure for operator canopy  
2500 mm max. with structure for operator canopy
4. Ground clearance\*: 300 mm Min,  
\* Lower most point of machine, irrespective of any system. Digging system parts should be in upper most condition while measuring ground clearance
5. Machine kerb weight\* (Self Propelled):  $<700 \pm 50$  kgs  
Machine kerb weight\* (attachment):  $<400 \pm 20$  kgs

\* Kerb Weight: The total mass of a Transplanter with all standard attachments and auxiliaries, and necessary operating consumables such as engine oil, transmission oil, fuel filled full fuel tank, without any operator or cargo loaded with harvesting material.

VI. Field layout: The field layout for the 2023 competition will be as follows.  
(All dimensions are in mm)

The Field Layout for competition will be as follows, however there could be some changes possible based upon the agro climatic conditions. The team needs to use this layout (indicative) as reference information for designing the best possible configuration:

1. There would be 2 beds at a turning radius of 2 meters apart
2. Each bed would consist of 2 rows of sapling planted at a distance mentioned below in the table.
3. The row to row and plant to plant distance is mentioned in the table below [students are expected to demonstrate and use the measurements as per the crop selection criteria.
4. The sapling count is indicated in the table below along with an approximate estimate of the total weight of the sapling
5. Students are expected to ride their equipment 25-50 meter straight and are asked to take a U-Turn and travel back to the start point covering another 25-50 meters (a total of 100-meter travel distance).

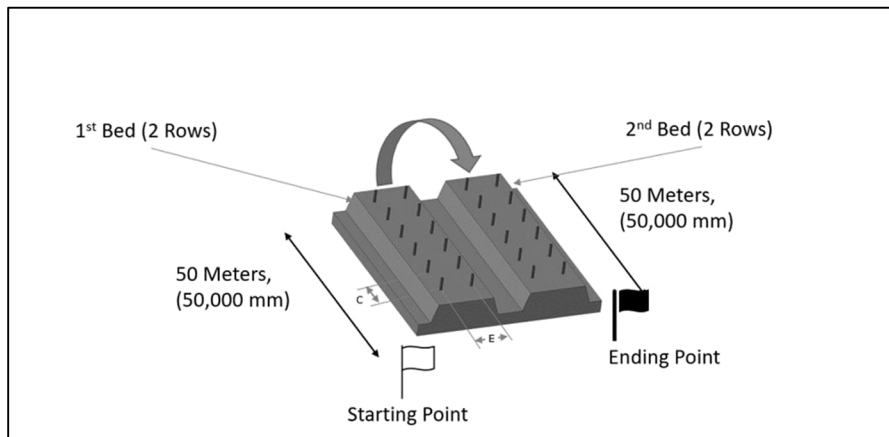


Fig. 2 Field Layout (Schematics)

6. The figure above (not as per scale) shows the track/field layout for easy understanding
7. Chart below is an indicative approximation of weights/number of saplings required.
8. Students are asked to consider the first row (as highlighted) below during their actual demonstration; however, their machine should demonstrate the varying row-row and Plant-Plan distances if asked by the judges during the demonstration
9. A sapling weight of approx. 168 grams is considered but students can measure the actual weight of sapling beforehand and can estimate the total weight of the saplings beforehand
10. All the dimensions in the figure below are in mm or as per indicated in the chart

Chili Plant (Bed Width: 1200 and Height: 300 Length: 50,000)							
Row- Row Distance ( E )	Plant to Plan Distance ( C )	Total Bed Length	No of Sappling (2 Row)- 50 mts	No of Sappling (4 Row)- 100 mts	Approx. Weight of 1 Sappling (grms)	Total Approx Weight (2 Rows)- 50 mts (Kgs)	Total Approx Weight (4 Rows)- 100 mts (Kgs)
600	600	50,000	167	333	168	28	56
750	750	50,000	133	267	168	22	45
900	900	50,000	111	222	168	19	37
Tomato Plant (Bed Width: 1200 and Height: 300 Length: 50,000)							
Row- Row Distance ( E )	Plant to Plan Distance ( C )	Total Bed Length	No of Sappling (2 Row)- 50 mts	No of Sappling (4 Row)- 100 mts	Approx. Weight of 1 Sappling (grms)	Total Approx Weight (2 Rows)- 50 mts (Kgs)	Total Approx Weight (4 Rows)- 100 mts (Kgs)
450	300	50,000	333	667	168	56	112
600	350	50,000	286	571	168	48	96
600	450	50,000	222	444	168	37	75
Brinjal Plant (Bed Width: 1200 and Height: 300 Length: 50,000)							
Row- Row Distance ( E )	Plant to Plan Distance ( C )	Total Bed Length	No of Sappling (2 Row)- 50 mts	No of Sappling (4 Row)- 100 mts	Approx. Weight of 1 Sappling (grms)	Total Approx Weight (2 Rows)- 50 mts (Kgs)	Total Approx Weight (4 Rows)- 100 mts (Kgs)
600	450	50,000	222	444	168	37	75
750	600	50,000	167	333	168	28	56
900	900	50,000	111	222	168	19	37

Fig. 3 Handy Calculations Chart

11. The bed width is shown in the indicative picture as below:

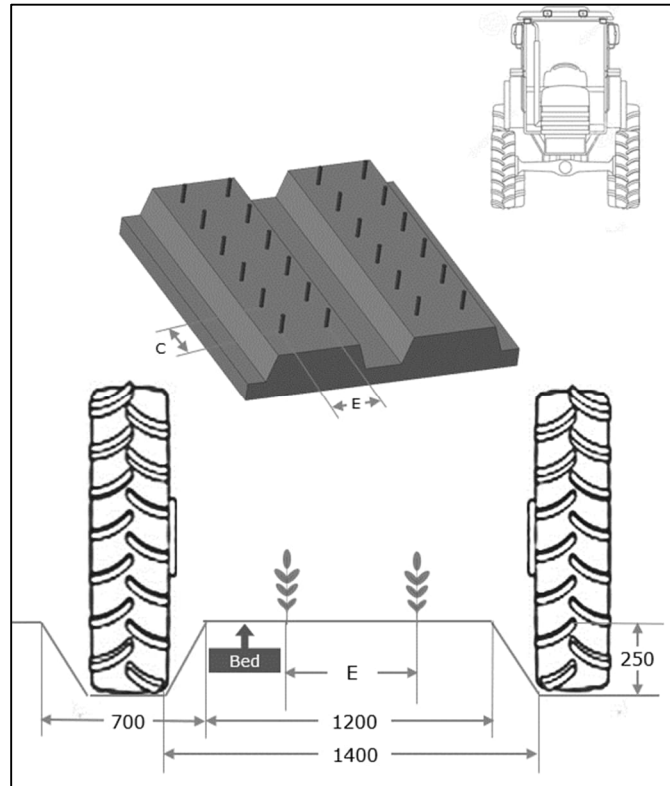
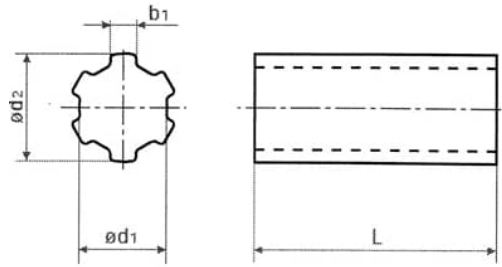


Fig. 4 Bed Dimensions (in mm)

### B.3.2 Prime Mover (Diesel Engine)

- a. (The prime mover for tractor pulling the attachment would be in the range of 35-40 HP. While for the self-propelled style to be limited with a 20-25 HP Diesel Engine only. For the attachment style design, a tractor will be provided by SAE TIFAN committee. Students who would select an attachment/implement driven machine design, to make sure that the attachment is compatible with 35-40 HP PTO and 3-point linkage driven tractors
  - I. Alteration in the engine is not permitted for any participating teams.
  - II. Each engine will come following scope of supply
    - a. Base Engine with wire starts aid
    - b. Air Cleaner
    - c. Exhaust muffler
    - d. Integrated Fuel tank
  - III. While designing the self-propelled machine please consider the standard engine, as suggested by TIFAN organizing committee. In terms of engine selection by the team it should have a standard spline shaft available for power take-off. The details of the spline shaft are as below. Team can choose to attach pulley or sprocket having internal splines to transfer power.
    - Spline shaft outer diameter (d2) =  $\varnothing 25 -0.11/-0.03$  mm
    - Spline The inner diameter (d1) =  $\varnothing 20.5 -0.43/0$  mm
    - Spline thickness(b1) =  $5 -0.18/0$  mm
    - Length of shaft= 36 mm.





*Fig. 5 Spline Shaft Drawing*

- b. Considering the current pandemic situation and challenges regarding the procurements, the Organizing committee is exploring the possibility to allow teams for alternate engine source. This will be communicated in the due course of time.
- c. In the event of this option is opened to teams for TIFAN2023, the following additional requirements to choose the prime mover, will be applicable.
  - I. The engine must be a piston engine using a four-stroke heat cycle
  - II. Hybrid powertrains, e.g., battery charged electric motors, are not allowed.
  - III. Any variable speed diesel engine having maximum powers based on the design style selected by students as mentioned above (for self-propelled or attachment driven), irrespective of the rated speed
  - IV. It is mandatory for each team to provide the Rated speed, high idle, rated power, Compression ratio and Bore x stroke dimensions (For attachment driven machine only)
  - V. Engine chosen by team (for attachment driven machine style) should not have any of its fuel injection equipment tampered and all the seals to be intact
  - VI. The engine identification plate must remain intact on the engine and should not be tampered with
  - VII. Air cooled or water cooled both options are permitted to be used. In the case of water-cooled engines there should not be any coolant leakage from hoses, cooling package etc.
  - VIII. Any leakages found on coolant will make the team liable for disqualifying in participation of events
  - IX. All necessary guarding for rotating components like fan, belt is mandatory in case of use by teams
  - X. An invoice of the same shall be produced mentioning the specification of the engine
  - XI. TIFAN team may conduct random inspection of your chosen engine and may perform checks and test if it is deemed to be necessary
- d. Below are the common rules for all teams using irrespective of any brand and make
  - I. All the activities related to the purchase and shipping of engines to be handled by respective teams
  - II. Only Original Equipment replacement parts may be used.
  - III. No cleaning or removal of material from intake or exhaust ports is permitted.
  - IV. Camshaft, crankshaft, connecting rod and flywheel must not be altered or modified.
  - V. Fuel System: No modifications/Alteration are permitted to fuel system components such as fuel line, injector, fuel pump etc. Any team attempting this alteration will be disqualified from competition.
  - VI. Flywheel Rotation: No flywheel rotation to advance or retard timing is permissible.
  - VII. Alteration of idling speed in engine is not permitted.

- VIII. Air Cleaner: The air intake may be relocated as per the design need, but appropriate OEM (Original Equipment Manufacturer) recommended parts must be used to relocate the air filter for minimum impact on the performance of engine. The air hose may be shortened or extended with same quality material, in such a manner that hose does not collapse at maximum suction of engine. Methods to prevent hose collapsing (spring) can be used as appropriate. No other type of hose will be allowed. A team may also add additional pre-filters to the top of the air intake. These parts must be included in the cost report
- IX. Muffler Relocation: If the Machine design requires an exhaust system re-configuration to keep it from impinging on part of the Machine, the re-routing must be done using tubing having appropriate tube to avoid backpressure. Any remote mounted exhaust system must use the original muffler and must be securely mounted so that it does not vibrate loose during the competition.
- X. Muffler Support: Supports for the exhaust pipe and muffler are required. Support must be attached exclusively to the engine.
- XI. Exhaust Pipe: Exhaust pipe may not protrude inside of the exhaust port, so as to alter port configuration. Any exhaust pipe length is allowed; however, pipe length may not be adjustable, and location of exhaust pipe should be such that it is not directing on the face of the operator and bystander near the machine during completion. Any location more than 45° with respect to ground is not recommended, no extra holes or tubes are allowed in the exhaust pipe. Protection from touching hot tubes is must to be provided
- XII. Exhaust System Durability required: The exhaust pipe and muffler must be completely intact and operational throughout the competition. Any Machine found to have a loose or leaking exhaust system will be removed from competition until the issue can be corrected. The complete exhaust system shall be located such that its extremities lie at least 100 mm within the perimeter of the Machine. In no case should the exhaust coming out of the engine be pointed out towards the face of the operator.
- XIII. No Starter motor installation is permitted teams need to use wire start method only as a measure of safety during competition.
- XIV. Alternator: The engine may be fitted with an alternator to generate electrical energy. It is necessary to have an alternator driven from the engine only. However, the team needs to inform the rating of the alternator and get confirmation from TIFAN technical team before installing the same on machine
- XV. Fuel tanks- OEM supplied fuel tanks with either metallic or non-metallic material can be used. Recommended fuel tanks of 10-12Liter capacity are preferable.
- XVI. There should not be any structural load Imposed on fuel tank and sound engineering practice shall be followed for its mounting on the machine. Use of vibration mount is recommended in case of mounting in high vibration area of machine
- XVII. The fuel Tank cap must have a provision for venting and there must be an aid for emptying / Draining the fuel tank if needed.
- XVIII. Any additional power boost devices for vehicle propulsion, rotating functional components of vegetable transplanter like conveyor, digger, or pick-up are not permitted
- XIX. If the electrical aids are used for powering functional components like conveyor, depth control, pickup etc., then such components should keep functioning even after removal of batteries from the system. I.e., the same shall obtain electrical power from engine driven alternators only.

- XX. Engine Governor: Random inspection of the governor may be conducted at any time for any engine make. (In the case of engine is equipped with a governor setting) Any attempt to defeat the engine governor to increase the engine speed grounds for immediate disqualification.
- XXI. The governor operation must always remain free of obstructions. The governor area must be shielded from debris. Any changes made will have to be reviewed by technicians.

### B.3.3 Tractor Driven Attachment

- I. The attachment should meet the ISO CATI/CAT II hitch geometry
  - a. CAT I:
    - i. Mast height 460+/-1.5mm,
    - ii. Lower Hitch distance: 683 +/-1.5 mm,
    - iii. Diameter of Top hitch pin 19mm,
    - iv. Diameter of lower hitch pin 22mm,
    - v. Clevis 65mm
  - b. CAT II :
    - i. Mast height 610+/-1.5mm,
    - ii. Lower Hitch distance: 825 +/-1.5 mm,
    - iii. Diameter of Top hitch pin 25.5mm,
    - iv. Diameter of lower hitch pin 28mm,
    - v. Clevis 65mm
- II. Tractor wheels reactions: 20%:80 % (Front: Rear) by mass
- III. Turning radius: < 2m
- IV. Attachment should be transported through tractor 3point linkage.
- V. The sapling planting can be driven through ground wheel drive or PTO drive shaft

### B.3.4 Transmission (Self- Propelled)

- I. Teams are free to design the power transmission systems on their own or use any OEM transmission readily available in market, such that maximum speed of the machine on a plain terrain is not more than 15 km/h in top gear. OEM transmissions of 2wheeler, 3 wheelers are acceptable if they are meeting the speed criteria.
- II. Continuous Variable Transmission (CVT) is also permitted with appropriate shielding. Teams may install reverse gear for reverse drive of the machine.
- III. Maximum speed in forward direction should be <15kmph and minimum speed in forward direction should be >0.5 kmph. Maximum speed in the reverse direction should be set < 5 kmph.
- IV. Teams can have single speed or multi speed gear box and maximum no of allowed forward speeds are 4 and reverse 2.
- V. Teams are free to use final reduction in the configuration in the form of constant velocity joint shaft, chain and sprocket or belt and pulley and can use standard OEM components from market.
- VI. Teams need to safely install gear shifting cables. Lever and shifting mechanism are to be installed at such locations which will not be a hindrance for operator and his safety.
- VII. All chains and belt drives need to be protected from coming in direct contact with the operator.
- VIII. Teams can use direct drive, chain or belt drive between engine and Transmission to meet the speed requirement and configure OEM transmission. All these drive mechanisms need to follow

sound engineering practice and should be appropriately designed. TIFAN technical committee will be the final approving authority on these designs.

- IX. If Cordon (universal) joints are used, they must be shielded radially (360°) with steel or fiber sheet. The maximum deflection angle for universal joints is 10°.
- X. The transmission shall be mounted on the machine structure with sound engineering practice and shall be designed appropriately.
- XI. Appropriate care shall be taken to ensure lubrication of the transmission system of the machine. The machine should be free from any leakage or seepage of fluid.

#### B.3.5 Hydraulics Systems:

- I. The hydraulic hose near to the operator should not be open
- II. The hydraulic systems, including fluid, hoses etc. should be designed in such a way that the operator should not come into contact even by mistake.
- III. Proper shielding for hydraulic joints should be ensured to protect operator and bystander from any kind of fluid leakage, seepage etc.
- IV. No hydraulic fluid joints near the engine exhaust or any hot components, in case it is inevitable to avoid due to design constraints, due care to protect the joint should be taken
- V. No hydraulic hoses should encounter electrical system parts and minimum clearance of 25 mm must be ensured all the time.
- VI. Machines with hydraulically assisted transmission should be designed with an appropriate braking system to avoid the machine overturn due to inadequate braking caused due to wrong hydraulic circuit design.
- VII. All machines using hydraulic systems will be evaluated for no leakage from system with an off road capability test of 45° angle.
- VIII. Hydraulic accumulators type stored energy device that may be incorporated. Team needs to consult TIFAN Technical team with the size of accumulator they intend to use before putting on actual machine.
- IX. Hydraulic power systems must be properly shielded, and documentation of the shielding made available for review

#### B.3.4 Visibility to operator

- X. The operator must have access to a direct arc of visibility ahead and to 90° on each side of the longitudinal axis of the Machine.
- XI. This field of vision must be achieved without the aid of any optical (or electronic) devices such as mirrors etc.
- XII. Movement of the operator's head within the confines of the Machine body to achieve a complete arc of vision is allowed.
- XIII. Operators should be able to turn around freely to see operation and obstacles in the field.

#### B.3.5 Electrical System

- I. For safety reasons, the maximum voltage on board of any Machine at any point must not exceed 12 Volts nominal (this includes on-board batteries, external batteries, Super Capacitors).
- II. Batteries or other electric energy storage devices for vehicle drive, conveying rotor, shaking of windrowing are prohibited
- III. Teams are recommended to choose off the shelf batteries available from OEM and refrain from making any self-designed prototypes for safety reasons.

- IV. Batteries must be mounted with sound engineering practice and not come loose during a roll-over of machine. There should not be any positive contact with the exhaust unit of the fuel system. The battery must be safely placed & concealed. Failing this, the technical inspectors may debar the team from dynamic events.
- V. Batteries must be able to provide power to safety items (brake light, reverse light and alarm if provided) for the duration of each event.
- VI. The batteries must be factory sealed (incapable of being opened or serviced) and not leak in the event of roll over.
- VII. Wiring harnesses should not be clustered and clumsy in an area. Proper design optimization & layout design should be available
- VIII. Brake Light: It is recommended that the machine be fitted with a red brake light that is SAE "S" or "U" rated. OEM brake light assemblies can be used. The brake light shall be illuminated when the brake system is actuated, and completely extinguished when the brakes are released. The brake light must be mounted at a height of minimum of 1 meter above the ground.
- IX. Reverse Light and Alarm: It is recommended for teams to fit reverse light and alarm using reverse gear. The reverse light marked with an SAE "R" on the lens and be equal to or exceed the SAE standard J759. (Or use standard OEM fitments) The reverse light must be mounted at a minimum of 70 cm above the ground. However, this requirement is made as optional for this year's competition.
- X. It is recommended for machine to be equipped with a horn mounted towards the front of the machine, in such a manner that is effectively audible to other machines and track marshals. With the machine in normal running condition, it must emit a sound greater than 85 dBA when measured 4 meters horizontally from the machine. However, this requirement is made as optional for this year's competition.

#### B.3.6 Usage of Electronics in Automated Multi Vegetable Transplanter

From TIFAN20 competition onwards, all teams are encouraged to incorporate at least one electronics based or electronics assisted system into the planting machine. This is to promote digitalization and modernization of agricultural equipment as affordable and valuable to end users. Teams which build concepts based on electronics will be considered for bonus score in innovation and design evaluation.

Below is the suggested list of automation that team can think of, however this list is not exhaustive, and more items could be added to it. Any team incorporating such electronics features with value addition for end customer will get appropriate credits for their efforts during the evaluation.

- Depth of hole adjustment
- Load cell-based sapling handling volume display
- Sapling loading-unloading crate handling aids
- Sapling Loss/damage/Quality monitoring aids
- Machine not starting unless all systems are neutral for safe operation
- GPS (GLOBAL POSITIONING SYSTEM) assisted machine location
- GPS assisted machine crop productivity/yield mapping etc.
- Automounts agriculture concepts
- Any other feature that brings value to the end user of this machine.

Teams are free to use additional batteries powered by renewable energy sources such as wind, solar etc.

#### B.3.7 Machine sound level

- I. The sound level of the Machine must not exceed 90 dBA when measured 4 meters away from the Machine.
- II. Maximum sound levels will be measured and recorded at the start line and teams exceeding the permissible level will be notified with a request for correction within a reasonable timeframe.
- III. The emergency shutdown mechanism must be provided by means of minimum one kill switch mounted on machine and accessible by person outside of machine.

#### B.3.8 Machine articulation

- I. Machine articulation/steering must be achieved by one system operated with both hands using a turning motion. It must be precise, with no excessive play. Teams can use mechanical, hydraulic or combination of these methods for articulation. OEM steering systems are also acceptable to use.
- II. Teams are free to use a steering wheel or steering bar for machine articulation.
- III. The maximum turning radius of the machine should be 2.0 m. The turning radius is the distance between the center of the circle and the extreme outside part of the Machine. The turning radius should help operator maneuver Machine with no damage to standing or harvested crop.
- IV. If used, all ball joints connecting steering linkages must be protected by rubber boots or caps.
- V. All the hardware such as nuts, bolts, pins etc. used in the steering system must have locking provision and a minimum of 2 threads out of nut is must.
- VI. At any point of time, the steering wheel should be able to control the Machine effectively.

#### B.3.9 Drive Tires and Wheel

Each team needs to use the tire and rims, and the team needs to purchase these items on their own.

- Tire Size: 7.5 – 16
- Ply rating: 6
- Section width: 164 mm
- Outer diameter: 803 mm
- Static Loaded Radius (SLR):372 mm
- Rolling circumference: 2393 mm
- Recommended Rim size: 5.5Fx16
- Adjustable trac width
- Remolded tires are not allowed for TIFAN 2023 competition
- No tracks or chains to be used. Only traction tires are acceptable
- For more details refer to the ITAC (Interactive Test and Calibrations) manual
- The drive tires may be at rear or front side depending on design.

### B.3.10 Suspension

Usage of suspension is not mandatory for TIFAN Competition purpose, and teams may or may not use suspension system in their Machine depending on their choice. Any team using suspension needs to design and fabricate it using sound engineering practice. OEM configuration may be used. Approval from TIFAN technical committee will be must before such machine enters the field for evaluation.

### B.3.11 Lighting

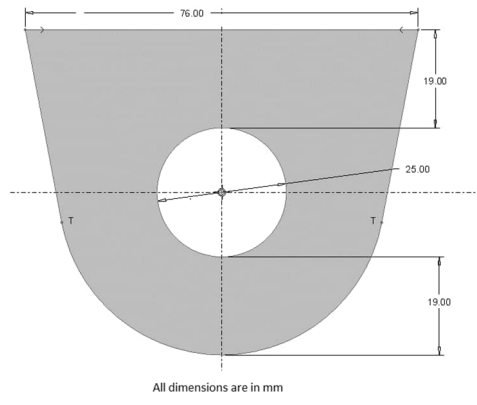
Other than lighting requirement specified in electrical section of this rule book, other devices for lighting to Machines are optional for prototype made for TIFAN competition purpose.

### B.3.12 Toeing provisions

Each machine must have provision for towing it in case of any failure during the dynamic event. The hitch points at the front and rear, along its longitudinal centerline. Hitch points must be structurally attached to the machine's main structure and must allow for transmission of both longitudinal and lateral towing loads from the machine to the hook or clevis of a tow rope without entanglement in machine components. The acceptable design of toeing is shown below

Towing plate Maximum thickness	9.5 mm
Hole diameter Minimum	25 mm
Radial clearance Maximum from hole	25 mm
Hole to tube Minimum clearance	19.0 mm
Hitch plate Minimum width were connected to frame	76 mm

*Table 2. Toeing Acceptable Design Dimensions*



*Fig 6. Toeing Design*

### B.3.13 Aid to stop the engine

The students opting for self-propelled machine should be able to use the “Mechanical Kill switch” to ensure added safety feature. They can have a Mechanical or Electrical switch detailed out in the section below:

Mechanical Aid:

To ensure the safety of everyone at the competition, all machines built by the team must have a provision to cut-off the diesel fuel either by mechanical or electrical means. The mechanical means could be a lever system pulling the fuel shut off or could be a wired system which enables the throttle to move in such orientation that it cuts off the fuel and thereby stops the engine. The design of this aid should be such that it does not compromise with any basic functioning of engine, and neither should it have any ill effect resulting the damage to engine.

The reference mechanical engine stop could be as below but not limited to this design.



*Fig 7. Mechanical Engine Stop Representation (Actual Picture)*

Electrical aid:

- I. The electrical system may include at least one kill switches, a brake light, and a battery power source. The kill switch if used must deactivate the engine ignition.
- II. Kill switch on diesel engines may also stop the air supply immediately. The system must have a spring-actuated air supply cut-off, which is activated by a Bowden cable.
- III. Electrical kill switch if used, can be mounted using below reference information

Team may use the Kill switch mentioned in the following links from the following type

- a. 01-171 Skidoo kill switch available at <http://www.mfgsupply.com/m/c/01-171.html?id=UxSl4Vzn>
- b. Aftermarket WPS#27-0152 or 27-0124  
<http://www.parkeryamaha.com/index.asp?PageAction=PRODSEARCH&txtSearch=27-0152&Page=1>

Location of Engine stop aid

The engine stop aid (mechanical or electrical) must be mounted in such a way that it is easily accessible to the operator or side member in easy reach of field working members. The aid must be mounted rigidly, with no sharp edges nearby. All open wires must be enclosed





*Fig 8. Engine Stop Aid (Actual Pictures)*

#### B.3.14 Machine identification

##### I. Machine Number Assignment

Numbers will be assigned by TIFAN organizing committee as part of the final list of selected teams after Virtual event and will be published on <http://saeindia.org/tifan/>.

- II. Every team must provide its machine number marking before bringing the machine to the competition
- III. This machine number plate shall include machine number painted with black letters on white background on a sheet metal plate of size 25x105 mm shall be mounted on front and rear of machines like tractors such that it is clearly visible to all technical evaluation members.
- IV. The numbers must remain readable throughout the competition.
- V. Avoid sharp edges or points on the inner and outer edges of the cutout numbers.
- VI. The coloring scheme, logo, slogans product name etc., chosen for the machine by each team must not be copied from existing brands already available. Any such violation may attract disqualification from competition at any stage.

#### B.3.15 Structural members for machine frame

All Machines must have a solid frame that prevents any part of the operator's body from contacting the ground.

Teams are free to use the standard sections for fabricating the base frame for the machine, however, they must meet the following criteria:

- I. If Circular steel tubing is used it must have an outside diameter of 25mm (1 in) and a wall thickness of 3 mm (0.120 in) and a carbon content of at least 0.18%.
- II. If a section other than circular tube is used, then its bending stiffness and bending strength must exceed that of circular steel tubing with an outside diameter of 25mm (1 in.) and a wall thickness of 3 mm (0.120 in.) and a carbon content of 0.18%.
- III. The wall thickness must be at least 1.57 mm (0.062 in.), regardless of material or section size. Documents of equivalency must include:
  1. Calculations must be presented at Technical Inspection which proves sufficient bending stiffness and bending strength. All calculations must be in SI units to three significant figures to the nominal tube sizes as specified by the invoice.
  2. Invoices pertaining to the purchase of material used for machine frames.
  3. Material test reports or certifications which specify the carbon content and yield strength.

- IV. The bending stiffness and bending strength must be calculated about a neutral axis that gives the minimum values. Bending stiffness is proportional to the product  $E \times I$ , where
  - $E$  Modulus of elasticity (205 GPa for all steels)
  - $I$  Second moment of area for the structural cross section

The Bending strength is given by equation:  $\frac{S_y \times I}{C}$

Where,  $S_y$  is Yield strength (365 MPa for AISI 1018 steel\*)

$C$  is Distance from neutral axis to extreme fiber

\*Bending moment of AISI 1018 steel (for tube dimension as above) = 387.38 Nm

### B.3.16 Welding of members

- I. When machine frame is made of members which are made of multiple tubes, joined by welding, must be reinforced with a welding sleeve.
- II. Sleeves must be designed to fit tightly on the inside of the joint being reinforced. External sleeves are not allowed.
- III. Sleeves must extend into each side of the sleeved joint, a length of at least two times the diameter of the tubes being reinforced and be made from steel at least as thick as the tubes being reinforced.
- IV. The general arrangement of an acceptable sleeved joint is shown in Fig.9 below

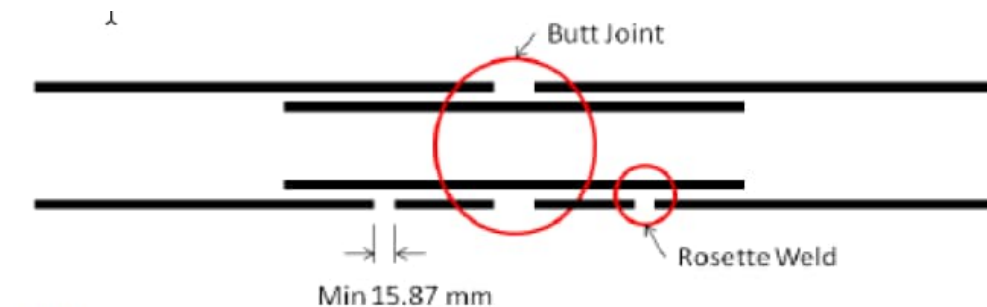


Fig. 9 Sleeved Joint

- V. A butt weld and four rosette welds (two on each tube piece, on holes of a minimum diameter of 16 mm are required.
- VI. A minimum of 4 linear inches of weld is required to secure the sleeve inside the joint, including the butt joint and the rosette welds.
- VII. No professional help for weldment creation is expected. The team needs to produce a video providing details of actual welding done by team members in their workshop.

### B.3.17 Firewall

- I. If the fuel tank is located away from the engine there must be a firewall between the engine compartment and fuel tank compartment.
- II. If the engine is mounted behind or underneath the operator seat, a properly designed shielding between engine and operator station area is mandatory.
- III. Fuel tank must be in a sealed container that prevents fuel from leaking in the event of fuel tank failure.
- IV. Splash shields must prevent fuel from being poured anywhere on the engine exhaust area during fueling.

- V. Engine must be completely enclosed and protect the operator in the event of an engine failure. Shielding must meet guarding requirements. This shielding must be made of metal max 0.50 mm thick. Multiple panels may be used to form the firewall but there must be no gaps between the joints.
- VI. Cutouts in the firewall are allowed, but they must have grommets or boots that prevent substantial amounts of fuel from getting into the cockpit. Firewalls can be bolted or riveted using metal brackets welded on frame.
- VII. All engine compartment venting must be directed away from the driver area.

#### B.3.18 Operator egress time

The machine design should be such that the operator must be able to exit on either side of the machine within five (5) seconds.

#### B.3.19 Body panels for machine

The farm machine rotating, and reciprocating parts must be fitted with body panels that cover the area which may be prone to entangled to operator, without hampering the functionality of the machine. These panels must be made of plastic, fiberglass, metal, or similar material. They must be designed to prevent debris and foreign object intrusion thrown off from the rotary parts to sideways and the operator. The panels must be mounted securely to the frame using sound engineering practices usage of zip ties is not acceptable.

#### B.3.20 Cover for universal shafts

If a universal joint is used near the operator control area it shall be shielded or booted such that the driver may not become entangled in the joint.

All rotating Parts/shafts/sprockets etc. should be covered with protection. No rotating part shall be left open, such cases will be penalized to ensure proper safety during the event. Proper protection should be installed to cover rotating parts. Appropriate grade with approval from technical committee member, is allowed to use as protecting material for shields.

The organizing committee holds the right to decide the safety level of machines based on inspection.

#### B.3.21 Fire Extinguisher

Each team must equip their machine with a fire extinguisher and have a spare secondary extinguisher meeting the following requirements:

- I. Each team must get their fire extinguishers for static evaluation.
- II. Each team must have two identical fire extinguishers with a minimum UL rating of 5B-C.
- III. Fire extinguishers must be labelled with the collage name and machine number.
- IV. One must be mounted at an appropriate location on the right side of the machine and shall be easily accessible by ground workers.
- V. The mounting bracket for the fire extinguisher must be securely attached to the main frame of the machine.

#### B.3.22 Throttle Controls

Only Mechanical hand or foot operated throttle controls are allowed. Controls must be designed to return to idle-stop in the event of a failure. The throttle cable must be covered (sheathed). Mechanical extensions to throttle control wires are not permitted. It is preferable to use throttle control parts from OEM configuration.

#### B.3.23 Seat of operator

When Teams are designing the operator seat for Self-Propelled implement then they must ensure that seat is designed wide and long enough to effectively protect the driver's body in the case of collisions

or rollovers. The machines which seem dangerous to operate would be liable to be excluded from competition and the final decision of TIFAN Organizing committee will be binding on all participating teams

- I. Seats shall be designed to have at least two planar surfaces when the driver is seated in the machine. The seat back plane shall be inclined between 65 and 90 degrees from horizontal (as viewed from the side). The seat bottom plane shall be underneath the driver and be horizontal or sloped such that the leading edge of the seat bottom plane is level with or higher than the intersection with the back plane. Seats may also include material oriented vertically along the sides of the seat bottom plane and the seat back plane designed to assist in laterally restraining the driver.
- II. Seat mounting: Seats shall have no less than four mounting points from the seat bottom plane and no less than two mounting points from the seat back plane. The seat bottom plane and seat back plane mounting points shall be symmetrical about the longitudinal center line of the seat itself or the machine. Any tabs utilized in mounting the seat shall be a minimum thickness of 2.3mm and have at least 38 mm of weld length per tab. Mounting Tabs shall not visibly deform when a load is applied.

#### B.3.24 Braking System

All the TIFAN competition machines are required to be equipped with an efficient braking system either hand or foot operated. Team may use in depended on brake pedal for LH or RH wheel for turning aid in field however it is mandatory to have brake pedal lock with such designs for field transport mode. The effectiveness of the braking system will be tested during Machine inspection. The Machine must remain immobile with operator on it when it is placed on a 20 % incline with the main brake in place. Moreover, a dynamic inspection may be performed on the Machine-handling test. The brake should be able to stop the Machine running at top speed (or 15kmph) within 7.5 m. Teams can use OEMS brake configuration with proper adoption to their machine.

#### B.3.25 Fuel System

- I. The entire fuel system, including splash shield, drip pan, and engine (excluding intake air hoses) must be located within the envelope of the machine's frame. If a tank is mounted remotely the tank mountings must be designed to resist shaking loose. All fuel tank mounting points shall be used.
- II. Fasteners rules mentioned here in.
- III. Only a single fuel tank is permitted on the machine. Fuel tanks are restricted to the stock tank provided by the engine OEM. No holes are allowed in the tank even if they have been repaired. Fuel pumps may not be used.
- IV. All fuel lines must be located away from sharp edges, hot engine components and be protected from chafing. Grommet thing is required where the lines pass through any member of the machine.
- V. All lines must be SAE rated fuel lines or engine supplied only. Those should be attached securely to prevent minimum line movement using sound engineering practices. Variation in the ID and OD of fuel line is not permitted than that of supplied with the engine.
- VI. The fuel tank size should be 15 liter and it must be mounted in such a way so that if fuel spills it will not meet the operator of the machine.
- VII. Drip pans must be mounted using sound engineering practices. A drip pan mounting comprised only of fastening to the fuel tank filler neck is insufficient and is not allowed. Drip pans must be graded or inclined such that all spilled fuel drains from the drip pan, fuel must not pool anywhere in the pan.

VIII. Fuel must drain from the drip pan through a drain line with minimum ID of 9.5 mm, composed of pipe or tubing that carries fuel to the bottom of the machine and releases under the machine. Tubing shall be rated for fuel use.

#### B.3.26 Loading system

- I. The machine needs to load the saplings at center of rear side when considered to be moving in forward direction.
- II. The loading of saplings should be such that it is not damaged due to any of the components from the machine such as wheel etc.
- III. Manual picking and manual conveyer feeding of saplings is prohibited for this competition.

#### B.3.27 Machine Economics Calculations

Each team is required to prepare one slide with the title Machine Economics, using the following information to be added to the virtual TIFAN presentation  
Follow the below steps

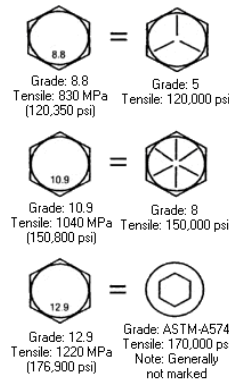
- i. Calculate the prototype estimated cost of your design and present it as slide during virtual round
- ii. Calculate the Fixed cost per hour of your proposed design of Automated Multi Vegetable Transplanter, following data to be used for fixed cost calculation.
  - Residual/Salvage value= 10 % of Prototype cost
  - Annual Usage of 600 hours and useful life of 10 years
  - Interest rate on investment to be considered as 12 %
  - Insurance & Taxes = 2 % of Prototype cost
  - Housing=1.5 % of Prototype cost.
- iii. Calculate the Variable cost per hour of your proposed design of Automated Multi Vegetable Transplanter, following data to be used for variable cost calculation.
  - Average fuel consumption=1.3 liter/hr.
  - Lubrication oil consumption = 3 % of fuel consumption
  - Average Rate of diesel fuel = Rs 95/ liter
  - Rate of lubrication oil= Rs 150/liter
  - Repair and maintenance =8 % of Prototype cost
  - Labor charge= Rs 50/hr.
- iv. Calculate total operating cost/hr. of the machine
- v. Calculate effective field capacity, following data to be used for calculation
  - Working Width = Your designed value, m
  - Travel speed = your designed value, kmph
  - Field efficiency = 80 %
- vi. Calculate the machine operating cost in Rs/ha
- vii. The summary of the above calculations in a tabular format to be shown on the slide.

#### B.3.28 Fasteners

Fasteners used in the machine systems mounting must meet the following guidelines.

- I. Fasteners must be made captive using NYLON locknuts, cotter nuts or safety wired bolts (in blind applications). Lock washers or thread sealants do not meet this requirement.
- II. Team must use threaded fasteners either ISO (Metric) or SAE which meet or exceed either, SAE Grade 5/ Metric Grade 8.8 specifications. See Figures below.

Metric      SAE



Source: Google images

Fig 10. Fastener Specification Representation

III. Threaded fasteners used must have a minimum of two (2) threads coming out of nuts.

#### B.3.29 Protecting guards

- I. Fenders: All machines must be fitted with stable and firmly bolted fenders to protect the driver from driving tires. The minimum vertical distance between tire and fender is to be kept 50 mm
- II. All rotating parts such as belts, chains, and sprockets that rotate, must be shielded to prevent injury to the operator or bystanders and to avoid the component flying apart due to centrifugal force.
- III. These guards/shields must extend around the periphery of the belt or chain and must be wider than the rotating part they are protecting. They must be mounted with sound engineering practice, to resist vibration.
- IV. Material should be at least AISI 1010 strength steel with minimum 1.5 mm thick -16 Gauge for fender whereas 1.27 mm thick -18 gauge for another component is allowed.
- V. Finger guards: Rotating parts must also be guarded all around, in addition to the guard around the periphery. All around guarding (finger guards) must prevent small, searching fingers from getting caught in any rotating part.
- VI. Non-rigid, fabric coverings such as "Frog skin", Ceconite, and neoprene not acceptable for use as finger guards.
- VII. A complete cover around the engine and drivetrain is an acceptable shield.

#### B.4 Provision to mount Event Sponsor Authority Logo

- I. All teams should make provision of a place for putting logo stickers on their machine. These logos sticker will be provided at the event place and mounting instructions will be provided during static events event
- II. Teams may display advertising from their machine's sponsors, provided it is in good taste and does not conflict with the machine's number.

#### B.5 Additional technical requirements

- I. During Machine design, construction, and competition planning, participating teams must pay attention to all aspects of safety, i.e., driver safety, the safety of other team members and spectator safety.
- II. Machines may have exactly two/four wheels, which under normal running conditions must all be in continuous contact with the road.
- III. Aerodynamic accessories/ attachment, which adjust or are prone to changing shape due to wind whilst the Machine is in motion, are not permitted.

- IV. Machine bodies must not be prone to changing shape due to wind and must not include any external accessories/ attachment that might be dangerous to other Team members, e.g., pointed part of the Machine body. Any sharp points must have a radius of 50mm or more alternatively they should be made of foam or similar deformable material.
- V. The Machine must not contain any objects that might injure the operator during a collision, if any.
- VI. All parts with where potential human touches are possible, should not be made of any material which may smash/explode into sharp shards.
- VII. Any rotating part or component should be covered and should be easy to open for quick inspection access.
- VIII. All objects in the Machine must be securely connected and well supported.
- IX. Access to the Machine by the driver must be as easy and practical as typically found in common production type Transplanter.
- X. Any access opening mechanisms (e.g., steps/ footrest) must be rigidly attached to the Machine.
- XI. Machines need to have appropriately designed hook points to ease transportation.
- XII. There must be two jack points in the Machine, one in the front and the other in the rear end.

## C. Part C: Evaluation Criteria

The students would be scored for their overall progress with respect to static evaluation which would comprise of a total of 400 points, followed by dynamic evaluation of the machine which would comprise of a total of 600 points. Final discretion of the scoring would be totally based on judge's decision satisfying all the criteria mentioned below or otherwise on understanding on the situation at the field.

### C.1 Technical Inspection

- a. All participating teams must pass a technical inspection before they are permitted to operate the machine in the field and other dynamic events.
- b. Every team needs to perform the self-assessment technical inspection as per the sheet attached and signed by team captain must be submitted to the evaluation team judge at site

SN	Rules / Criteria	Requirements met
1	All team members are undergraduate (i.e., B. Tech /B. E) and No Post Graduate team member	Yes/No
2	SAE Indian Membership available for all members and Faculty. This can be done at the main event site as well	Yes/No
3	Driver License available with team driver. Need to carry minimum LMV license	Yes/No
4	Maximum No of team members are 25, Minimum nos is 15 Nos	Yes/No
5	Faculty Advisor is available for the project	Yes/No
6	Machines is Conceived, designed, fabricated by the student team members without direct involvement from professional engineers, automotive engineers, machinists, or related professionals.	Yes/No
7	The manufacturing location of the machine is like the place of institute	Yes/No
8	Any team participating second time for same theme must explain and provide document to explain the difference in their current machine in respect of following 1) Performance 2) Productivity 3) Cost of Operation 4) Innovation, if applicable	Yes/No
9	Manufacturing done in-house (College workshop or outside)	Yes/No
10	If team is utilizing outside facility for manufacture, Appropriate documentation with consent and approval from Faculty and HOD is to be available with team, to maintain for using facilities outside of campus.	Yes/No
11	Is driver aware of the basic rules of driving a motor vehicle s	
12	Track (tread) width	1200-1800
13	Maximum Overall Length	2800
14	Maximum Overall height	2000
15	Ground clearance, Minimum	250
16	Any modification to the fuel system of the engine	Yes/No
17	Engine idling speed, any changes done	Yes/No



18	Is air cleaner relocated	Yes/No
19	If the air cleaner is relocated, has enough care taken to avoid the suction hose collapsing due to suction?	Yes/No
20	Is Exhaust muffler location altered	Yes/No
21	If the exhaust muffler is relocated, is pipe with minimum ID 32 mm used?	Yes/No
22	Is the support for exhaust piping sound enough to withstand the engine vibrations	Yes/No
23	Exhaust tail pipe location is not directing towards operator	Yes/No
24	The angle of exhaust pipe with respect to ground plane is not more than 45°	Yes/No
25	No holes in Exhaust piping, from where there is chance to get gases leak	Yes/No
26	No exhaust pipe is out of overall machine perimeter beyond 100 mm	Yes/No
27	No starter motor is Installed by team. (Only rope start is permitted)	Yes/No
28	Is any alternator mounted by team?	Yes/No
29	If an Alternator is used just to power batteries that power electrical items like brake light, horn, reverse alarm etc.	Yes/No
30	No electric aid for machine propulsion or functioning of machine functional components is used	Yes/No
31	Engine governor high idle speed is not changed than factory setting (3300 rpm)	Yes/No
32	No obstruction to the governor component	Yes/No
33	Maximum forward travel speed is <15 kmph	Yes/No
34	Maximum reverse travel speed is <5 kmph	Yes/No
35	All the CVT transmission rotating parts are shielded adequately	Yes/No
36	All chains and belt drives are protected from coming in direct contact with the operator.	Yes/No
37	If Cordon (universal) joints are used, they are shielded radially (360°) with a minimum 3mm steel sheet.	Yes/No
38	The maximum deflection angle for universal joints is 10 °	Yes/No
39	Appropriate care is taken for ensuring lubrication to the transmission system of the machine.	Yes/No
40	The machine is free from any leakage or seepage of fluid.	Yes/No
41	The operator is able visibility ahead and to 90° on each side of the longitudinal axis of the Machine.	Yes/No
42	Operators should be able to turn around freely to see operation and obstacles in the field.	Yes/No
43	The maximum voltage on board of any Machine does not exceed 12 Volts nominal	Yes/No
44	Battery if used, is be mounted with sound engineering practice and not come loose during a roll-over of machine.	Yes/No
45	No positive contact with the exhaust unit of the fuel system.	Yes/No
46	Battery, if used, is safely placed & concealed. Only OEM battery is used	Yes/No
47	If brake light, reverse light, and alarm use, they should be powered by battery	Yes/No

48	Brake Light if fitted, are OEM brake light assemblies or as per SAE standard rating	Yes/No
49	The brake light gets illuminated when the brake system is actuated, and completely extinguished when the brakes are released.	Yes/No
50	The brake light height is minimum of 1 meter above the ground.	Yes/No
51	If reverse gear is used recommendation is to fit reverse light and alarm. This is recommended; however it is optional for this year's competition	Yes/No
52	It is recommended for machine to be equipped with a horn mounted towards the front of the Machine. However, this is optional for this year's competition	Yes/No
53	The emergency shutdown mechanism is provided by means of minimum one kill switch mounted on machine and accessible by person outside of machine.	Yes/No
54	Mechanical /hydraulic or combination of both is used for machine articulation or steering	Yes/No
55	Maximum turning radius of the machine. Recommended is <2.0 m	Yes/No
56	Figure 8 test is conducted at Campus, to verify machine articulations	Yes/No
57	If ball joints connecting steering linkages are used all must be protected by rubber boots or caps.	Yes/No
58	All the hardware such as nuts, bolts, pins etc. used in the steering system had locking provision and a minimum of 2 threads out of nut.	Yes/No
59	The steering wheel can control the Machine effectively all the time	Yes/No
60	If suspension is used, sound engineering practice followed, or OEM configuration is used. This is optional	Yes/No
61	Toeing provision on machine is provided as per dimensions specified in rule book	Yes/No
62	Aid to stop the engine (either mechanical or electrical means) is provided on the machine	Yes/No
63	Location of engine stop aid (Mechanical or electrical) is easily accessible	Yes/No
64	The engine stop aid is mounted rigidly, with no sharp edges nearby. All open wires/cable are properly enclosed	Yes/No
65	Machine Identification no is provided as per rule book at rear left side of machine such that clearly visible from all sides, front, and rear of the machine.	Yes/No
66	Structural members for machine frame are made as per the rule book requirement with carbon content of at least 0.18%.	Yes/No
67	If a section other than circular tube is used, then it is bending stiffness and bending strength calculations are done and are meeting the rule book requirements	Yes/No
68	Material test reports or certifications which specify the carbon content and yield strength are available on demand by technical inspection team at site	Yes/No
69	When machine frame is made of members which are made of multiple tubes, joined by welding, its reinforcement is done using a welding sleeve.	Yes/No
70	Sleeves designed are fitting tightly on the inside on the joint being reinforced.	Yes/No
71	No External sleeves are used in machine frame	Yes/No

72	Usage of external Sleeves for drive parts is permitted if used with sound engineering practices	Yes/No
73	If the engine is mounted behind or underneath the operator seat, a professionally designed shielding between engine and operator station is designed and fitted on machine	Yes/No
74	All engine compartment venting must be directed away from the operator area.	Yes/No
75	If the exhaust system is relocated no pipe of exhaust system is coming in the engine fuel pouring area. If any such pipe is coming splash shields are provided to prevent fuel from being poured during fueling	Yes/No
76	The maximum time for an operator to be able to exit on either side of the machine is within five (5) seconds.	Yes/No
77	Any rotating and or reciprocating parts are fitted with body panels/protective shield without hampering the functionality of the machine.	Yes/No
78	The above panels are mounted securely to the frame using sound engineering practices. No zip ties/tie band are used.	Yes/No
79	Material should for shield is having steel with minimum 1.5 mm thick	Yes/No
80	Provision for fire extinguisher is available on in the RHS of the machine and is easily accessible.	Yes/No
81	A spare secondary extinguisher (minimum UL rating of 5B-C) is available with team with collage name and machine number	Yes/No
82	Only Mechanical hand or foot operated throttle controls are used	Yes/No
83	Hand or foot throttle spring on engine is not tampered by team and have provision to return to idle stop.	Yes/No
84	The throttle cable is covered and protected from cutting due to sharp corners of other parts	Yes/No
85	Operator seat is having minimum two planar surfaces (vertical and horizontal) One surface for sitting the other for backrest	Yes/No
86	Seat mounting is having minimum four mounting points from the seat bottom plane	Yes/No
87	The machine is equipped with an efficient braking system either hand or foot operated. Making all drive wheels lock simultaneously. OEM brakes are recommended	Yes/No
88	Brake pedal lock is provided in case independent LH or RH brake pedals are provided.	Yes/No
89	Brake test using top speed (or 15kmph) is performed in campus	Yes/No
90	The fuel tank is relocated from the engine by a team. Fuel tank other than KOEL Engine is not used	Yes/No
91	No extra fuel tank is mounted by team	Yes/No
92	If fuel tank is relocated all fuel lines must are away from sharp edges, hot engine components and are protected using rubber grommet	Yes/No
93	If fuel tank is relocated, all lines must be SAE rated fuel lines, OEM or engine supplied only.	Yes/No

94	The fuel tank must be mounted so that if fuel spills it will not meet the operator of the machine.	Yes/No
95	Provision for drip pans is made such that all spilled fuel drains on ground without meeting any hot components	Yes/No
96	The working width of the cutting system should be a minimum of 750 mm	Yes/No
97	Machine is having provision to load the sapling at center of rear side moving in forward direction.	Yes/No
98	Threaded fasteners used have minimum two (2) thread coming out of nuts.	Yes/No
99	Threaded fasteners used have minimum SAE Grade 5/ Metric Grade 8.8	Yes/No
100	Any steps/ footrest is used, is rigidly attached to the Machine	Yes/No
101	Provision is made for jack points in the Machine frame in case of any repair work	Yes/No

*Table 3. List of Evaluation Criteria*

- c. The inspection will determine if the machine satisfies the requirements and restrictions of the TIFAN competition rules.
- d. Machines which are incomplete and not ready for site technical inspection will be sent away.
- e. Any machine may be re-inspected at any time during the competition and correction of any non-compliance will be required.
- f. Technical inspection will consist of four (3) separate parts as follows
  - I. Machine Build Scrutiny
    - 1. Engine inspection and governor setting-Governor Setting Check
    - 2. Frame Material Documentation: Receipts documenting the materials purchased, or otherwise acquired, and used to build the frame.
    - 3. Self-Certification Check Sheet: A properly completed Self Certification Check Sheet.
  - II. Kill switch and dynamic brake testing
    - 1. The external kill switch will be tested for functionality. If it passes the test, then the machine will be dynamically brake tested.
    - 2. Each machine must demonstrate its ability to lock at least two drive all wheels and come to rest in a straight line after acceleration run specified by the inspectors.
    - 3. If a machine fails to pass any part of the inspection it must be corrected/modified and brought into compliance with the
  - III. Incline test (Off road capability)
 

Machines must demonstrate, in an Inclining test, wherein it must pass on ram of 30 ° in transverse and 45°in longitudinal and shall stay there for till the technical inspector inspectors its assembly for leakages of fluids.
- g. Inspection Stickers
 

A multi-part inspection sticker will be issued in sections to each machine as each of the three parts of technical inspection is completed. The inspectors will place the inspection sticker on the right side of the machine. This inspection sticker must remain on the machine throughout the competition. Machines without all parts of the inspection sticker may not be permitted to operate under engine power.
- h. Self-Certification by Teams
 

Before bringing the machine to technical inspection each team must

  - 1. Pre-inspect the machine for compliance with the rules

2. Complete the official Self Certification Check Sheet (will be made available on <http://saeindia.org/tifan/>)
  - i. Once a machine has passed technical inspection its configuration may not be modified. All accessory components such as roofs, wings, bumpers, etc. are considered part of the configuration and must always remain on the machine.
  - j. Approved machines must remain in “as-approved” condition throughout the competition. Any repairs of a part that is not identical to the broken part must be approved prior to the repair.
  - k. Non-identical parts not approved will be subject to an appropriate performance penalty.

## C.2 Evaluation Process

### C.2.1 Judging Categories

The machine developed under TIFAN competition are judged in a series of static and dynamic events including safety scrutiny, technical inspection, cost, sales & marketing presentation, review of engineering design and finally the field performance at TIFAN location. Dynamic events are scored to determine the field performance of the farm machine.

The high-level distribution points for the competition would be as below, subjected to vary depending upon the format of competition at the actual event in awake of the pandemic situation.

Static Event	(400 points)	Remarks
Engineering Design & Innovation. Refer section C.3.1 in this rule book document	150	Points would be allocated based on sound design of machine, submission of design report and on any added innovation considered by the student. (Scores are subjective to Judge’s final decision)
Cost Evaluation and Manufacturing. Refer section C.3.2 in this rule book document	100	Points would be allocated based on details provided by the students on total cost of the machine, including any special skills demonstrated during manufacturing of parts of machine. (Scores are subjective to Judge’s final decision)
Consciousness towards Farm mechanization (Machine utility for end user).	75	Overall understanding of machine and farm equipment. Judges have final discretion on checking the knowledge of the students understanding in farming and farm machine mechanization. (Scores are subjective to Judge’s final decision)
Sales and Marketing presentation. Refer section C.3.3 in this rule book document	75	Students are expected to demonstrate their Sales and marketing understanding of the machine on customer’s standpoint. (Scores are subjective to Judge’s final decision)
Dynamic/Field Event	(600 points)	Criteria

<p>Planting Efficiency% (Total saplings intactly placed in the ground from the total saplings considered). Refer section D.3.1 in this rule book document</p>	<p>150</p>	<p>Scores would be % value of total points allocated.</p> <p><i>For ex. If the Planting efficiency comes to be 90%. Students would be allocated 90% of 150 (Total Points) = 135 or judges' best decision.</i></p>
<p>Precision of planting [Multiple Crop, Plant Distance, Row distance]. Refer section D.3.2 in this rule book document for precision calculation and for crop spacing refer section B.3.1</p>	<p>100</p>	<p>Ability to consider actual distance considered row to row and crop to crop. For example. Judges to take an average of both the distances considered.</p> <p>For example, when, the theoretical Row to Row distance is 600 mm and the average Row to Row distance obtained by students is 450 mm. [Considering row to row distance of any 10 random measurement if unable to measure all- Judges to choose based on keen observation of the row-to-row distance]</p> <p>R-R Distance (Avg Eff) = <math>450/600 \times 100 = 75\%</math></p> <p>Similarly, when the theoretical Crop to Crop distance is 600 mm and the average Row to Row distance obtained by students is 550 mm. [Considering row to row distance of worst of 10 random measurement if unable to measure all- Judges to choose based on keen observation of the row-to-row distance], then the marking system would be</p> <p>C-C Distance (Avg Eff) = <math>500/600 \times 100 = 83\%</math></p> <p>Then the effective average of all the collective efficiency be: <math>75+83/2 = 79\%</math></p> <p>In this case, the students to get 79 points out of 100 points.</p>
<p>Sapling damage % (Total Sapling damaged out of total sapling's to be planted for designated area). Refer section D.3.3 in this rule book document</p>	<p>100</p>	<p>Damage may include conditions such as not proper sowing, saplings getting damaged due to the machine itself or inability to perform the operations as mentioned in the rulebook.</p>

		<i>For ex. If the Sapling damage comes to be 10%. Students would be allocated (100-10) % of 100 (Total Points) = 90 points, subjective to judge's final discretion.</i>
Machine Field Efficiency or productivity. Refer section D.3.4 in this rule book document	100	This would be subjective to judge's final discretion which would involve several factors including the sapling quality, machine's ability to perform the task to the final call on shortest time taken to consider covering the total travel distance)
Machine fuel economy during field operation (Lit/hr.) Refer section D.3.5 in this rule book document	100	This would be evaluated based on the total fuel consumption from start to end of the activity. Judge's final discretion would be considered in evaluation.
Machine handling and operator comfort. Refer section D.3.6 in this rule book document	50	Overall quality of the machine including the safety and Noise quality of the machine to be best evaluated.

Table 4. List of Evaluation Criteria

Note – The above distribution is for reference purposes and subjected change based upon the agro-climatic conditions of crop, soil, and the actual site conditions as decided by TIFAN OC.

### C.3 Static Evaluation

#### C.3.1 Engineering Design & Innovation Evaluation

- a. The objective of the engineering design and Innovation event is to evaluate the engineering effort that went into the design of the farm machine and how the engineering meets the intent of the problem statement (theme) s detailed in the competition objective
- b. Teams will be judged on the creation of design specifications and the ability to meet those specifications, computer aided drafting, analysis, testing and development, manufacturability, serviceability, system integration and how the machine works in field to perform its intended function. Each of these parts of the engineering product development cycle will be judged within the following subsystems:
  1. Soil Opening unit (Digging)
  2. picking and sapling handling unit (Conveying system for the given crop sapling)
  3. Conveying & drop unit (Final output material collection)
  4. Power transmission system (Engine, Pulleys, belt, chains etc.)
  5. Other engineering systems like Chassis, Brakes, Powertrain, Suspension, Steering and Ergonomics.

The machine that illustrates the best use of engineering to meet the design goals and the best understanding of the design by the team members will win the design event.

Teams are reminded that in the Engineering Design Event, teams are evaluated on their design. Components and systems that are incorporated into the design as finished items are not

evaluated as a student designed unit but are only assessed on the team's selection and application of that unit. For example, teams that design and fabricate their own shocks are evaluated on the shock design itself as well as the shock's application within the suspension system. Teams using commercially available shocks are evaluated only on selection and application within the suspension system.

- c. The engineering design event consists of two parts:
  - I. Design Evaluation
  - II. Design Report that will be used as a part of the design evaluation.

#### C.3.1.1 Design Report

- I. Design Report must not exceed eight (8) pages, consisting of not more than four (4) pages of text, three (3) pages of drawings and one (1) optional page containing content to be defined by the team (photos, graphs, etc.). All pages must be A4.
- II. The Design Report should contain a brief description of the machine with a review of your team's design objectives, machine concepts, and a discussion of any important design features. Note or describe the application of analysis and testing techniques (FEA (Finite Element Analysis), part/system/machine testing, etc.). Evidence of this analysis and back-up data should be brought to the competition and be available, on request, for review by the judges.
- III. Note that while the Design Report is not explicitly scored, it may be the "Resume of your farm machine", preparing your team for on-site Design Evaluation judges to view your design efforts in its most positive light. C3.3 Design Spec Sheet -Required Submission
- IV. Design Spec Sheet -A completed specification of farm machine must be submitted. The Specification Sheet template can be found at <http://saeindia.org/tifan/>
- V. Design Report and the Design Spec Sheet, while related, are independent documents and must be submitted as two (2) separate files and communication will be sent to teams on the timeline and method of submission
- VI. The Design Report must include one set of three (3) view drawings showing the machine, from the front, top, and side.
- VII. Each drawing shall appear on a separate page. The drawings can be manually, or computer generated.
- VIII. Photos should be placed on the optional page and will not be replacement of drawings.
- IX. Design Report and Design Spec Sheet Formats
  - 1. The Design Report must be submitted electronically in Adobe Acrobat Format (PDF). The document must be a single file (text, drawings and optional content are all inclusive).
  - 2. The design report file must be named as follows:  
Machine #\_College name\_TIFAN\_DesignReport.  
EXAMPLE: Machine# 001\_XYZ University\_TIFAN2023\_DesignReport.pdf.
  - 3. The maximum size for the file is 5MB
  - 4. Design Spec Sheets must be submitted electronically in Microsoft Excel Format (\*.xlsx file).
  - 5. The format of the Spec Sheet MUST NOT be altered. Like the Design Report, the Design Spec Sheet file must be named as follows: Machine #\_College name\_TIFAN2022\_specs.  
EXAMPLE: Machine# 001\_XYZ University\_TIFAN2023\_specs.xlsx.
- X. WARNING: Failure to exactly follow the above submission requirements may result in exclusion from the Design Event. If your file is not submitted in the required format or is not properly named, then it cannot be made available to the design judges and your team may be excluded from the Design Event.



- XI. Design reports must be submitted to the email ID those will be communicated on <http://saeindia.org/tifan/> from time to time and described in Part E of these rules. Reports must be received by the due date listed in within the due date only
- XII. Penalty for Late Submission or Non-submission  
Late submission or failure to submit the Design Report will be punished at negative ten (-10) points per day. If your Design Report is received more than ten (10) days late it will be classified as “Not Submitted” and your team will not participate in the Design Event and will receive zero (0) points for design.

#### C.3.1.2 On Site Design Evaluation

- I. The design judges will evaluate the engineering effort based upon the team’s Design Report, responses to questions, and an inspection of the farm machine
- II. The design judges will inspect the machine to determine if the design concepts are adequate and appropriate for the application of TIFAN completion theme
- III. It is the responsibility of the judges to deduct points if the team cannot explain the engineering and construction of the farm machine
- IV. Support Material: Teams may bring with them to Design Evaluation any photographs, drawings, plans, charts, example components, or other materials that they believe are needed to support the presentation of the machine and the discussion of their development process. Use of laptop or notebook computers, posters, and binders is allowed.
- V. One or more team members may make the presentation to the judges. The presentation itself is limited to a maximum of six (6) minutes, followed by a Q&A for four (4) minutes
- VI. Any team member on the presentation floor may answer the questions even if that member did not speak during the presentation itself.  
Scoring.
- VII. The judges may at their discretion award the highest placing team points out of the 200 points.

#### C.3.2 Machine Prototype Cost Evaluation & Manufacturing

##### C.3.2.1 Machine Cost:

- I. Cost Report: The cost report provides all the background information to verify the machine’s actual cost.
- II. Prototype Cost: The prototype cost is the actual cost and the points, and the points related thereto.

##### C.3.2.2 Cost Report

This can contain a maximum of three sections.

- I. Report Section 1 -Overview (Optional): The optional overview is intended to give each team the opportunity to point out, and briefly comment on, any design features or fabrication processes that are innovative or are expected to result in significant cost savings. Teams may also use the overview to explain items or processes that might appear to be discrepancies within the report. The overview section is limited to a maximum of four (4) pages and is optional. This should be included as part of the Cost Documentation .pdf file.
- II. Report Section 2 -Costing Sheets: The core of the report is the series of costing sheets. This section must contain the one-page summary sheet broken up into individual subsystems. Each subsystem needs an individual sub-assembly sheet (Form A). Note that Machine Assembly Labor cost is for the labor it takes to assemble a subassembly to the frame. All fabricated parts on the sub-assemblies’ sheets (Form A) require a Form B. Note that the sub-system assembly time is the time it takes t’ assemble all the parts in that assembly together.
- III. Report Section 3 -Cost Documentation: This section includes copies of receipts, invoices, price tags, catalog pages, on-line prices, or other documentation, to substantiate the costs of the parts

and materials of any item costing more than Rs. 200. Cost documentation must be at full retail Indian prices. The report is expected to be comprehensive, well documented, truthful, and accurate.

Every team must download and use the Microsoft Excel template for cost reports those will be made available at <http://saeindia.org/tifan/>. This document may not be modified from its current form failing to which will attract zero (0) points for the cost report.

A PDF file with all the cost documentation described above must be submitted to TIFAN organizing committee The cost report file must be named as follows: Machine#\_College name\_TIFAN2023\_ Cost Report. For example: Machine# 001\_XYZ University\_TIFAN2023\_CostReport.

Cost report hard copy: Teams must bring a hard copy of their cost report to the cost judges on site. Teams that fail to bring a hard copy to judging may receive zero (0) for their cost.

#### C.3.2.3 Penalty for late or non-submission

- I. Cost reports arriving after the deadline will be penalized ten (10) points per day up to a maximum of one hundred (100) points. Failure to submit a cost report will result in zero (0) points for the cost event.

#### C.3.2.4 Cost Correction

- I. The judges may increase costs and/or fabrication times if they believe that the figures submitted are below current prices for the item, source, or process involved.
- II. Prices or times that are higher than the judge expects will not be corrected.
- III. Mathematical errors will be penalized. Reports that are highly inaccurate, highly incomplete, or in which the costs cannot be substantiated, may be rejected and their entire cost event will be scored accordingly.
- IV. Teams that are required to bring their machine to on-site for cost judging in the prescribed time slot informed during the event

#### C.3.2.5 Cost Adjustment Form

- I. The purpose of the cost adjustment form is to make additions to the previously submitted report. Items may be deleted, but the total adjustment for the individual component categories must be positive (cost will not be subtracted).
- II. This gives the team the chance to add items that were not previously planned. It is not an opportunity to redo the entire report.
- III. For teams that are cost-audited and going to multiple races, the items found during the cost audit cannot be included in this sheet.
- IV. The total amount of adjustments may not exceed 10% of the total cost of the machine previously submitted.
- V. If the adjustment exceeds 10%, the additional amount will be added with a multiplier of 3 times (3x). If the adjustment exceeds 25%, the report will be considered incomplete and will not be graded.

#### C.3.2.6 Prototype Cost

- VI. The prototype cost is scored on the cost, as corrected by the judges, to produce the finished farm machine brought to the competition, and will be calculated as follows:

$$\text{Prototype cost} = \frac{(C_{max} - C_{your})}{(C_{max} - C_{low})} \times 100$$

Where: C<sub>your</sub>-Machine cost, as corrected  
 C<sub>low</sub> -lowest machine cost, as corrected  
 C<sub>max</sub>-highest machine cost, as corrected

### C.3.3 Sales and Marketing presentation

#### C.3.3.1 Objective

The objective of the Sales and Marketing Presentation is for the team is to convince the “Executives” of a hypothetical manufacturing company to purchase the team’s farm machine and put it into production at the rate of 5000 units per year.

C.3.3.2 For the presentation, teams are to be required to assume that the judges are to be a mixed group of corporate executives who may have experience in marketing, production, and finance as well as engineering.

C.3.3.3 Teams will present a cost benefit analysis report for their implement with respect to manual/traditional planting methods.

#### C.3.3.4 Presentation –Format

- I. One or more team members may make the presentation to the judges.
- II. The presentation time is limited to ten (10) minutes, followed by Q&A of Five (5) minutes.
- III. Only judges are permitted to ask questions. Any team member on the presentation floor/stage may answer the questions even if that member did not speak during the presentation itself.
- IV. Projection Equipment: Teams planning to use data projection are responsible for bringing, for their own data and laptops

#### C.3.3.5 Presentation scoring:

The presentation event will be scored based on such categories as

- I. The content of the presentation
- II. The organization of the presentation
- III. The effectiveness of visual aids
- IV. The speaker’s delivery, and
- V. The team’s responses to the judge’s questions.

The team’s score will be the average of the individual judge’s scores.

## D. Part D: DYNAMIC EVENTS

The dynamic events are intended to determine field worthiness and performance under certain laid down criteria for the farm machine developed by the student teams.

### D.1.1 Pre-Field evaluation check

The objective of this evaluation is to check if the machine built by the team is field worthy when it is subjected to field evaluation criteria.

Each team will be required to demonstrate the machine running in static evaluation event itself to ensure all its system functions and worth taking to field. The machine will be taken to demo plot to check the functioning of digging of soil and to check the depth of cut required during actual event of dynamic tests

Any machine which is not able to demonstrate this check will not be allowed for any other static and field evaluation events unless it is rectified or reworked to have basic competition machine requirements.

The static evaluation will be weighed based on the performance of each team in the pre-field evolution check.

## D.2 Test field for dynamic event

### D.2.1 Overall field size

As mentioned in section B 3.1, subsection VI, the field size is considered to adequately fit the two-bed configuration aptly. The lengths of the bed as mentioned would remain 50 meters. The spacing between the two beds would be as sufficiently close to one another, replicating a farm scenario, considering the appropriate turning radius (2.0 meter) a farmer would consider. As the students be aware that after travelling the 50 meters, they would be turning the vehicle back to the starting point covering another bed in parallel to the first one they travelled earlier, a total of 100 meters of a distance. Students to note that the length of the bed would remain constant. They be able to demonstrate the crop to crop or row to row distance appropriately where they would be evaluated as per the capability of the machine to demonstrate the flexibility. (As seen in Section B 3.1, subsection VI, the students should have the ability to consider different crop). Judges have rights to ask the students to demonstrate the machine's ability by considering any crop to crop or row to row distance or field scenario during final inspection.

### D.2.2 Soil Specification.

There could be variety of type of soil depending upon the location of competition for that particular year theme as well as crop to be considered while the demonstration. However, team can refer below values as worst-case scenario for their designs if they would want to consider.

- I. Type of soil- Black cotton or that which is suitable for the plant
- II. Resistance of soil- 0.7 Kg/cm<sup>2</sup>

## D.3 Major Machine performance Indices during Dynamic event.

For the TIFAN 2023 competition having theme of Automated Multi vegetable Transplanter development will undergo a series of events to determine their machine performance against various indices as described below.

### D.3.1 Planting Efficiency:

Planting efficiency: Planting efficiency will be calculated to know how efficiently the farm machine plant the saplings at actual the field, using below equation.

$$\eta_{pla} = \frac{\text{Total no of saplings in actual planted}}{\text{Theoretical no of saplings to be planted in area under consideration}} \times 100$$

For example, if the students are given 1000 total saplings (depending upon field size, row to row & plat to plant distance) and they were able to plan 900 out of 1000 saplings then, as per the equation,

$$\begin{aligned} \eta_{pla} &= \frac{900}{1000} \times 100 \\ &= 90\% \end{aligned}$$

For counting the right saplings planted, the judges would evaluate how the saplings are routed well in the ground. To have the efficiency go up, the students should have a good quality check in place for machines ability to plant the sapling.

### D.3.2 Precision of Planting:

Planting precision will be calculated to know how precisely (or accurately) the farm machine plant the saplings at actual the field, we will calculate the precision% using below equation.

$$\text{Row to Row spacing } \mu_r = \frac{\text{Total average actual row to row spacing}}{\text{Theoretical row to row spacing}} \times 100$$

$$\text{Plant to Plant spacing } \mu_p = \frac{\text{Total average actual plant to plant spacing}}{\text{Theoretical plant to plant spacing}} \times 100$$

$$\text{Total Precision \%} = (\text{Row to Row spacing } \mu_r + \text{Plant to Plant spacing } \mu_p) / 2$$

For example, when, the theoretical Row to Row distance is 600 mm and the average Row to Row distance obtained by students is 450 mm. [Considering row to row distance of any 10 random measurement if unable to measure all- Judges to choose based on keen observation of the row-to-row distance]

$$\text{Row - Row Distance (Avg Eff)} = 450/600 \times 100 = 75\%$$

Similarly, when the theoretical Crop to Crop distance is 600 mm and the average Row to Row distance obtained by students is 550 mm. [Considering row to row distance of worst of 10 random measurement if unable to measure all- Judges to choose based on keen observation of the row-to-row distance], then the marking system would be

$$\text{Plant - Plant Distance (Avg Eff)} = 500/600 \times 100 = 83\%$$

Then the effective average of all the collective efficiency be:  $75+83/2 = 79\%$

In this case, the students to get 79 points out of 100 points.

### D.3.3 Sapling damage %:

Number of saplings damaged during planting operation out of total sapling's to be planted (theoretical). Sapling damage % calculated based on below formula

$$\eta_{pla} = \frac{\text{Total no of saplings damaged in planting}}{\text{Theoretical no of saplings to be planted for area under consideration}} \times 100$$

Damage may include conditions such as not proper sowing, saplings getting damaged due to the machine itself or inability to perform the operations as mentioned in the rulebook.

*For ex. If the sapling damage comes to be 10%. Students would be allocated (100-10) % of 100 (Total Points) = 90 points, subjective to judge's final discretion.*

#### D.3.4 Machine Field Efficiency or productivity

Field efficiency is defined as the ratio of actual field capacity of the machine to the ideal or theoretical field capacity of the same machine and can be calculated as below. Same formula for self-propelled and Tractor attachment can be used.

$$\text{Field Efficiency} = \frac{\text{Effective field capacity, acre/hr}}{\text{Theoretical Field Capacity, acre/hr}} \times 100$$

Effective field capacity (Acre/hr.) required in the above equation to be calculated as below.

$$\text{Effective field capacity} = \frac{\text{Area Covered by machine, acre}}{\text{Total time taken (Productive+Non-Productive), hr}} \times 100$$

Similarly, the theoretical field capacity to be calculated as below,

$$\text{Theoretical field capacity} = \frac{\text{working width (m)} \times \text{operation speed} \left(\frac{\text{km}}{\text{h}}\right)}{10}$$

For calculation of theoretical field capacity, we will use theoretical operation speed max value 15 km/h (standard for all) and working width would be theoretical row to row distance of crops planted. We will only need to calculate the machine field efficiency if planting efficiency of machine is more than 60%

#### D.3.5 Machine fuel economy during field operation:

The capacity of the fuel tank to be considered by the students should be of 20 Liters of fuel size for self-propelled machine. Machine fuel economy calculation would be calculated based on following method

- I. Machine Fuel economy (Lit/hr.) during field operations will be measured as below
  1. Fill the fuel tank up to tank neck, before field operation
  2. Perform the Automated Vegetable Transplantation
  3. Measure the time taken to complete the given area (sec)
  4. Refill the tank up to tank neck, after field operation
  5. Measure while refilling the fuel, using measuring jar
  6. Express the difference as fuel consumption (Lit/hr.)
- II. Another measure of fuel economy is to measure the amount of fuel consumed, for the area covered, will be measured as below.

$$\frac{\text{Ltr}}{\text{Acre}} = \frac{\text{Amount of fuel refill required at end of operation, Ltr}}{\text{Area Covered (Width x Length), acre}}$$

- III. In case of tractor attachment planter, we can measure the economy of Tractor used.

#### D.3.6 Machine handling and operator comfort

Qualitative assessment of the farm machine operation based on the following

- I. Ease of handling the controls
- II. Accessibility and reach required to operate the controls

- III. Ergonomics aspects considered while designing the various operator controls
- IV. Level of comfort to the operator
- V. Noise and vibration levels while operating the machine  
Operator ear noise (OEN) levels are measured at operator ear at high idle condition using the sound level meter which are reported in dB(A) as shown below
- VI. Note that for self-propelled machine we would have NVH checks, where the operator would be standing/seating at



*Figure 11: Representation of Operator Ear Noise (OEN) measurement using sound level meter*

Noise levels are also measured at pass by noise (PBN) which at 2m away from center of the vehicle and 1.5 m above the ground at operator ear plane as shown in figure 2 and 3.

*Note: - Measuring instrument shown here are for illustration purpose only. TIFAN OC committee reserves the right to change the same based upon the actual availability and background as observed at site during actual event.*

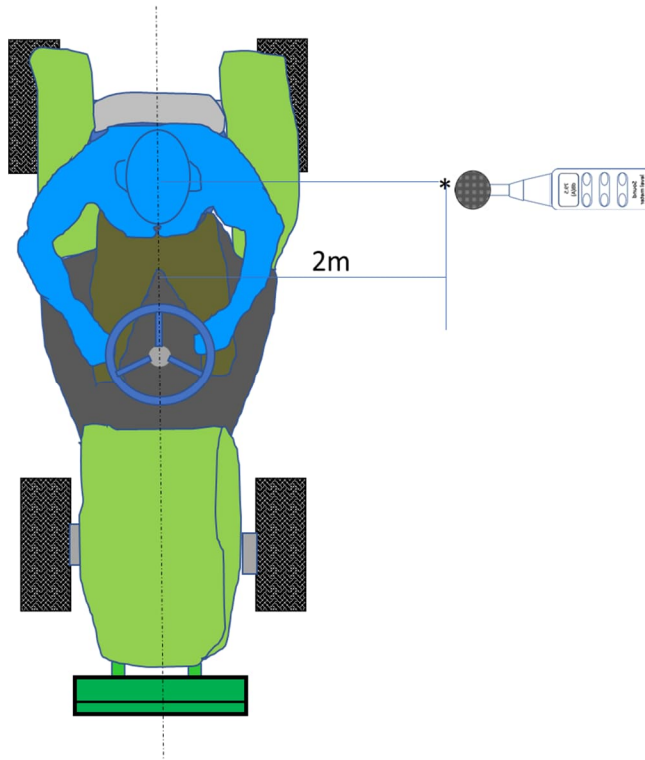


Figure 12: Pass by Noise measurement location – Top view

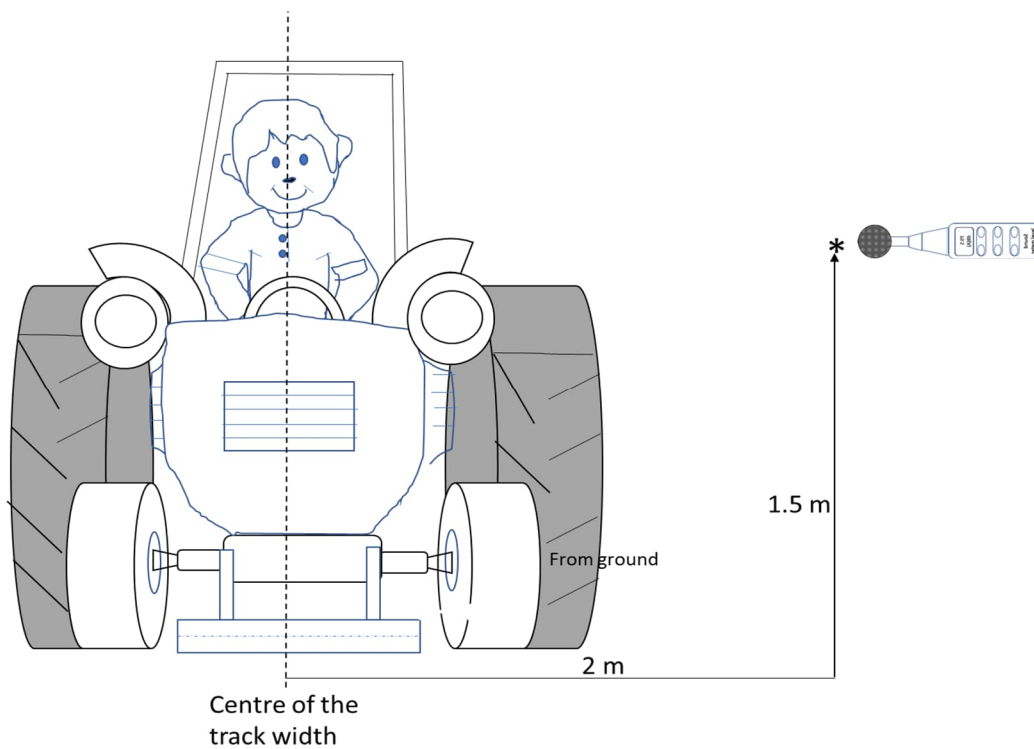
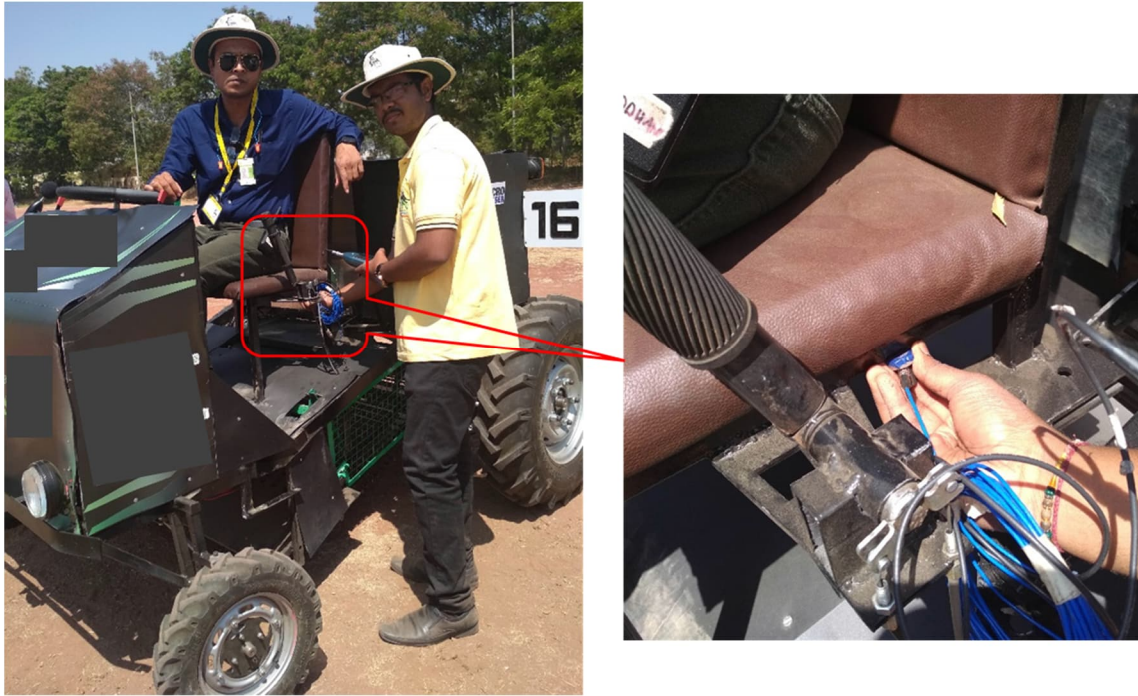


Figure 13: Pass by Noise measurement location – front view

Vibration levels are measured at Seat, steering and operator foot location using the Hand-held vibration meter as shown in figure 4, and 5. For tractor mounted/attached planter vibration on tractor due to planting implement



would be measured at same places shown in picture while raising the implement out of ground and planting mechanism on (without saplings).



*Fig 14. Vibration level measurement at Seat using vibration meter (Actual Pictures)*



*Fig 15. Vibration level measurement at footrest location using vibration meter for self-propelled (Actual Pictures)*

*Note: - Measuring instrument shown here are for illustration purpose only. TIFAN OC committee reserves the right to change the same based upon the actual availability and background as observed at site during actual event.*

## E. Part E: COMPETITION PROCEDURE AND GENERAL RULES

### E.1 Disciplinary items

- I. All team members identified as captains or operator and all faculty advisors MUST attend all meetings as designated. Attendance at meetings is mandatory. Failure to attend meetings can result in disqualification of members or the entire team.
- II. Tiebreakers: Tiebreakers for dynamic events will be the second-best run time or score for the given tied event. If both scores for tied teams in the event are equal, then the tie remains.
- III. Pre-inspection Operation Prohibited: Machines may not be started or driven prior to passing technical inspection, except as required as part of the inspection process itself.
- IV. Engine governors are subject to check and resetting.
- V. Refueling: Refueling of machines must be performed with (1) the engine shut-off and (2) the operator out of the machine and (3) fire extinguisher must be on hand and pointed toward the machine/fuel tank whenever being refueled.
- VI. When the machine is driven anywhere except within the practice area or on event courses it must move at walking speed with a team member walking along side at a normal pace. During the performance events when the excitement is high, it is particularly important that machines move at a walking pace in the paddocks. The walking speed rule will be strictly enforced and point penalties will be assessed for violations.
- VII. Under no circumstances anyone other than the operator ride on the machine.

### E.2 Code of Conduct

- I. Teamwork Area: The team's work area should be clearly defined and should always be kept uncluttered. When a team leaves their area, it must be left clean.
- II. All teams' members should be wearing PPE (such as eye protection, ear plug, safety shoes) in the paddock when performing any activity involving fuel, grinding welding, or cutting.
- III. All the TIFAN participants can be proud of the excellent sportsmanship and co-operation among all teams.
- IV. Good conduct and compliance with the rules and the official instructions are expectations and requirements for every team member.
- V. An incident of unsportsmanlike conduct, the organizing committee is authorized to impose an appropriate penalty.
- VI. Unsportsmanlike conduct can include arguments with officials, disobedience of official instructions and the use of abusive or threatening language to any official or other participant. Depending on the seriousness of the infraction the penalty for such actions can range from a deduction of up to fifty percent (50%) of the team points to expulsion of the entire team. Penalties of this type will only be imposed after a complete review of the incident by the organizing committee.
- VII. Alcohol and Illegal Material

Alcoholic beverages, firearms, weapons of any type and illegal materials are prohibited at TIFAN competition site during the competition. The penalty for violation of this rule is the immediate expulsion of the entire team, not just the individual(s) involved. This rule applies to team members, advisors and any individuals working with the team on-site.

- VIII. Smoking is prohibited in all competition areas.

- IX. Parties: Disruptive parties either on or off-site must be prevented by the faculty advisor or team captain.
- X. Trash Clean-up: Clean-up of trash and debris is the responsibility of the teams. Please try to keep your paddock area clean and uncluttered. At the end of the day, each team must clean their work area.
- XI. Site Condition: Please help the organizing committee to keep the site clean. The sites used for TIFAN competition may be private property and should be treated as such. Competitors are reminded that they are guests of the owners. All trash should be placed in the receptacles provided. Failure to clean the premises will result in an unsportsmanlike conduct penalty.
- XII. The use of motorcycles, quads, bicycles, scooters, skateboards, rollerblades or similar person-carrying or motor driven devices by team members and spectators in any part of the competition area, including the paddocks is prohibited.
- XIII. Spectator Rule
  - i. The Organizing Authority typically do not have a direct line of communication with spectators other than on-the-spot at the competition; thus, the competitors, faculty and volunteers are expected to help inform the spectators of the safety rules and help restrict spectators to the spectator areas.
  - ii. Alcoholic Beverages: Spectators may not drink or possess alcoholic beverages at any competition location.
  - iii. Access Restrictions: Spectators must keep a specified distance back decided by the Organizing Authority, from any area where the machines are operating under power. Motor machine competitions are potentially dangerous and safety rules will be strictly enforced.
  - iv. Children: A competition site is not a safe place for children and unsupervised young people. Spectators who fail to strictly control their children will be asked to leave the site.
  - v. Removal of Spectators: The event officials and Organizing Authority have the absolute right to restrict spectator access to any parts of the site and to eject anyone who violates safety rules or ignores the instructions of officials.
  - vi. Unsafe Practices and Conduct: All participants are required to exercise safe practices and always avoid unsafe activities during the competition. The event Organizing Authority has the discretionary authority to impose a just penalty for any conduct.
- XIV. Safety: Team Responsibility
  - i. Safety is the primary consideration in the design of TIFAN competition machines and conduct of event during the competitions
  - ii. Teams need to include safety considerations in all parts of their program.
  - iii. At all performance events, it is the responsibility of the team to ensure both the machine and operator meet and follow all the requirements and restrictions of the rules.

### **E.3 Force Majeure**

The TIFAN Organizing Committee and SAEINDIA shall not be held responsible for non-fulfillment of their obligations under this agreement due to the exigency of one or more of the Force Majeure events such as but not limited to the acts of God, war, flood, earthquake, strikes, lockouts, pandemics, epidemics, riots, civil commotion, scarcity of water, electricity or other such basic facilities etc., and shall inform the participating colleges on the occurrence and cessation of the event within one week of such decision being made. If the Force Majeure conditions continue beyond a reasonable period where running the event is not

feasible either due to the Force Majeure conditions or any other reasons, the event may be canceled for the year.

**“Force Majeure Events”:** -

- a) Earthquake, flood, inundation and landslide, storm, tempest, hurricane, cyclone, lightning, thunder, pandemics but not limited to COVID19 or OMICRON, or any other variants beyond control, epidemics or other extreme atmospheric disturbances or any other act of God.
- b) Strikes, labor disruptions or any other industrial disturbances not arising on account of the acts or omissions of the organizers, war, hostilities (whether declared or not), invasion, the act of a foreign enemy, terrorism, rebellion, riots, weapon conflict or military actions, civil war, ionizing radiation, contamination by radioactivity from nuclear fuel, any nuclear waste, radioactive toxic explosion, volcanic eruptions, or other such occurrences beyond the control of the organizers.
- c) Acts of expropriation, compulsory acquisition, or takeover by any government agency of the said venue where the event is to be held or any part thereof.
- d) Any prohibitory order of any Court

E.4 References

- I. Previous TIFAN Rule Books
- II. SAE India BAJA 2016 Rule book
- III. SAE India SUPRA 2020 Rule book

F. PART F: ANNEXURE

- Annexure-1: Indemnity Format.
  - To be shared in due course of time
- Annexure-2: Octroi Letter.
  - To be shared in due course of time

Amendments

1. New Release 1.0 - 5<sup>th</sup> September 2022
2. Revision 1.1 – 20<sup>th</sup> September 2022 – Updated Table of Contents, updated sections A.4.3, A.8.4, A.11, B.3.1, B.3.2, C.3.2.2, D.2.2, E.3, E.4, Updated Figure 4.