2019 Technical Regulations
Level 4: SUB Class
Version 1.1

Proudly Supported by
Australian Government
Department of Defence

An initiative of
RE-ENGINEERING AUSTRALIA FOUNDATION
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PREFACE

This document only contains ‘Technical Regulations’. A separate document encompasses the ‘Competition Regulations’.

These regulations WILL be valid for all 2019 State Finals and the 2019 National Final.

Diagrams and images used in this document are an illustrative representation only and do NOT necessarily constitute a ‘legal’ design.

Summary of Main Revisions from Review of 2018 Season

The following summary provides an overview of all technical related regulations that have been revised from the 2018 season’s regulations.

It is each team’s responsibility to thoroughly read this document in order to identify wording changes and to understand any impact this MAY have on their project.

All changes between this season and last season are identified within the document by using red underlined text.

Updated Regulation Articles

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Updated Regulation Articles

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All changes in subsequently released 2019 editions (V1.1 onwards), are identified within the document by using green underlined text.
ARTICLE T1 - Definitions

T1.1 Australian Competition Season
State and National Finals events are managed by Re-Engineering Australia Ltd., are generally held over 2 - 3 days and MAY include various programmed social and competition activities. These events aim to provide all participants with an educational and personal development experience.

T1.2 Language Used
The language of the rules is tiered. Those clauses expressed as “MUST” are mandatory and failure to comply WILL attract objective penalties - points and/or trial and/or in the extreme, disqualification. Those expressed as “SHOULD” or “MAY” reflect some level of discretion and choice. Some clauses WILL be satisfied through team registration processes or declarations signed as complied with as part of the Challenge Terms and Conditions, whilst others WILL be tested through a variety of objective and subjective judging.

T1.3 Penalties
A range of penalties WILL be applied for non-compliance with identified regulations. These penalties include:

T1.3.1 Point Penalty
Invoked from non-compliance with technical regulations and some competition regulations governing portfolio or trade booth restrictions. These are identified as [Point Penalty].

T1.3.2 Time Penalty
Invoked from non-compliance with Technical Regulations which are identified as critical through the use of the danger symbol at left and listed in ARTICLE T2.5. These WILL be identified as [Time Penalty] and WILL be applied as 30 seconds to every voyage trial for every critical regulation violated up to a maximum of 3 minutes.

T1.3.3 Eligibility
Teams need to meet certain eligibility criteria to compete at a State or National Final. Failure to comply with certain eligibility criteria MAY lead to disqualification from the competition, a judging element or class of competition. [Eligibility].

T1.4 Surface Finish & Decals
A surface finish on a SUBS in Schools Submarine is considered to be any applied visible surface covering the profile of the submarine. A decal is material adhered to a component or surface finish. To be defined as a decal, 100% of the area of the adhering side MUST be attached to a surface. Surface finishes and decals are included when measuring the dimensions of any components they feature on. Refer to the Competition Regulations for more information.

T1.4.1 SUBS in Schools Logo Decal
This consists of the SUBS in Schools logo graphic printed on either black or white. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. The SUBS in Schools logo decal MUST have minimum dimensions of 90mm x 50mm.
T1.4.2 REA Foundation® Logo Decal
This consists of the REA Foundation Ltd logo text and globe graphic printed on either black or white. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. The REA Foundation logo decal MUST have minimum dimensions of 90mm x 50mm.

T1.4.3 Australian Government - Department of Defence Logo Decal
This consists of the Australian Government Department of Defence logo text and coat of arms graphic. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. The Department of Defence logo decal MUST have minimum dimensions of 90mm x 50mm.

T1.4.4 Visual Connections Logo Decal
This consists of the Visual Connections logo text and graphic. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. The Visual Connections logo decal MUST have minimum dimensions of 90mm x 50mm.

T1.4.5 SAAB Logo Decal
This consists of the Saab logo graphic printed on either black or white. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. The SAAB logo decal MUST have minimum dimensions of 60mm x 30mm.

ASC Logo Decal
This consists of the ASC logo graphic printed on either black or white. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. The ASC logo decal MUST have minimum dimensions of 60mm x 30mm.
T1.5 Hand Finishing
Hand finishing is defined as use of a hand controlled device (e.g. abrasive paper) for removing only the irregularities that MAY remain on the surface of the submarine.

T1.6 Engineering Drawings
CAD-produced drawings and models of the submarine. Along with a compatible 3D Printing files, a third-party should be able to produce a fully assembled submarine. These drawings should include all relevant dimensions, tolerances and material information. SUBS in Schools engineering drawings include detail to specifically identify and prove compliance for the virtual cargo.

T1.7 SUBS in Schools Submarine
This is also referred to as ‘the submarine’, and MUST be designed and manufactured according to these regulations for the purpose of participating in trials on the SUBS in Schools State or National Final events. Controlled remotely using chosen control surfaces, the submarine WILL need to navigate a course containing obstacles, while avoiding collisions. “The submarine assembly” refers to the external visible assembly of components/features that make up the submarine, all other components including motors, servos etc. MUST be internal. The submarine assembly MUST ONLY consist of the components and/or features listed below.

The submarine assembly MUST consist of the following MANDATORY components and/or features:
- A body (which includes a virtual cargo)
- Fore cap/Bow cap
- Aft cap/Stern cap
- On/Off Switch
- Fin/Sail

The submarine assembly MAY also consist of the following OPTIONAL components and/or features:
- Trailing antenna/aerial
- Trailing Satellite Receiver (Including receiver housing floating on the water surface)
- Propeller/s (Including propeller cover/s)/Propulsor(s)
- Surface finish and decals
- Fore control surfaces/ mechanisms
- Aft control surfaces/ mechanisms
- Internal systems as necessary

Adhesives are permissible for joining components.

Failure to have any of the listed mandatory components or features WILL result in all relevant penalties being applied
Article T1 | Definitions

T1.8 Vertical Reference Plane
To assist with describing dimensions, it is assumed that a two dimensional invisible vertical plane exists along the longitudinal centre line of the submarine. This is known as the vertical reference plane.

T1.9 Fully Assembled Submarine
A SUBS in Schools submarine, presented ready for trials, resting in a cradle on a horizontal solid surface, free of any external force other than gravity.

T1.10 Body
The body is defined as the primary connective structure of the submarine. It is a solid, uninterrupted piece of PVC pipe of constant cross section, encompassing the virtual cargo. For dimensional purposes the body also includes any attached decals and surface finishes.

T1.11 Fore cap / Bow cap
Defined as a feature connected to the front of the submarine body, satisfying overall dimensional rules. This DOES NOT include the fore control surfaces.

T1.12 Aft cap / Stern cap
Defined as a feature connected to the rear of the submarine body, satisfying overall dimensional rules. This DOES NOT include the aft control surfaces.

T1.13 Propeller / Propulsor
A propeller on a SUBS in Schools submarine is a small impeller designed to move water when rotating. This movement of water causes the connected body to move as well, as per Newton’s 3rd law.

T1.14 Fore Control Surfaces
Are fin shaped features connected to the fore control mechanisms on the fore cap, used to control the flow of water around itself and produce motion. These MUST satisfy overall dimensional rules once connected to the fore cap.
T1.15 Aft Control Surfaces
Are fin shaped features connected to the aft control mechanisms on the aft cap, used to control the flow of water around themselves and produce motion. These MUST satisfy overall dimensional rules once connected to the aft cap.

T1.16 Fin / Sail
A feature which is connected to the submarine body, mimicking the appearance of a normal submarine. This feature MUST NOT protrude past the body into the area of the fore or aft cap, and MUST satisfy overall dimensional rules once connected to the body.

T1.17 Moving Components
Moving components are permitted on a submarine. A moving component is defined as any part or assembly of parts that is attached to a NOTher part of the submarine via either sliding, rotational or flexible joints and is NOT prevented from moving by some locking feature. The range of motion of a moving component is defined as the full motion of the component. A submarine MUST remain legal over the entire range of motion of any moving components. During specifications compliance judging, a submarine WILL be measured with moving components positioned at the extents of their range of motion and at any other location within their range of motion required to determine the compliance with rules over the full range of possible motion. Components intended to be “rigid” but exhibiting minor flexure WILL NOT be classified as “moving components”.

ARTICLE T2 - General Principles

T2.1 Regulations Documents
REA Foundation Ltd. issues the regulations, their revisions and amendments made. Technical Regulations - This document. The Technical Regulations document is mainly concerned with those regulations that are directly related to SUBS in Schools submarine design and manufacture. Technical Regulation article numbers have a ‘T’ prefix. Competition Regulations – A document separate to this one which is mainly concerned with regulations and procedures directly related to judging and the competition event. Competition Regulation article numbers have a ‘C’ prefix.

T2.2 Interpretation of the Regulations
The final text of these regulations is in English should any dispute arise over their interpretation. The text of a regulation, diagrams and any related definitions should be considered together for the purpose of interpretation.

Text Clarification - Any questions received that are deemed by REA Foundation Ltd. to be related to regulation text needing clarification WILL be answered by REA Foundation Ltd. The question received, along with the clarification provided by REA Foundation Ltd., WILL be published to all competing teams at the same time on the REA Foundation Ltd. website.

T2.3 Amendments to the Regulations
Any amendments WILL be announced and released by REA Foundation Ltd. by email NOTification to all teachers nominated in the school registration, as well as the updated revision being uploaded to the website at http://rea.org.au/subs-in-schools/. Any amended text WILL be indicated thus (using red underlined text).
T2.4 Safe Construction
Specification Compliance Judging - All submitted submarines WILL be inspected closely to ensure that they are engineered and constructed safely for the purpose of conducting underwater trials. If the Judges rule any aspect of the submarine to be unsafe, the team WILL be given an opportunity to rectify issues without penalty. Failure by teams to rectify any unsafe issues prior to the commencement of the trials WILL result in the submarine being withdrawn from the trials and no points WILL be awarded.

During Trials – The Officials WILL routinely inspect submarines for safety during scheduled trials. If the Officials rule a submarine to be unsafe, repairs WILL be permitted however penalties MAY apply as published in the Competition Regulations.

T2.5 Compliance with Critical Regulations
Points are deducted for non-compliance with the technical regulations. These penalties are only imposed once, per infringement.

T2.5.1 Some regulations have been identified as critical regulations and WILL attract both a 4 Point Penalty and a 30 second Time Penalty as per ARTICLE T1.3. The critical regulations are:
T3.1/T3.2/T3.3/T3.6/T3.7/T4.1/T6.2/T6.3

T2.6 Rectification of Critical Regulation Infringements
Any team whose submarine has been deemed by scrutineers to have infringed a regulation attracting a Time Penalty, WILL be given an opportunity to rectify this prior to trials with the effect of removing the time penalty. The original point penalty WILL stand.

T2.7 Measurements
T2.7.1 Dimensional measures
All submarine component dimensions are inclusive of any applied paint finish or decal. A series of specially manufactured gauges WILL be used to verify dimensional compliance.

T2.7.2 Whilst your CAD design MAY comply with dimensional regulations, the process of machining, painting and assembly WILL individually impact on the final dimensions of the finished product submitted for scrutineering. It is the actual product that is measured in scrutineering. It is NOT the design intent that is judged in scrutineering.

T2.7.3 Scrutineering of submarines WILL be conducted by examining submarines throughout all possible configurations, including where there is moving parts that effect dimensions.

T2.8 Trailing aerial/Satellite receiver
For the purpose of scrutineering judging and trial judging, non-rigid trailing aerials and trailing satellite receivers (including waterproof housing and servo wires) WILL NOT be considered as part of the submarine assembly. Rigid aerials WILL be considered to be part of the submarine assembly and therefore WILL count towards scrutineering measurements and trial judging.

T2.9 Design, Manufacture & Construction
T2.9.1 CAD/CAM Designs
All submarines MUST be designed and engineered using CAD (Computer Aided Design) and CAM (Computer Aided Manufacture) technology. CAD software used should provide for 3D part modelling, assembly and 3D realistic rendering. The CAM package should allow students to construct and print 3D models, and show evidence of these in their portfolio. We recommend the use of AUTODESK Inventor software.
T2.9.2 Propeller Cover
For safety purposes all propellers MUST be enclosed by a guard/cover around its entire circumference and width. Propeller covers MUST be designed to prevent contact with hands and fingers. Propeller covers WILL be checked by scrutineering judges and those deemed unsafe MAY be ineligible to attempt trials.

T2.10 Finishing & Assembly
T2.10.1 All submarines are expected to be finished to a high standard and MUST reflect the features of the documented CAD design.
T2.10.2 All team submarines MUST be assembled, painted and finished by team members only. Documented supporting evidence MUST be submitted with signed declaration.
T2.10.3 Teams MUST NOT use water soluble surface finishes or other products on their submarine and any applied surface finish MUST be thoroughly dry prior to trials.

T2.11 Decals
T2.11.1 REA Foundation Ltd. Corporate Partner Logos.
These sticker decals MUST be displayed on all submarines at State, National and International Events and will be supplied by REA at event check-in. Refer to T1.4 for more information. Each decal infringement attracts a 2pt penalty.
T2.11.2 Minimum Dimensions
All REA Corporate Partner sticker decals MUST maintain their minimum dimensions as per ARTICLE T1.4. Any trimming of decals will result in a 2pt penalty for each infringement.
T2.11.3 Positioning of Corporate Partner Sticker Decals
All edges of the stickers MUST be visible in the side view. Refer to ARTICLE T1.4, each decal infringement attracts a 2pt penalty.
T2.11.4 Decal Integrity
Teams MUST ensure that all decals are waterproof and do NOT separate from the submarine during trial activities. Each decal infringement attracts a 2pt penalty.
T2.11.5 Regional Sponsors
If your region is supported by a sponsor, corresponding sponsor recognition MUST be included in displays, portfolio and on the car.

T2.12 Undefined Features
The submarine assembly MUST only consist of components listed in T1.7.
ARTICLE T3 - General Regulations

T3.1 Overall Length [30 Time Penalty | 4pt Penalty]
The overall length of the complete submarine measured between the longitudinal extremes of the submarine product, including all components, MUST NOT exceed 1000mm.

T3.2 Overall Width (Beam) [30 Time Penalty | 4pt Penalty]
The overall width of the complete submarine product including all components measured transversely MUST NOT exceed 300mm.

T3.3 Overall Height [30 Time Penalty | 4pt Penalty]
The overall height of the complete submarine product including all components measured vertically MUST NOT exceed 300mm.

T3.4 Status During Trials [2pt Penalty]
The submarine assembly MUST be designed so that no items are removed, replaced or added to the assembly during scheduled trial events.

T3.5 Repairs/Maintenance [Disqualification]
Teams are NOT permitted to change the design of their submarine during the competition, however teams are permitted to fix and maintain their submarine throughout the competition. This MAY include but is NOT limited to replacing or fixing batteries, motors, servos, propellers etc., so long as the submarines initial design remains unchanged.

Teams are NOT permitted to substitute with alternate designs or delete from the fully assembled submarine any of the following components.

- Fore cap / Bow cap
- Aft cap / Stern cap
- Body
- Pressure Hull
- Sail/Fin
- Control Surfaces

These components WILL be marked by scrutineers in parc ferme and teams found to have breached this rule MAY be disqualified.
T3.6  **Body Construction**
A single continuous piece of PVC pipe material **MUST** exist between the fore and aft caps, encompassing the virtual cargo. It **MUST** ensure the overall dimensions remain within specifications. It **MUST** consist of purely rigid components (**NOT** flexible or loose parts).

T3.7  **Virtual Cargo**
A virtual cargo is a volume that **MUST** exist completely within the submarine body. The virtual cargo **MUST** have minimum dimensions of 500mm in length and 80mm in diameter.

**ARTICLE T4 - Fore and Aft Cap Regulations**

T4.1  **Construction Material**
The caps **MUST** be made of purely rigid components (**no** flexible or loose parts).

T4.2  **Positioning**
With the exception of the connecting components, the **bow** and **stern** caps **MUST NOT** enter into the body.

ARTICLE T5 - Control Surface Regulations

Teams **MAY** choose to control their **submarine** using optional **bow** and **stern** control surfaces, where applicable the following rules apply.

T5.1  **Control Surface Identification**
Where fitted, the surfaces defining both the bow and stern control surfaces **MUST** be identified clearly within the engineering drawings submitted for judging.

T5.2  **Bow Control Surface Positioning**
Where fitted, the whole of the bow control surfaces **MUST** be entirely forward of the body.
T5.3 Stern Control Surface Positioning
Where fitted, the whole of the stern control surfaces MUST be entirely behind the body.

T5.4 Construction & Rigidity
Where fitted, the control surface dimensions MUST remain unchanged during trials, i.e. MUST be rigid – ruled at the judge's discretion.

ARTICLE T6 - Fin / Sail Regulations

T6.1 Fin / Sail Positioning
The fin/sail MUST be connected to the main body and be rigid. It MUST NOT exist past the bow or stern of the body, and MUST ensure that the overall height and width remain within specifications.

T6.2 Fin / Sail Length
The minimum length of the fin/sail (measured longitudinally in the vertical reference plane) at its smallest length is 100mm.

T6.3 Fin / Sail Height
The minimum height of the fin/sail measured from the submarine body extending vertically in the vertical reference plane is 50mm.

T6.4 Fin/Sail Width
The minimum width of the fin/sail on all zero trim waterlines, measured perpendicular to the vertical reference plane, at the widest point along its length is 30mm.
ARTICLE T7 - Appendices

T7.1 Example Orthogonal Drawing