WARMAN® Design & Build Competition

32nd WARMAN DESIGN & BUILD COMPETITION 2019

ENGINEERS AUSTRALIA

SPONSORED BY WEIR

Project SOLVE

Swift Ocean – Land Vessel Evacuation

CONTEXT

Gondwana is a small planet orbiting a star on the outer fringes of our Galaxy. More than a thousand years ago the Gondwanans mined precious metals and stored residue laced with toxins including arsenic and mercury in twenty spherical pressure vessels. These vessels have been successfully stored in a fenced compound near the shore of an ocean. A meteor shower is predicted to strike in 30 days and a destructive tidal wave would be generated if one landed in the nearby ocean. The release of the toxic waste into the environment would be catastrophic. Fortunately, teams of engineering students from Earth are about to visit Gondwana as part of their work experience programmes. Over the last 31 years, visiting engineering students have rendered invaluable assistance with such engineering problems, and on this thirty-second occasion, the Gondwanans again seek help from these budding engineers to solve the problem.

DILEMMA

The Gondwanans only want to disturb the aging vessels if a disaster is imminent so want a system to transfer the vessels to a temporary inland compound only in the event of an approaching tidal wave. Scientists predict that the time for a destructive tidal wave to reach the compound from the time of a meteor impact would be short but the twenty vessels must be transferred within this brief window.

CHALLENGE

Twenty waste storage (payload) vessels are located in a rectangular compound and all of these vessels must be transferred to an inland compound with higher protection walls as fast as possible. A garage providing protection near the location can be used as a staging area from which to deploy a system that will collect, transport and deposit the vessels into the inland compound. As the Gondwanans are cautious beings they will remain well inland and remote from the operation until after the shower so the challenge is to design and build a system to autonomously collect, transfer and place all twenty vessels as swiftly as possible.

Objective

The objective is to design, build and demonstrate a prototype transfer system in a laboratory environment. Points will be scored when your autonomous system collects, holds and transfers vessels within the maximum allotted time, which for the competition is 60 seconds.

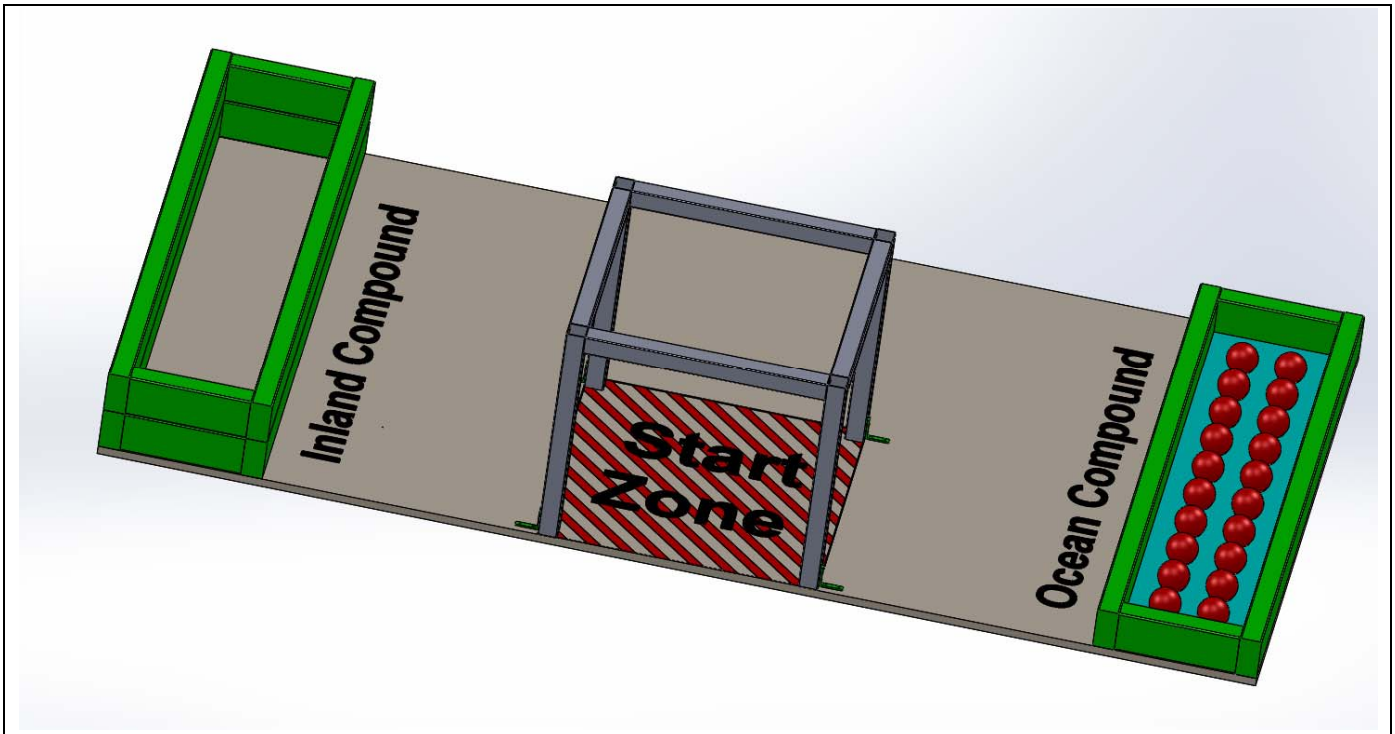


Figure 1. Schematic view of the Competition Track

Competition Coordinators:

A/Prof Don Clucas	don.clucas@canterbury.ac.nz	Phone: +64 3 3692212
A/Prof Craig Wheeler	craig.wheeler@newcastle.edu.au	Phone: 02 4033 9037

Competition Supervisor:

A/Prof Warren Smith	w.smith@adfa.edu.au	Phone: 02 6268 8262

Details follow:

- Competition Guidelines
- Competition Rules
- Frequently Asked Questions
- Further Competition Details
- Spirit of the Competition
- Appendix A - General Arrangement and Detailed Drawings of the Competition Track
- Appendix B – Other components and assembly details

Document Control:

Rev 1.0 Released 16/1/2019

Competition Guidelines

Wording: *The language of the guidelines is tiered. Those clauses expressed as "SHALL" are mandatory and failure to comply will attract penalties which in the extreme could lead to disqualification at the International Final. Those expressed as "SHOULD" or "MAY" reflect some level of discretion and choice.*

ELIGIBILITY

G 1. Teams that are eligible to represent their campus in the National Final SHOULD consist of students from a first or second year engineering design course/subject/unit in an Australasian (or other countries, by arrangement) mechanical-based BE or 3+2 ME programme. Teams SHALL consist of at least two students, with teams of three or four strongly recommended, but it is recognised that larger teams MAY be educationally appropriate at some universities. If an alternative team structure is envisaged, a Competition Coordinator should be consulted to ensure that other teams are not unreasonably disadvantaged.

SAFETY

G 2. Safety is of paramount importance when participating in this competition. All engineers SHOULD know that injury and damage to equipment and the environment occurs when the control of energy (in any form - whether strain, potential, kinetic or thermal) in a system is lost.

G 3. As appropriate, protective clothing, footwear, safety glasses or full-face masks SHOULD be worn by students working on systems during construction, testing and competitions.

G 4. Students are encouraged to carry out a risk assessment for their system prior to campus testing. Students are encouraged to embrace risk management in their own activities and MAY need to demonstrate safe operation and produce risk assessment documentation in order to compete in either the campus heat or at the International Final.

G 5. Compressed gas systems MAY be used, but if used, students SHALL gain Campus Organiser approval based on a safety assessment.

Such systems presented at the International Final SHALL be examined against the following principles and SHALL be found to be acceptable to the International Competition Coordinators.

- Home fabricated pressure system components SHALL NOT be used.

- Commercial components SHALL be used (unions, vessels, cylinders, lines, etc).

- Evidence of proof testing of compressed gas systems SHALL be provided.

To avoid disappointment, students using compressed gas MAY consult with the International Competition Coordinators prior to arrival at the International Final. The International Competition Coordinators' approval decision SHALL be final after examination of the presented system and documentation at the International Final.

G 6. Systems that are deemed by the officials and judges to be hazardous SHALL NOT be permitted to run. For example, employing any form of combustion SHALL be considered hazardous.

COMPETITION TRACK, EQUIPMENT AND ENVIRONMENT

G 7. The Track SHALL be fabricated using primarily one sheet of Medium Density Fibreboard (MDF), with nominal dimensions 2400 x 1200 x 18 mm, arranged as shown in

Figure 1 and detailed drawings included as per Appendix A. The supporting frame, not shown, for the sheet may be fabricated by any convenient method.

NOTE: *MDF sheets as supplied may be slightly larger than the nominal 2400 x 1200 mm dimensions and are generally 2420 x 1210 mm. All dimensions shown in Appendix A are based on sheet sizes of 2400 x 1200 mm. Competition Tracks at the International Final SHALL be constructed from 2400 x 1200 mm sheets in accordance with Appendix A.*

G 8. The track sheet with relevant features attached SHALL be identified as the Competition Track as shown in Figure 1. The attached features include; the 40mm square steel SHS frame defining the Garage boundary walls and roof, brackets to hold the garage to the track, a vessel spacing board, and the 90 x 45mm MGP10 Pine Timber Framing defining the two compound boundaries.

G 9. The upper surface of the MDF sheet of the Track SHALL define the competition base plane, which is nominally horizontal. Hatching and lettering shown in all figures are for clarity and SHALL not be applied to the track.

G 10. The competition base plane SHALL be no less than 300 mm above the supporting floor at the International Final. The supporting table or frame is not shown in Figure 1.

G 11. The height of the ocean end compound frame SHALL be 90mm +/- 2.0mm, shown in Figure 1, above the base plane and the inland compound frame SHALL be 180mm +/- 4.0mm. The frames SHALL be attached to the track using wood screws from the underside of the track.

G 12. A nominally 10mm thick MDF vessel spacing board SHALL be placed inside the ocean end compound, shown in Figure 1 and Appendix A. Twenty evenly spaced nominally 50mm diameter holes in this board SHALL be used to loosely locate the vessels which will rest on the track. The upper hole edge MAY be square as drilled or cut but SHALL NOT be chamfered more than 2.0 x 45deg or filleted more than R2.

G 13. The Competition Track SHALL contain the Start Zone shown as the hatched area bounded by the external surfaces of the metal frame which is representative of a vehicle garage with four doors. This SHALL house the system prior to starting the run. Arrangement and dimensions of the Garage are shown in Figure 1 and Appendices A and B. It SHALL be made from galvanised unpainted 40 x 40mm Steel SHS. Material Specification The full SHS frame SHALL NOT be painted but for cosmetic reasons the heat affected areas of the welds MAY be coated with a zinc based paint such as: Spray Paint

G 14. Four angle brackets with 50 mm leg length SHALL be used to secure the Garage to the Track as shown in Figure 1 and Appendix A. Suitable angle brackets are pictured in Appendix B1. The angle brackets SHALL be attached to the external faces of the Garage welded frame assembly with the legs parallel to the vertical longitudinal plane of the track. See Appendix A1 for positioning.

G 15. The MDF and timber surfaces of the Track SHALL be brush or roller coated with one coat of ESTAPOL® Water Based Xtra Clear – Satin as a sealer followed by two coats of Wattyl ESTAPOL® - Polyurethane Matt (in accordance with Wattyl's recommendations for use with MDF - Refer: http://lpb-dev.azurewebsites.net/Uploads/TDS/D5.59%20Estapol%20Polyurethane%20Gloss-Satin-Matt.pdf and http://lpb-dev.azurewebsites.net/Uploads/TDS/D5.58%20Estapol%20Water%20Based%20Xtra%20Clear%20Gloss-Satin.PDF). Recycled track surfaces SHOULD be lightly sanded and re-coated with two coats of Wattyl ESTAPOL® - Polyurethane Matt.

G 16. The twenty payloads (vessels) SHOULD be plastic balls 2.5" (6.5cm) Bestway ® Splash and Play air filled "Game Balls". The balls SHALL be evenly spaced in the ocean end compound using the board described in G12 and shown in Figure 1. The Bestway brand balls SHALL be used at the International Final.

NOTE: *The balls can be purchased from ToyWorld which has Australian outlets Nationwide. They are supplied in boxes of 100 balls. The distributer is Associated Retailers Ltd, 169 Burnley Street, Richmond 3121, Victoria. The Super ToyWorld and Hobbies store in Canberra is willing to ship. They can be contacted on (02) 6280 7150. See also www.toyworldact.com*

They may also be available from (https://www.mrtoys.com.au/outdoor-sports-water-toys/pools-and-water-fun/bestway-65cm-splash-play-100-bouncing-balls-554.html).

G 17. Teams SHALL accept that the presence of bright lighting and photographic equipment including flash and infrared systems MAY be part of the competition environment.

G 18. Teams SHALL accept that the presence of air conditioning / ventilation induced air movement MAY be part of the competition environment.

PROOF OF CONCEPT SYSTEM

G 19. The system SHOULD collect **TWENTY** payload vessels out of the ocean framed compound and deposit them into the inland framed compound within 60 seconds.

G 20. The system SHALL cease operation within 60 seconds.

G 21. The system SHALL represent essentially a ground-based solution.

G 22. The system SHALL be initially positioned in the Start Zone and be fully supported by the base plane of the competition track.

G 23. Campus Organisers MAY modify the rules and or competition track for their local competition but the guidelines and rules as stated SHALL be strictly adhered to at the International Final.

COMPETITION RULES

R 1. A payload vessel refers to **ONE** of **TWENTY** plastic balls being transferred from the ocean compound to the inland compound. Points SHALL be awarded for collecting only or depositing one or more payload vessels.

SYSTEM MATERIALS AND MANUFACTURE

R 2. Students SHALL manufacture and fabricate their "proof of concept" system themselves using commonly available materials, components and methods.

NOTE: *At the International Final Campus Organisers MAY be required to confirm that the system presented has been appropriately manufactured in keeping with the spirit of the competition. While students MAY purchase components "off-the-shelf", it is not intended that they purchase systems / major subsystems as solutions directly.*

R 3. In keeping with the spirit of the competition, teams SHALL NOT use LEGO ® Mindstorms ® or similar comprehensive kitted systems at the International Final.

R 4. In keeping with the spirit of the competition, teams MAY use Arduino or similar PIC based components.

R 5. In keeping with the spirit of the competition, teams MAY adapt / modify / integrate elements sourced "off-the-shelf".

PROCEDURE

R 6. The mass of the team's system (SYSTEMmass) SHALL be measured by an official. The system mass (i.e. without payload and device positioning equipment) SHALL NOT be greater than 6 kilograms.

NOTE: *A maximum system mass of 6 kg has been selected to reflect carry on allowances by Jetstar and Virgin airlines so as not to disadvantage interstate and international teams travelling to the International Final who MAY wish to transport their system as carry on. Teams must appropriately satisfy the airlines restrictions/limitations for carry on and/or checked luggage, including restrictions for transporting dangerous goods such as batteries.*

R 7. The team SHALL then be called to the trackside.

R 8. There SHALL be no contact by team members or their system with the Competition Track before setup commences.

R 9. When ready, an official will signal that the setup SHALL commence. The team SHALL be allowed a maximum of 120 seconds for setup. In this time they are to set up their system in the Start Zone.

R 10. During setup, the team MAY use additional objects not considered part of the "system" to assist with setup. Any additional objects used SHALL be removed from the competition track during setup.

R 11. During setup, physical contact SHALL NOT be made by team members, their system, or any additional objects used to assist with setup, with any portion of the competition track other than any external and internal faces of the Garage SHS and the part of the competition base plane represented by the hatched area, refer Figure 1 and Appendix B2.

R 12. The Team SHALL indicate to the appropriate "official" when their setup is complete.

R 13. After setup, and prior to running, everything placed and left on the competition track SHALL be considered to be part of the system.

R 14. After setup, and prior to running, the system SHALL be subject to volume constraints. The system SHALL be wholly contained within the 580 x 580 x 500 (w x d x h) start zone as defined by all the outer surfaces of the Garage. The volume and positioning conditions SHALL be physically checked by an official.

R 15. After set up and prior to running, the system SHALL only be held or supported by the competition base plane and must be ready to start. The system SHALL NOT be in contact with or be restrained by the SHS members of the Garage. The system SHALL NOT be restrained by personal contact by team members. The system SHALL be capable of remaining in the set up condition indefinitely. Electronics MAY be powered up.

R 16. On instruction and by a signal from the "official starter," or a start light count down system, the run SHALL commence.

R 17. The system SHALL be started using a single action that does not impart motion or energy to the system.

R 18. The run SHALL be designed to finish within 60 seconds.

R 19. After performing the single action start, team members SHALL NOT control or touch the system in any way during the run. Wireless control is specifically prohibited. Any interference by team members SHALL result in a zero score for the run. If team members choose to intervene to protect a system that is malfunctioning, a zero score for the run SHALL be recorded.

R 20. During the run the system SHALL NOT come into contact with anything below the competition base plane (defined in G9). The system MAY contact the Competition Track comprising the track, the garage, the ocean and inland compound walls, and the vessel positioning board (defined in G12). This rule SHALL NOT apply to lost payload vessels.

R 21. The system or payload MAY hang over the edges of the perimeter of the Competition Track during and at the end of the run.

R 22. At the completion of the run, all parts of the system SHALL cease translation on the Competition Track and remain in this state indefinitely relative to the competition base plane. Mechanisms and items within the system MAY continue to move but no further functions SHALL be executed.

R 23. The team or system MAY indicate to the timekeepers when they declare their run to be complete. However, the timekeepers SHALL make the final judgment as to when the system ceases translation and all functions have ceased and the recorded time MAY exceed the team's or system's declaration.

R 24. To ensure that judging has been completed teams SHALL NOT retrieve their system or assist in gathering other items until directed by an official.

R 25. The system and payload SHALL NOT damage or contaminate the competition track. The run SHALL NOT contaminate or damage the payload vessels. Teams presenting a system that damages or is deemed to have potential to damage the competition track or payload vessels MAY be disqualified from the competition.

R 26. One or more components of the system left on the competition track SHALL NOT constitute contamination.

R 27. As directed, teams MAY attempt two runs.

R 28. The system MAY be modified between runs but the mass, volume and time constraints must be satisfied for a run to achieve a valid non-zero score. SYSTEMmass SHALL be recorded before each run.

R 29. Violations of procedural rules SHALL result in a zero run score being recorded.

R 30. The judges' decisions on all matters pertaining to the competition SHALL be final.

SCORING

R 31. Within 60 seconds the system SHALL cease all operations. Systems continuing to perform collection or delivery operations after 60 seconds SHALL receive a zero RUNscore. Vessels indefinitely held within the system MAY continue to move.

R 32. Better systems will achieve the objectives of collecting and depositing the most payload vessels in the inland compound within 60 seconds, whilst adhering to procedural, volume and positioning constraints.

R 33. At the International Finals, video recording SHALL be used if potential podium winning time scores are within +/- 5 seconds.

R 34. If two or more teams have equal COMPETITIONscores the team competition placing SHALL be determined by the SYSTEMmass of the run achieving the highest RUNscore. The lower SYSTEMmass will be preferred.

R 35. The COMPETITIONscore SHALL be calculated using the following:

$$RUNscore = COLLECTscore\ x\ 5 + DEPOSITscore\ x\ 10\ + (60 - RUNtime)\ x\ 1.5$$

COLLECTscore = the number of payload vessels collected, but not fully deposited in the inland compound, and indefinitely fully supported by the system within 60 seconds. Vessels MAY be moving within the system. Does not include vessels in contact with the system ***and*** *any part of the competition track.*

DEPOSITscore = the number of payload vessels fully within the inland compound after 60 seconds. For full protection from the tidal wave, deposited vessels SHALL be fully below the top surface of the compound. Vessels may be in contact with the system ***and/or*** *any surface inside the inland compound.*

RUNtime = for runs that deposit all twenty vessels within 60 seconds. Time from the 'Start' command until the system deposits all vessels. Vessels SHALL have ceased bouncing.

Otherwise = 60

SYSTEMmass = the net mass, in grams, of the system placed onto the track, excluding payload and setup tools, which achieved the highest RUNscore.

COMPETITIONscore = Max RUNscore + Min RUNscore/2

Notes: RUNtime = Time for the complete run rounded up to the nearest half second

(e.g. 15.2s becomes 15.5s and 15.7s becomes 16s)

R 36. The system may be modified between runs but the procedural, mass, volume and time constraints must be satisfied for a run to achieve a non-zero run score.

Frequently Asked Questions

1. Does the system have to stay in contact with the competition track at all times?

Yes. The scenario is for essentially a ground based system (see G21). The guidelines and rules do define what can be legally contacted (see G22, R15, R19, etc).

2. Can part of a system be "discarded" off the competition track without penalty?

No. If the system, or part of the system, is discarded off the competition track this would lead to a zero run score (R20). Parts of the system MAY be left on the Competition Track.

3. Can part of the system overhang the extremities of the competition track without penalty when negotiating the track?

Yes, (see R21). The system can exist in space beyond the projected extremities of the plan of the track during or at the completion of the run and not be penalised provided volume and positioning constraints of the system are met prior to running (see R14). Contact between the system and anything below the track base plane is not permitted**.**

5. Autonomous – does this mean that the system on the competition track cannot receive input or instructions from a Subsystem off the track (such as a computer)? Or does it mean that the system on the competition track can receive input from a Subsystem off the track (such as a computer) but that Subsystem (computer) cannot be manipulated by a team member during the run? An example of the second would be if the system was controlled by motors that ran to a pre-programmed route transmitted from the computer.

Autonomous in this competition implies every control system for the system is to be part of the system on the competition track and fit within the start volumes. No remote-to-the-track control systems of any sort can be used (manual or pre-programmed, hard wired or wireless) – see R19. Such configurations would be considered to be part of the system and violate position and volume constraints (see R14).

6. Are programmable chips allowed?

Yes. You can use a programmable chip, but there is to be no remote communication during the run. However, LEGO ® Mindstorms ® or similarly kitted systems are not allowed (see R4 and R5).

7. What is the allowable voltage and power of any employed electrical systems?

There are no restrictions this year but it clearly needs to be safe.

8. Can off-the-shelf items be used?

Commonly available components such as toy and machine parts are able to be used. The spirit of the competition is that students manufacture and fabricate their system themselves, meaning that professionals are not engaged to do it for them. It is possible for some assistance to be obtained (e.g.; for a weld) but this should be minimal or where possible be done by the students themselves. The production of major components should not be outsourced.

9. Is there a requirement on the end state of the system at the completion of the run?

No. However R23 defines the state of the system that satisfies a completed run.

10. If a vessel is in contact with both the system and the track, including the ocean and inland compounds, is the vessel regarded as being collected or deposited?

Any vessel still in contact with the system and any part of the Competition Track would be considered lost.

11. Can the system extend out the roof of the garage?

Yes, the system can move through any side or roof of the garage.

12. Can the system attach or grip the garage SHS.

Yes, but there can be no contact between the device and garage SHS before the Start command is given. Teams should note R26.

Further Competition Details

INTERNATIONAL FINAL

It is planned that the Warman International Final will be held in late September to mid-October 2019 in Sydney at a location to be determined. The competition has traditionally been run Friday to Sunday but maybe run Thursday to Saturday or even Wednesday to Friday.

Prizes for Campus Winners and International Podium Places will be awarded at the International Final. An International Final "Judges' Prize" and an NCED "Design Prize" may also be awarded.

The planned format will have students gathering on the morning of Day 1 in Sydney. Lunch, followed by a tour of Weir Minerals Ltd will follow. Scrutineering and additional judging will be conducted on Day 2 and there will be briefings, presentations and practice sessions held on Day 2. The actual running of the International Final and the Awards Ceremony will be on Day 3.

A team registration form will be available – please submit it to Engineers Australia (EA) as early as possible. Travel arrangements are coordinated by EA. Team details are required early August at the latest (unless otherwise advised).

Teams registering and accepting the invitation and sponsorship to participate at the Final also accept that their names and photographs and video of them can be used for publicity purposes by EA and Weir Minerals. All team members and attending Campus Organisers will be required to sign an appropriate authority in relation to this use.

In meeting costs, the competition sponsorship has in past years funded two students per team. It is hoped that this will be possible again in 2019. Depending on funding, it is hoped that Campus Organisers will also be funded. Campuses will be billed for additional students and for other people for whom arrangements are made whether or not they actually attend the Warman weekend.

SPIRIT OF THE COMPETITION

Although the rules may look rigid you will find that they have been written in a way which allows, and in fact encourages, creative and innovative solutions. This is not always the case in real-world engineering projects. In this project and competition, the rules are there because we have tried to be very clear on points which will be important when student groups come together for the International Final. For this reason, it is essential to work with your Campus Organiser from an early stage, and for the campus organiser to verify decisions with the International Competition Coordinators so that everyone has the same understanding of the meaning of the rules.

If you think you see a loophole, clear it with your Campus Organiser before you rely on it in the competition. Even if it is accepted at the local level, you might be in for a shock at the International Final where the interpretation might be different. Provision will be made for confidentiality, so your idea will not be passed on to other students.

It is highly recommended that all students communicate with their Campus Organiser and that if a ruling is required by the International Competition Coordinators, this is sought by the

Campus Organiser. Students SHOULD NOT contact the International Competition Coordinators directly for an individual ruling.

The competition tracks, both at the Campus Competitions and the International Final, will be made with reasonable care but because it is a real engineering object it may well be "wrong" in various small ways. For example the competition base plane might have a slight longitudinal slope. Your team is expected to consider these possibilities in your design, and develop a system that can function even if the competition track has slight imperfections and inaccuracies. In other words, you are not allowed to blame failure of your system on some minor imperfection with the competition track.

A FINAL COMMENT ON SAFETY

Please be aware that in 2003 during a campus competition, a student was lucky to escape serious eye injury when a Subsystem went off unexpectedly. While Campus Organisers run their own competitions independently, they are strongly encouraged to consider all aspects of safety in relation to the conduct of their competition.

Appendix A - General Arrangement and Detailed Drawings of Competition Track

Sheet 1 – General Arrangement View

Sheet 2 – Vessel Spacer

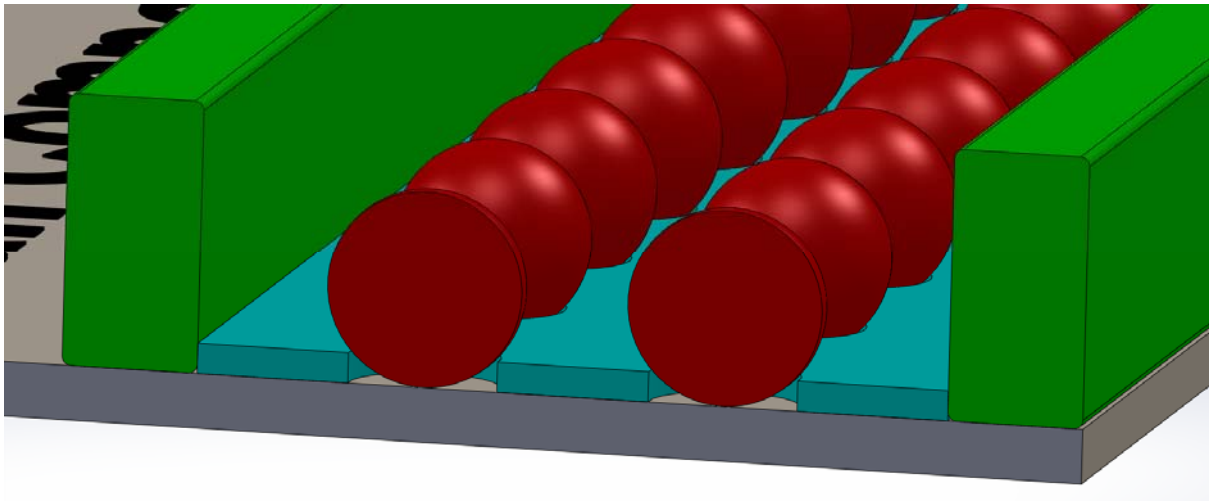
Sheet 3 – Compound Frame

Sheet 4 – Welded Frame Assembly

Appendix B

Appendix B1 Angle Brackets for the Garage/Track Connection

Appendix B2. Angle bracket locations for the Garage/Track connection. Start Zone with black edge line showing the start zone boundary. Prior to starting the system SHALL be wholly within the volume bounded by the track surface (hatched area) and the external surfaces of the 40x40 SHS frame. Prior to starting the system SHALL NOT be in contact with the 40x40 SHS frame or any part of the competition track outside the hatched area.

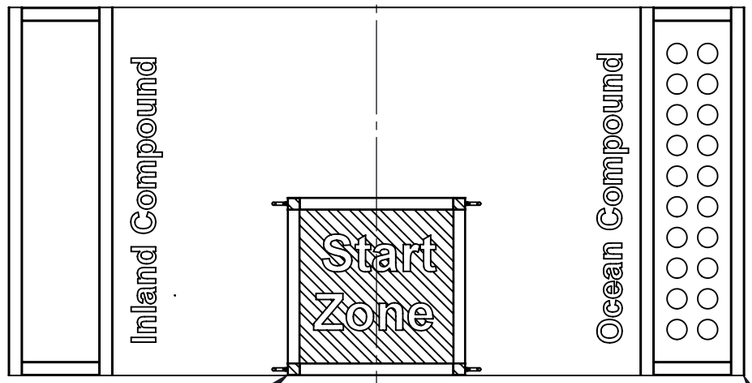


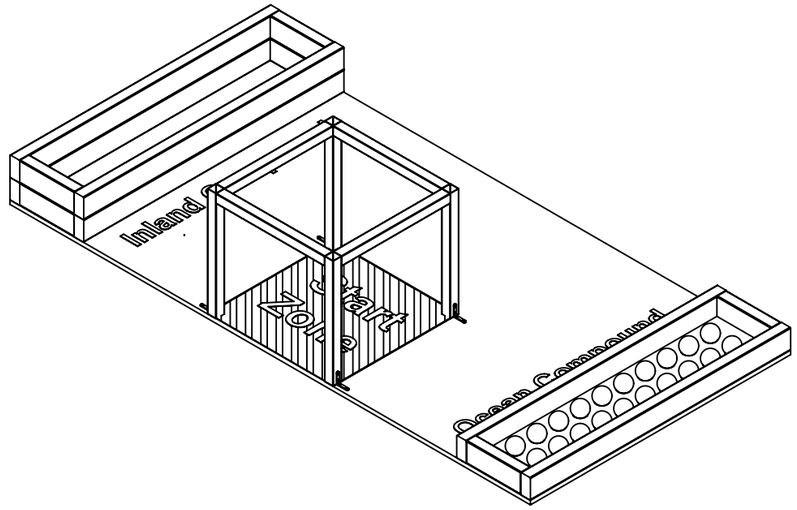
Appendix B3. Section through the vessels and vessel spacing board.
Note the clearance between the vessel and hole. The vessels rests on the track base plane not the edge of the hole.

NOTES - (UNLESS OTHERWISE SPECIFIED)

1. ALL DIMENSIONS IN MILLIMETERS.
2. GD&T AS PER ISO1101-2004.

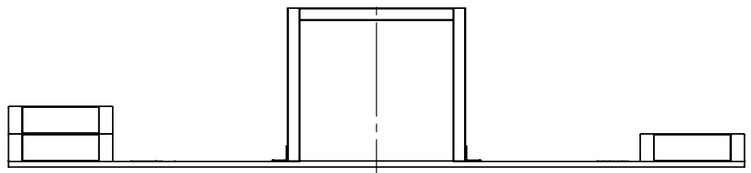
REVISIONS					
ZONE	REV.	DESCRIPTION	ECO	APPROVED	DATE
	REV1	RELEASE		XXX	01JAN13





FRAME MOUNTED FLUSH WITH TRACK EDGE AND CENTRAL TO THE TRACK

TYP. COMPOUND FRAME FLUSH WITH FRONT AND END OF TRACK EDGES



THIRD ANGLE PROJECTION

MATERIAL: SEE PART DRAWINGS

FINISH: SEE PART DRAWINGS

TOLERANCE (UNLESS OTHERWISE SPECIFIED)

DECIMAL mm

.X ± .1 **.XX** ± .03 **.XXX** ± .010 **ANG.** ± 1°

TRACK ASSEMBLY

DESIGN	DWG NO.	REV
XXX	Sheet 1	REV1

DRAWN	PROJECT	
DMC	Weir Warman Competition 2019	

SUPERVISOR	ISSUE DATE		SHEET
XXX	Jan 2019	DRAWING NOT TO SCALE	1 OF 4

NOTES - (UNLESS OTHERWISE SPECIFIED)

1. ALL DIMENSIONS IN MILLIMETERS.
2. GD&T AS PER ISO1101-2004.

REVISIONS					
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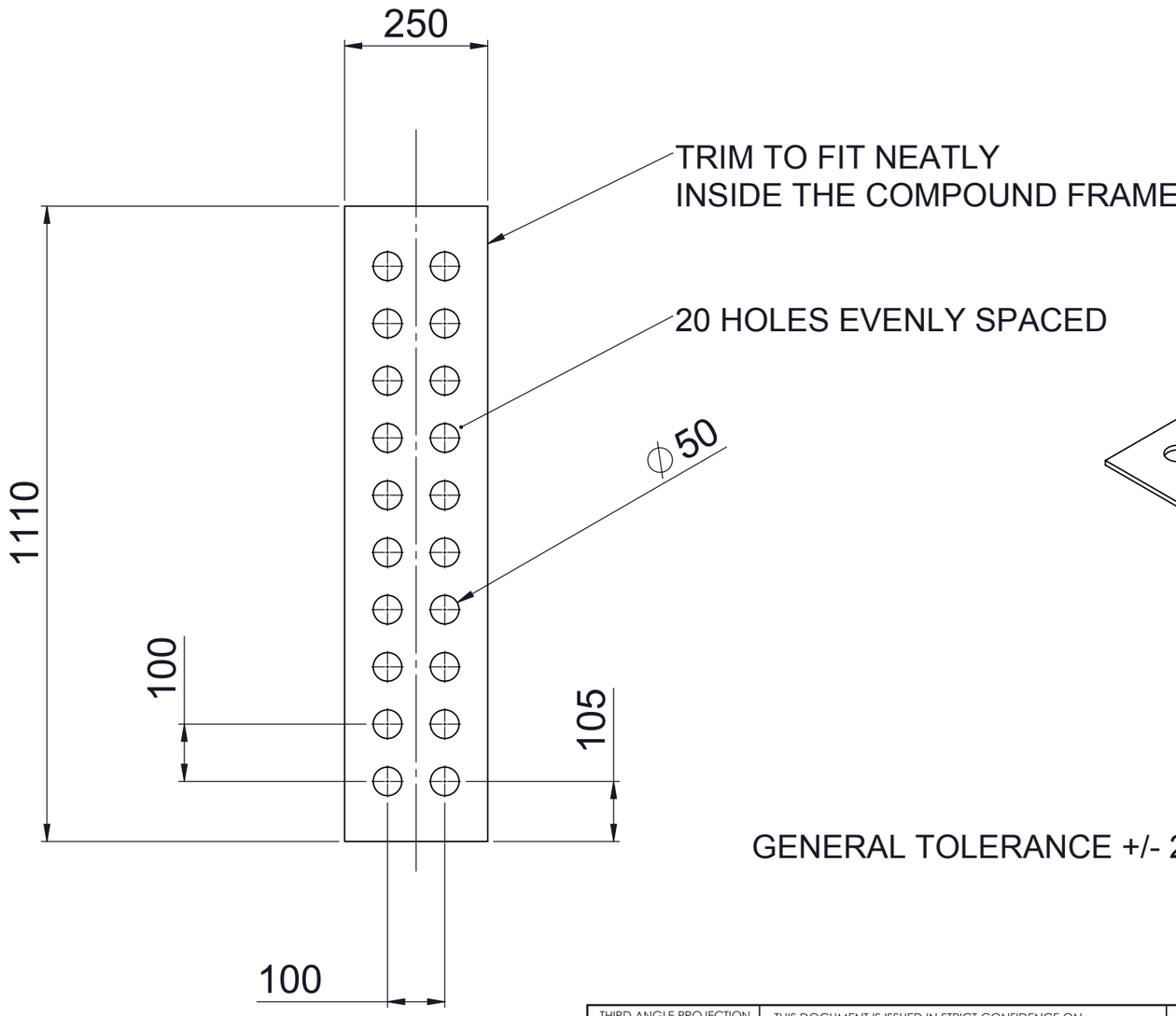
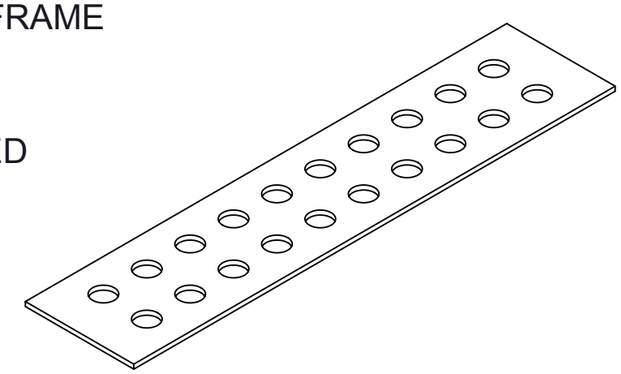
	REV1	RELEASE		XXX	01JAN13





GENERAL TOLERANCE +/- 2mm

THIRD ANGLE PROJECTION

MATERIAL: 10mm MDF

FINISH: Wattyl Estapol Matt

TOLERANCE (UNLESS OTHERWISE SPECIFIED)

DECIMAL mm

.X ± .1 **.XX** ± .05 **.XXX** ± .010 **ANG.** ± 1°

Vessel Spacer

DESIGN: XXX	DWG NO.: Sheet 2	REV: REV1
DRAWN: DMC	PROJECT: Weir Warman Competition 2019	
SUPERVISOR: XXX	ISSUE DATE: Jan 2019	DRAWING NOT TO SCALE
		SHEET: 2 OF 4

NOTES - (UNLESS OTHERWISE SPECIFIED)

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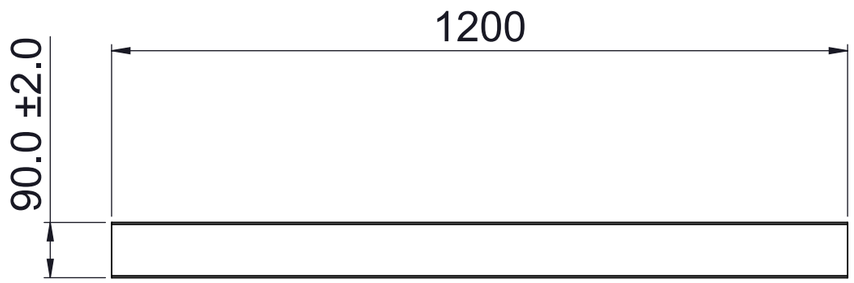
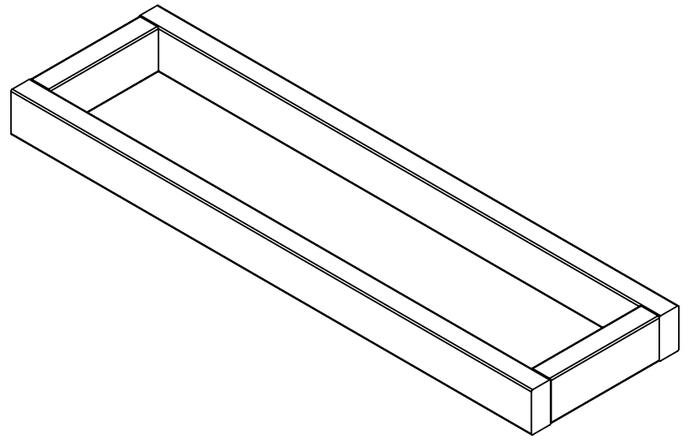
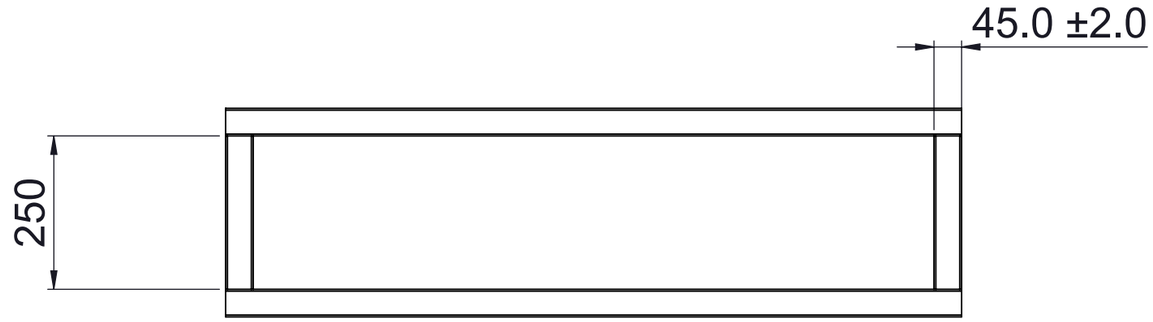
2. GD&T AS PER ISO1101-2004.







MANUFACTURE 3 FRAMES
GENERAL TOLERANCE +/-5mm

THIRD ANGLE PROJECTION

MATERIAL: 90 x 45mm MGP10 Pine Timber Framing

FINISH: Wattyl Estapol Matt

TOLERANCE (UNLESS OTHERWISE SPECIFIED)
DECIMAL mm
.X ± .1 .XX ± .03 .XXX ± .010 ANG. ± 1°

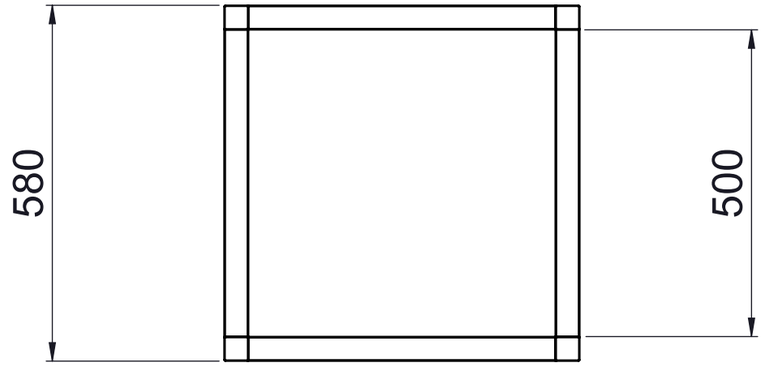
Compound Frame

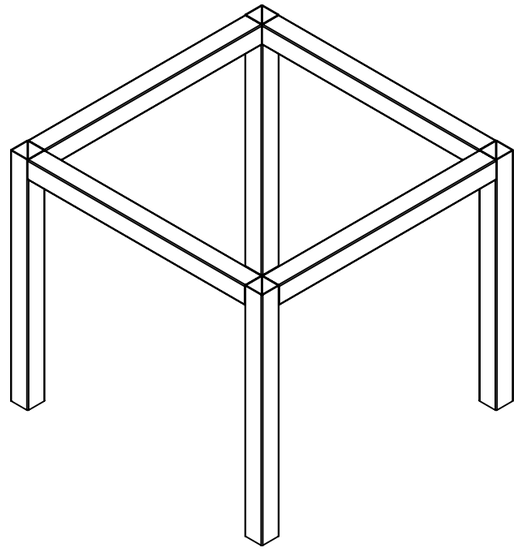
DESIGN: XXX	DWG NO.: Sheet 3	REV: REV1
DRAWN: DMC	PROJECT: Weir Warman Competition 2019	
SUPERVISOR	ISSUE DATE: Jan 2019	DRAWING NOT TO SCALE
		SHEET: 3 OF 4

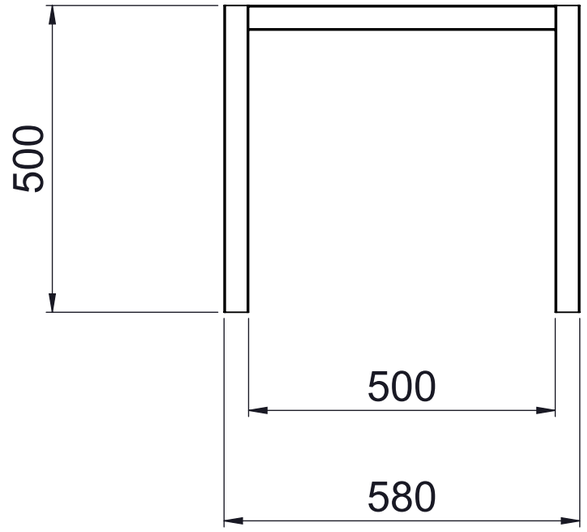
NOTES - (UNLESS OTHERWISE SPECIFIED)

1. ALL DIMENSIONS IN MILLIMETERS.
2. GD&T AS PER ISO1101-2004.

REVISIONS					
ZONE	REV.	DESCRIPTION	ECO	APPROVED	DATE
	REV1	RELEASE		XXX	01JAN13







WELD ALL CORNERS

CUT ALL PARTS 500mm +/-2mm

GENERAL TOLERANCE +/-5mm

THIRD ANGLE PROJECTION

MATERIAL: All Parts Unpainted 40x40x1.6 SHS

FINISH: Galvanised: As Supplied

TOLERANCE (UNLESS OTHERWISE SPECIFIED)

DECIMAL mm

.X ± .1 **.XX** ± .03 **.XXX** ± .010 **ANG.** ± 1°

Welded Frame Assembly

DESIGN: XXX	DWG NO: Sheet 4	REV: REV1
DRAWN: DMC	PROJECT: Weir Warman Competition 2019	
SUPERVISOR: XXX	ISSUE DATE: Jan 2019	DRAWING NOT TO SCALE
		SHEET: 4 OF 4