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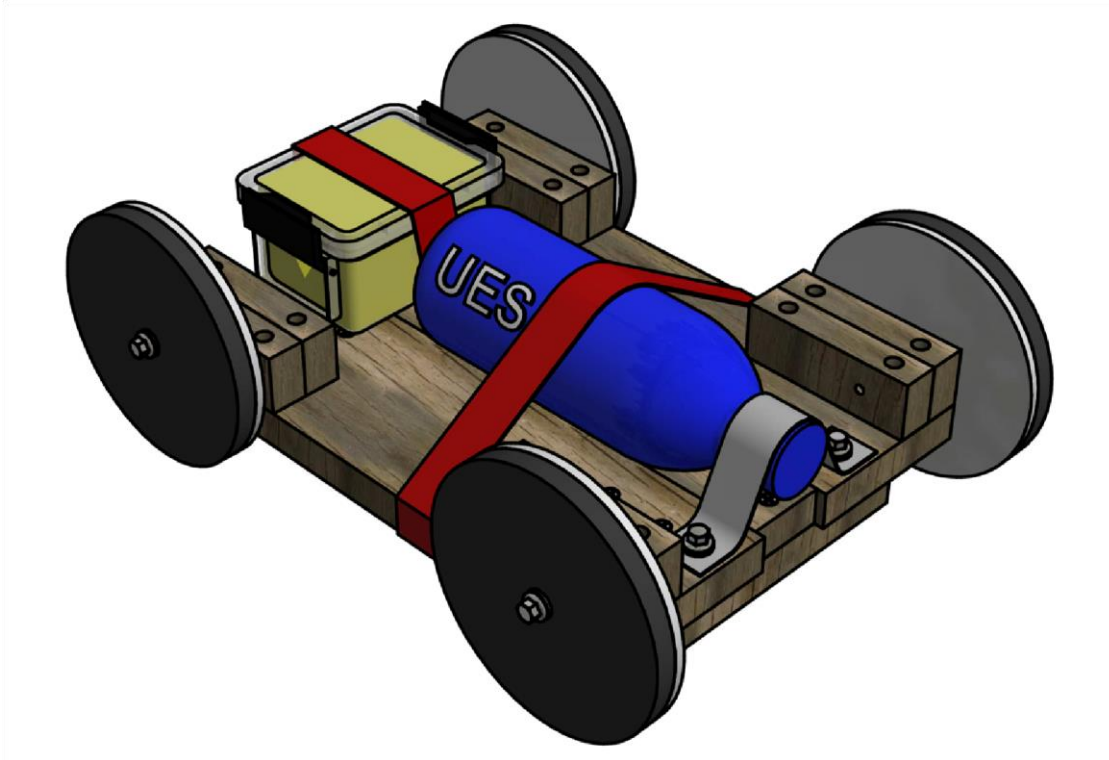

MARS LANDER/ ROVER PROTOTYPE CONCEPT

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1. CLIENT BRIEF

UES has been approached by their client, EMPACT, to design a prototype Mars Lander/Rover, for an upcoming bid to be a part of an international space exploration consortium. The prototype is to be a scaled down version of the final Lander/ Rover and will be required to safely carry a designated payload simulating a real life payload, and conform to a strict set of constraints.

1.1. Requirements

1.1.1. The Mars Rover/ Lander will be required to simulate the full-size Lander/ Rover being deployed with a human astronaut and equipment payload. The prototype will be required to carry simulated cargo of a 600ml water bottle and egg 'astronaut', herein referred to as the 'payload'.

1.1.2. The Lander/ Rover prototype will be required to roll unpowered down a 2m ramp of between 30° - 45°, unaided in a straight line, and completing a 1m vertical drop at the end of the ramp without sustaining damage to the payload. The prototype must finish movement on its wheels.

1.2. Dimensional Constraints

1.2.1. EMPACT has specified that the Lander/ Rover prototype must conform to a maximum set of dimensions.

1.2.2. The prototype must measure less than 420mm x 297mm, with no portion of the prototype exceeding 210mm in height.

1.3. Materials Constraints

1.3.1. EMPACT has specified that the total value of construction materials of the prototype must not exceed $30.

1.3.2. Second hand materials may be used in place of new materials, with these materials incurring 50% of the cost of a new item.

1.4. Construction Constraints

1.4.1. The prototype must be able to be constructed using techniques available to the average student/ householder.

1.4.2. Drilling, gluing, sawing with handheld tools are considered acceptable technologies. **Welding, heavy machinery and similar technologies are not considered acceptable.**

1.4.3. The prototype must be designed so that the payload can be loaded onto the prototype with no complex assembly required. (i.e. closing a box flap is acceptable, screwing a panel is not).

1.4.4. The prototype must be designed so that condition of the payload can be assessed from approx. 1m without accessing the prototype.

1.5. Impact and Cushioning Constraints

1.5.1. The prototype must be designed so that no manual intervention is required to meet any of the aforementioned constraints/ requirements from the time it is released on the ramp to the time it ceases movement.

1.5.2. The prototype must end movement with its wheels in contact with the ground.

2. DESIGN SOLUTION

2.1. Dimensional Constraints

2.1.1. UES has designed a prototype that conforms to the maximum dimensions specified by the client.

2.1.2. The UES prototype has final dimensions of 375mm x 271mm with a maximum height of 125mm.

2.2. Materials Constraints

2.2.1. UES has designed a prototype with a final construction cost of $28.50.

2.2.2. UES has not used and second-hand materials in this design.

2.3. Construction Restraints

2.3.1. UES has designed the Lander/ Rover to minimise complicated construction methods by maximising the use of off-the-shelf items.

2.3.2. The UES prototype requires basic woodworking tools to complete construction. UES has provided alternative tools where possible to increase the ability of contractors to successfully build the prototype.

2.3.3. The prototype has been designed so that the payload is secured to the chassis via simple tie down straps.

2.3.4. The prototype has been designed so that the ‘cockpit’ has been constructed out of a clear plastic container, with view holes in the crash protection sponge to enable

assessment of the condition of the egg 'astronaut'. The water bottle will be strapped to the outside of the chassis, and is easily visible from all angles.

2.4. Impact and Cushioning Requirements

2.4.1. UES has designed the prototype to be able to freely roll without additional propulsion.

2.4.2. The prototype has been designed so that the wheel assembly tension can be adjusted to ensure that the prototype tracks in a straight line.

2.4.3. UES has designed the prototype so that the Lander/ Rover is able to flip over and have its wheels remaining in contact with the ground.

3. TENDER EVALUATION CRITERIA

3.1. Demonstrated Experience - 30%

3.1.1. Specific Experience and Qualifications - 20%

Tenderers must demonstrate specific experience or qualifications relating to construction. UES has identified poor construction standard of the Lander/ Rover as a Moderate risk to the project. To mitigate this risk and to ensure that tenderers have the relevant construction skills to successfully construct the Lander/ Rover prototype, UES require tenderers to provide proof of skills, qualifications or past construction experience. Evidence is to be detailed in the contractors' tender response. Tenderers will receive a score out of 20 based on the total pieces of evidence provided. Acceptable evidence may include but not be limited to: ○ Trade or certificate qualifications related to construction work.

- ○ Demonstration of completed construction projects utilising the following skill sets:
- ○ Timber cutting/ sawing.
- ○ Drilling. ○ Timber assembly using drill drivers and screws. ○ Bolting structures including tightening bolts with spanners/ wrenches.

Pieces of Evidence	0 Pieces of evidence	1 Piece of evidence	2 Pieces of evidence	3 Pieces of evidence	4+ Pieces of evidence
Score	0	5	10	15	20

3.1.2. Management/ Supervisory Experience - 10%

Tenderers are required to demonstrate experience of a managerial or supervisory nature. UEC have identified poor time management skills leading to the Lander/ Rover not being finished by the deadline as a Moderate risk to the project. To mitigate this hazard UES require tenderers

to provide evidence of project management skills, time management skills and work ethic through demonstration of suitable experience. Evidence is to be detailed in the contractors' tender response. Tenderers will receive a score out of 10 based on the total pieces of evidence provided. Sufficient experience may include but not be limited to:

○ Management qualifications or certificates. ○ Work experience as a manger/ supervisor. ○ Leadership role within a sporting team (coach/ captain). ○ Supervision/ organisation of volunteering activities.

Pieces of Evidence	0 Pieces of evidence	1 Piece of evidence	2 Pieces of evidence	3 Pieces of evidence	4+ Pieces of evidence
Score	0	2.5	5	7.5	10

3.2. Tenderers Resources - 20%

Tenderers must demonstrate their ability to be able to construct the Lander/ Rover prototype to a high standard. UES has identified lack of proper tooling as a Moderate risk to the Lander/ Rover project. In order mitigate this risk and ensure that construction of the Lander/ Rover prototype is to an acceptable standard, leading to a successful outcome for the project, UES requires contractors to be able to acquire suitable tools to build the prototype. The below table contains tools essential for the construction of the prototype based on the current design. Tenders will receive a score based on the table by providing photographic evidence of the tools listed. Evidence is to be detailed in the contractors' tender response. Where an alternative has been supplied, tenderers can not score points for both the standard and alternative item, and tenderers can subsequently not receive points for additional alternative items for the same tool. Tenderers can score a maximum of 22 points, and total score will be converted to a percentage of the total 20% for this portion of the criteria.

Standard Equipment		Alternative Equipment	
Tool	**Score**	**Tool**	**Score**
Mitre Saw or equivalent	3	Circular Saw / Jigsaw	2
		Hand saw	1
Electric Drill	3	Hand drill	1
Measuring Tape	3		
Combination Square or equivalent	3		
Adjustable wrench or 10mm spanner.	2		

Drill driver - Philips head.	2	Screwdriver - Philips head	1
3mm drill bit	1		
4.5mm drill bit	1		
8mm drill bit	1		
Builders pencil or equivalent	1		
Knife – Serrated Bread Knife Preferred.	1		
Cigarette Lighter/ Matches	1		

3.3. Development Towards Final Design - 20%

Tenderers are required to demonstrate their understanding of the requirements of the Lander/ Rover prototype. In order to ensure the best possible outcome for the project, UES require tenderers to propose improvements to the initial design of the Lander/ Rover. These improvements are to be listed in the contractors' tender response, including amended costings, tools required and construction sequence. Any changes to the original design are to be approved by UES prior to construction. UES reserve the right to make none, some or all of the proposed improvements. Tenderers can score a maximum of 20 points for this criterion based on the table below.

Number of Design Improvements Suggested	0 Design Improvements Suggested	1 Design Improvement Suggested	2 Design Improvements Suggested	3 Design Improvements Suggested	4+ Design Improvements Suggested
Score	0	5	10	15	20

3.4. Commitment to Safety - 10%

3.4.1. Risk Identification – 5%

UES requires all contractors to complete construction of the Lander/ Rover in a safe manner. In order to avoid any unpredictable hazards that might occur, it is necessary to provide a risk management plan. Tenderers must demonstrate their commitment to completing the project safely by identifying hazards not detailed in the Risk Assessment. New hazards are to be detailed in the contractors' tender response along with suitable risk control measures.

Tenderers will be awarded a score based on the table below, which will be converted to a percentage of the total 5% possible for following sub-criteria.

Number of New Hazards Identified	0 New Hazards Identified with Adequate Control Measures	1 New Hazard Identified with Adequate Control Measures	2 New Hazards Identified with Adequate Control Measures	3 New Hazards Identified with Adequate Control Measures
Score	0	1	2	3

3.4.2. Safety Equipment – 5%

UES has identified physical injury to contractors as a High risk during the construction of the Lander/ Rover prototype. To mitigate this hazard tenderers are required to provide photographic evidence of the following items of Personal Protective Equipment (PPE) for each member of the construction team:

- Safety Boots
- Safety Glasses/ Goggles
- Ear Muffs/ Earplugs
- Safety Gloves

Evidence is to be detailed in the contractors' tender response. Tenderers MUST demonstrate evidence of ALL items to receive a score for this sub-criterion.

PPE Demonstrated	No	Yes
Score	0	5

3.5. Communication - 20%

3.5.1. Prompt Response – 10%

UES has identified poor communication skills as a High risk to the Lander/ Rover project. To mitigate this risk UES requires tenderers to provide evidence of prompt professional communication. Tenderers are required to provide evidence of responding to communications within 24 hours. Pieces of evidence must be provided from different dates to be accepted. Evidence is to be detailed in the contractors' tender response. Tenderers will be awarded a score based on the table below, which will be converted to a percentage of the total 10% possible for following sub-criterion.

Examples of Prompt Response	0 Examples of Prompt Response	1 Example of Prompt Response	2 Examples of Prompt Response	3 Examples of Prompt Response
Score	0	1	2	3

3.5.2. Accurate Record Keeping – 10%

UES also require tenderers to provide evidence of accurate recording of communications. Tenderers are required to provide evidence of record keeping in the form of meeting minutes. Evidence is to be detailed in the contractors' tender response. Tenderers will be awarded a score based on the table below, which will be converted to a percentage of the total 10% possible for following sub-criterion.

Examples of Accurate Record Keeping	0 Examples of Accurate Record Keeping	1 Example of Accurate Record Keeping	2 Examples of Accurate Record Keeping	3 Examples of Accurate Record Keeping
Score	0	1	2	3

4. SPECIFICATIONS

4.1. Bill of Materials

Item	Supplier	Link	Purpose	Quantity	Cost	Total
Claymark 89 x 19mm x 1.2m Dressed Pine	Bunnings	https://www.bunnings.com.au/claymark-89-x-19mm-x-1-2mstandard-grade-dressed-pinesheet_p8401491	Rover Chassis	1	$4.50	$4.50
Felt Gard 125mm Heavy Duty Felt Pad - 4 Pack	Bunnings	https://www.bunnings.com.au/felt-gard-125mm-heavy-duty-feltpad-4-pack_p3961641	Rover Wheels	1	$7.40	$7.40
Zenith 10G x 40mm screws - 25 Pack.	Bunnings	https://www.bunnings.com.au/zenith-8-10g-x-40mm-treated-pinescrew-25-pack_p2420248	Chassis Assembly	1	$3.60	$3.60
M6 x 50mm Hot Dipped Galvanised Coach Screw	Bunnings	https://www.bunnings.com.au/zenith-m6-x-50mm-hot-dippedgalvanised-coachscrew_p2310080	Wheel Axles	4	$0.44	$1.76
M6 x 25mm Hot Dipped Galvanised Coach Screw	Bunnings	https://www.bunnings.com.au/zenith-m6-x-25mm-hot-dippedgalvanised-coachscrew_p2310076	To hold down front bottle strap.	2	$0.33	$0.66
M6 Hot Dipped Galvanised Flat Washer	Bunnings	https://www.bunnings.com.au/zenith-m6-hot-dipped-galvanisedwasher_p2310151	Spacers for Wheel Axles	10	$0.12	$1.20
Grunt 25mm x 1m Pull Tie Down Strap - 2 Pack	Bunnings	https://www.bunnings.com.au/grunt-25mm-x-1m-pull-tie-downstrap-2-pack_p4310725	Secure Payload to Chassis	1	$5.40	$5.40

Handy Storage 270ml Mini Storage Box 120 x 85 x 63mm	Bunnings	https://www.bunnings.com.au/handy-storage-270ml-mini-storagebox-120-x-85-x63mm_p0012920	Cockpit for Astronaut	1	$2.98	$2.98
Morgan Jumbo Sponge	Bunnings	https://www.bunnings.com.au/morgan-jumbo-sponge_p4460815	Crash Protection for Astronaut	1	$1.00	$1.00
					Total	$28.50

4.2. Tools Required

Item	Quantity	Purpose
Mitre Saw or equivalent	1	Cutting timber pieces for chassis
Electric Drill	1	Drilling pilot holes and screwing components together
Measuring Tape	1	Measuring for position of cuts and drill holes.
Combination Square or equivalent	1	To ensure all markings for cutting are square. To ensure chassis is constructed square.
Adjustable wrench or 10mm spanner	1	Assembly of wheel axles.
Drill driver - Philips head.	1	Drive screws for chassis construction.
3mm drill bit	1	Drill pilot hole for timber screws
4.5mm drill bit	1	Drill holes for axles.
8mm drill bit	1	Drill holes in wheels

Builders pencil or equivalent	1	Marking position of cuts and drill holes.
Knife – Serrated Bread Knife Preferred.	1	To cut crash protection sponge to size and shape. To cut straps to size.
Cigarette Lighter/ Matches	1	To seal ends of cut straps to stop fraying.

4.3. PPE Required

PPE	Quantity – Per Person
Safety Boots - Pair	1
Safety Glasses/ Goggles	1
Ear Muffs/ Ear plugs	1
Safety Gloves	1

4.4. Tolerances

UES has designed the Mars Lander/ Rover prototype to maximise the use of all specified materials and hence has extremely tight tolerances for all components of construction as per the following:

4.4.1. ±1mm on all timber cuts.

4.4.2. ±1mm to centre of all pilot hole mark-up measurements.

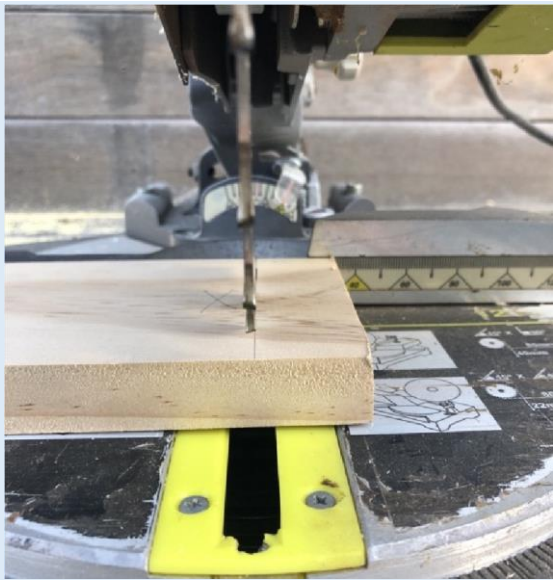
4.4.3. ±2mm on chassis final length and width measurements.

4.4.4. ±2mm chassis corner to corner – square measurements.

4.4.5. ±2mm on overall completed dimension.

4.4.6. No part of the chassis or payload is to extend above/below or forward/aft of the wheel outer dimensions. This will ensure that the wheels are the only part of the prototype that can make contact with the ground.

4.5. Construction Sequence

Step		Instruction
1.0	Preparation	
1.1		*Ensure all materials and tools are correct as per tables 'Bill of Materials' and 'Tools Required' in this document.*
1.2		*Ensure all risk mitigation strategies have been implemented as per the 'Risk Management Plan' before commencing construction.*
2.0	*Cutting of Timber Pieces*	
2.1		*Ensure Mitre Saw is setup for square cutting. Ensure if using a circular saw that the saw is setup for square cutting.*
2.2		***STOP - Before cutting be sure to identify which is the 'waste' side of the cut (the part of the timber on the outside of the pencil mark. Don't start the cut right on the line you marked earlier with the pencil. Instead, cut right next to the line on the waste side. This will ensure that the width of the cutting blade is not removed from the desired length.*** 
2.3		***STOP - Ensure measurements for the next cuts are made after the previous cut, to ensure that the width of the blade is not removed after measuring. Do not mark all measurements prior to cutting.***

2.4	*Using the tape measure and pencil, measure and mark the lengths as per Drawing 11 – CUTTING LIST beginning with CHASSIS FRAME PART 3.*
2.5	*Using the saw complete the cuts through the timber. Check measurements after cutting.*

3.0	*Pre-Drilling of Holes*
3.1	*Mark drill hole positions on 2x chassis pieces – CHASSIS FRAME PART 1 as per Drawing 5.*
3.2	*Mark drill hole positions on chassis piece – CHASSIS FRAME PART 2 as per Drawing 6.*
3.3	*Mark drill hole positions on chassis piece – CHASSIS FRAME PART 4 as per Drawing 8.*
3.4	*Mark drill hole positions on 8x Axle Blocks – CHASSIS FRAME PART 3 as per Drawing 7.*
3.5	*Mark drill hole position on chassis piece – CHASSIS FRAME PART 5 as per Drawing 9.*
3.6	***STOP - Before drilling holes, be sure to double check all measurements against Drawings to ensure accuracy.***
3.7	*Ensuring the drill is square, use the drill and 3mm drill bit to drill the pilot holes for the screws through the chassis pieces.*
3.8	*Ensuring the drill is square, use the drill and 8mm drill bit to countersink the pilot holes to a depth of 10mm, as per Drawing 7 – CHASSIS FRAME PART 3.*
3.9	*Ensuring the drill is square, use the drill and 4.5mm drill bit to drill the 4.5mm holes for the Coach Screw Axles as per Drawing 7 – CHASSIS FRAME PART 3.*
4.0	*Assembly of Chassis*
4.1	*Position chassis pieces 2x CHASSIS FRAME PART 1, CHASSIS FRAME PART 2 and CHASSIS FRAME PART 4 as per Drawing 4 – PLAN.*
4.2	***STOP – Ensure CHASSIS FRAME PART 2 is installed with centre pilot hole on the outside of the chassis as per Drawing 4 – PLAN.***
4.3	*Using the drill and drill driver, drive one screw into each 3mm pilot hole until head of screw is flush with timber.*
4.4	*Check Chassis frame is square and conforms to dimensions as per Drawing 4 - PLAN*

4.4	*Position Axle Block CHASSIS FRAME PART 3 as per Drawing 4.*
4.5	*Using the drill and drill driver, drive one screw into the pilot hole until head of screw bottoms out in 10mm countersunk hole as per Drawing 4 – SECTION A-A.*
4.5	*Repeat until all 8x Axle Blocks have been installed as per Drawing 4 – PLAN.*
4.6	*Place the Water Bottle Stop Block – CHASSIS FRAME PART 5 in place as per Drawing 4 – PLAN and Drawing 4 – SECTION A-A.*
4.7	*Using the drill and drill driver, drive one screw into the 3mm pilot hole until head of screw is flush with timber.*
5.0	*Assembly of Wheels/ Axles*

5.1	*Using the measuring tape and pencil, mark the centre point on each wheel as per Drawing 12. Using the 8mm drill bit, drill through the centre of each wheel from the felt side.*
5.2	*Assemble the wheel and axle assembly as per Drawing 2. The sequence of components shall be as follows:* ○ *M6 Coach Screw* ○ *M6* *Washer* ○ *Wheel –* ***BLACK RUBBER SIDE FACING*** ***OUT.*** ○ *M6 Washer* ○ *Axle Block*
5.3	*Using the 10mm spanner or wrench, screw the wheel assembly into the axle block at each corner.*
5.4	*Screw the wheel assembly until there are no gaps between any of the wheel assembly components. Stop before the washers start to compress the rubber side of the wheel.*
5.5	*Wheel should be able to complete at least one full rotation when flicked. If not unscrew the wheel assembly ¼ turn and repeat if necessary.*
6.0	*Cutting of Cargo Securing Straps.*

6.1	*Using the knife, cut the 2 tie-down straps to the following lengths, ensuring the cut is at a 45-degree angle to enable easier buckling of the strap:* • *1 x 630mm* • *1x 530mm.*
6.2	*Use the cigarette lighter/ matches to slightly melt and seal the ends from fraying.*
6.3	*Using one of the off-cut sections, cut 1x length at 180mm, completing the cut at a 90-degree angle. This piece will be used for the Water Bottle Retaining Strap.*
6.4	*Use the cigarette lighter/ matches to slightly melt and seal the ends from fraying.*
7.0	*Attaching Front Water Bottle Retaining Strap*
7.1	*Mark holes in the chassis as per Drawing 3 – PLAN.*
7.2	*Using the 4.5mm drill bit, drill holes in the chassis as per Drawing 3 – PLAN.*
7.3	*Mark holes in the Front Water Bottle Retaining Strap as per Drawing 3 – PLAN.*
7.4	*Using the 4.5mm drill bit, drill holes in Front Water Bottle Retaining Strap as per Drawing 3 – PLAN.*
7.5	*Using the 10mm spanner or wrench, screw the Water Bottle Retaining Strap onto the chassis with the coach screws and washers as per Drawing 3 – PLAN.*
8.0	*Shaping of Crash Protection (Sponge)*
8.1	*Cut sponge into a block the exact inner dimensions of cockpit as per Drawing 10.*
8.2	*Cut the block in half horizontally as per Drawing 10.*
8.3	*Cut channels into each half as per Drawing 10.*
9.0	*Final Assembly*
9.1	*Place half of the crash protection sponge into the Egg Storage Mini Bin as per Drawing 2.*
9.2	*Place the egg on top of the sponge as per Drawing 2.*

9.3	*Place the second half of the crash protection sponge on top of the egg.*
9.4	***STOP – Ensure when closing the egg housing pressure is applied slowly, allowing the sponge to slowly conform to the shape of the egg.***
9.5	*Place the lid on top and slowly apply pressure to close the lid and latch closed.*
9.6	*Place the egg housing onto the chassis as per Drawing 3 – PLAN.*
9.7	*Feed the Egg Housing Tie Down around the chassis and egg container as per Drawing 3 – PLAN and SECTION C-C, ensuring the buckle is at the rear of the Lander/ Rover.*
9.8	***STOP – Ensure when tightening the Egg Housing Tie Down Strap that no pressure is applied by hand to the top of the container.***
9.9	*Tighten the Egg Housing Tie Down Strap until the Egg Housing is secure to the chassis.*
9.10	*Place the water bottle cargo onto the chassis as per Drawing 3 – PLAN, ensuring the neck of the bottle is fed into the Front Water Bottle Retaining Strap.*
9.11	*Feed the Water Bottle Tie Down Strap around the chassis and water bottle, and tighten until water bottle is secure to the chassis as per Drawing 3 – PLAN and SECTION B-B..*

4.6. Testing

To ensure the Lander/ Rover prototype has been constructed to a sufficient standard, leading to a successful outcome for the project, UES require the successful contractor to conduct the following tests post construction.

4.6.1. Drop Test

To simulate the 1m drop at the end of the test ramp, the contractor must conduct a 1m drop test of the prototype from the following positions without payload:

4.6.1.1. Horizontal, upright.

4.6.1.2. Horizontal, upside down.

4.6.1.3. Vertical, front down.

4.6.1.4. Vertical, back down.

The test should be performed on a hard surface. The prototype should not sustain any damage from these tests. Once the contractor is satisfied that the prototype can withstand these tests, the tests are to be repeated with payload intact.

4.6.2. Roll Test

To ensure that the Lander/ Rover prototype can travel down the test ramp unaided in a straight line, the contractor must perform the following tests:

4.6.2.1. 5m roll test, upright.
4.6.2.2. 5m roll test, upside down.

The prototype must be able to track in a straight line for 5m in both positions. If the prototype has a tendency to veer to the side, the contractor must adjust the wheel tension in order to rectify this.

5. Risk Management Plan

5.1. Risk Matrix

Likelihood or Frequency	Consequence Severity				
	Low	Minor	Moderate	Major	Critical
Almost Certain	High	High	Extreme	Extreme	Extreme
Likely	Moderate	High	High	Extreme	Extreme
Possible	Low	Moderate	High	Extreme	Extreme
Unlikely	Low	Low	Moderate	High	Extreme
Rare	Low	Low	Moderate	High	High

5.2. Risk Matrix Definitions

Risk	Definition
Extreme	• Failing EFPC unit or/and • Unable to attend work for few days due to Injury which requires medical attention.
High	• Failing a major component/assessment in EFPC or/and • Unable to attend work for a day due to Injury which requires medical attention.
Moderate	• Failing an assessment worth 10-20% or/and • Injury which requires medical attention.
Low	• Failing an assessment worth less than 10% or/and • Injury which requires personal first aid only.

5.3. Risk Assessment

Stages	Hazard	Risk	Likelihood	Severity	Risk Level	Mitigation	Residual Risk Level

Design	Poor Communication Skills	• Misunderstood project requirements. • Lack of direction with team members unclear of requirements.	Possible	Moderate	High	• Share contact details. • Weekly meetings. • Written and distributed meeting minutes. • Weekly Progress Reports. • Gant Chart	Low
	Lack of digital design experience.	• More time will be required to learn using new software. • Poor quality of design drawings. • Not submitting Design Package on time.	Possible	Minor	Moderate	• Allocate task to team member with design experience. • Seek for supplementary help from other companies or attend designing software tutorials.	Low
	Poor time management.	• Not completing the Design Package by the deadline.	Possible	Minor	Moderate	• Use Gant chart to identify and track all tasks and assignments. • Conduct weekly meetings to ensure all team members know tasks and are staying on track.	Low
Construction	Contractor lacks required experience to construct prototype.	Prototype test failure • Uncompleted project •	Possible	Moderate	Moderate	• Specify demonstration of Specific Experience in TECs. Design prototype to use • 'off-the-shelf' items where possible. Design prototype to • require only basic construction techniques.	Low

	Lack of proper tooling.	• The prototype not built to design specifications. • Poor construction quality.	Likely	Moderate	Moderate	• Specify Demonstration of Resources in TECs. • Supervise all contractors and ensure the design package file is followed in steps or seek for needed apparatus from other companies	Low
	Use of Power Tools/ Hand Tools	• Physical injury	Likely	Moderate	High	• Specify required Personal Protective Equipment (PPE) in TECs. • **<u>If not attainable, at least Safety boot, glasses and gloves need to be worn.</u>**	Low
		• Damage to prototype	Possible	Minor	Low	• Specify demonstration of Specific Experience in TECs. Ensure specifications and • construction sequence are sufficiently detailed.	Low
		• Wastage of materials.	possible	Low	Low	• Ensure specifications and construction sequence are sufficiently detailed. • Ensure all measurement on drawings are accurate and clear.	Low

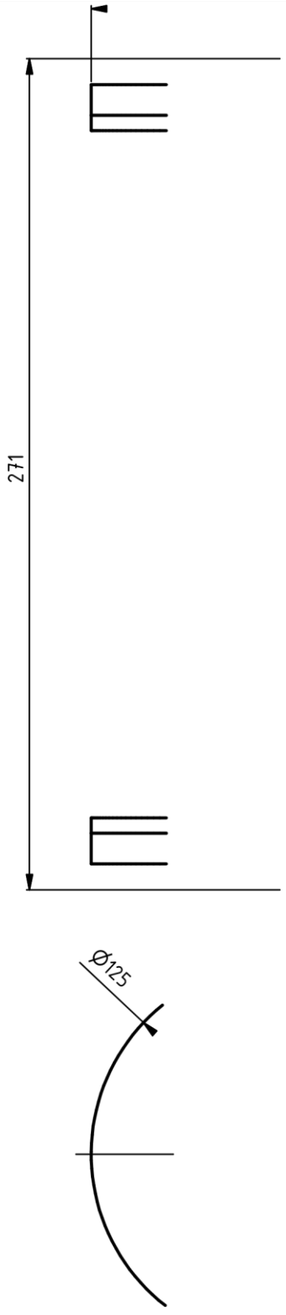
Testing	Inappropriate prototype landing	• Chassis or wheels get damaged.	Possible	Low	Low	• Ensure the rover is launched exactly from the centre middle of the testing ramp.	Low
		• Prototype flips during testing.	Possible	Low	Low	• Design so prototype is still able to roll on wheels if upside down. • Place the payload further behind, so the centre of gravity will change, so the prototype will not flip.	Low
	Payload being ejected from prototype.	• Physical injury.	Rare	Moderate	Moderate	• Tighten the bottle and the egg container for safety purposes before conducting the test. Ensure no one stands in • the landing area.	Low
		• Damage to payload.	Unlikely	Minor	Low	• Test prototype with straps prior to finalising design. • Tighten the bottle and the egg container for safety purposes before conducting the test.	Low

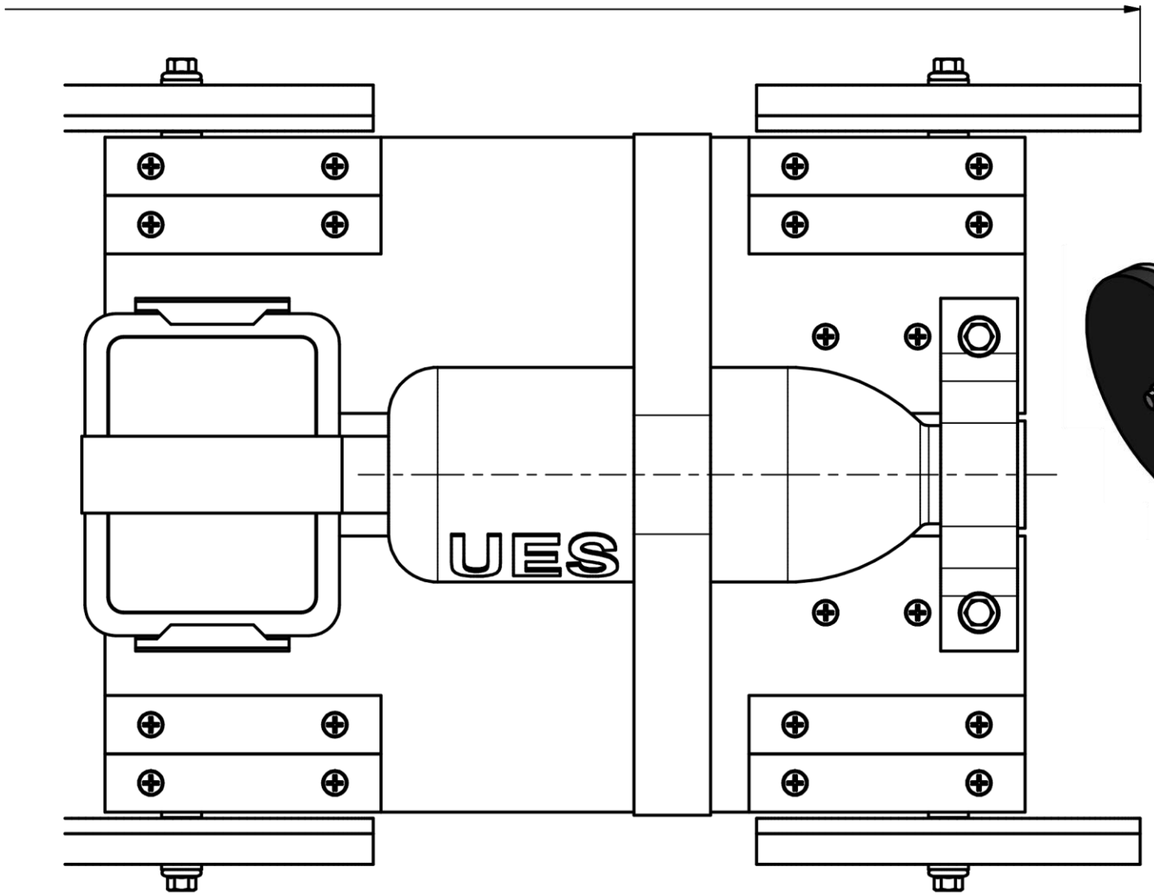
	Prototype fails testing	• Losing marks due to not following the marking criteria.	Possible	Minor	Low	• Build prototype of design and test prior to finalising design. • Use appropriate cushioning to protect egg.	Low

APPENDIX A – DRAWINGS

See next page.

GENERAL NOTES:

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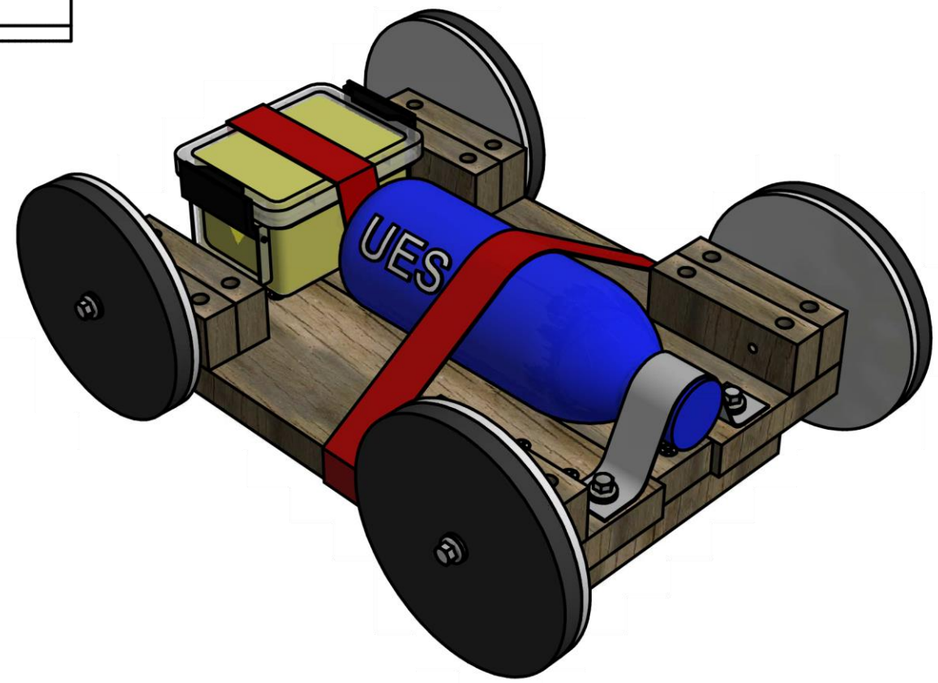
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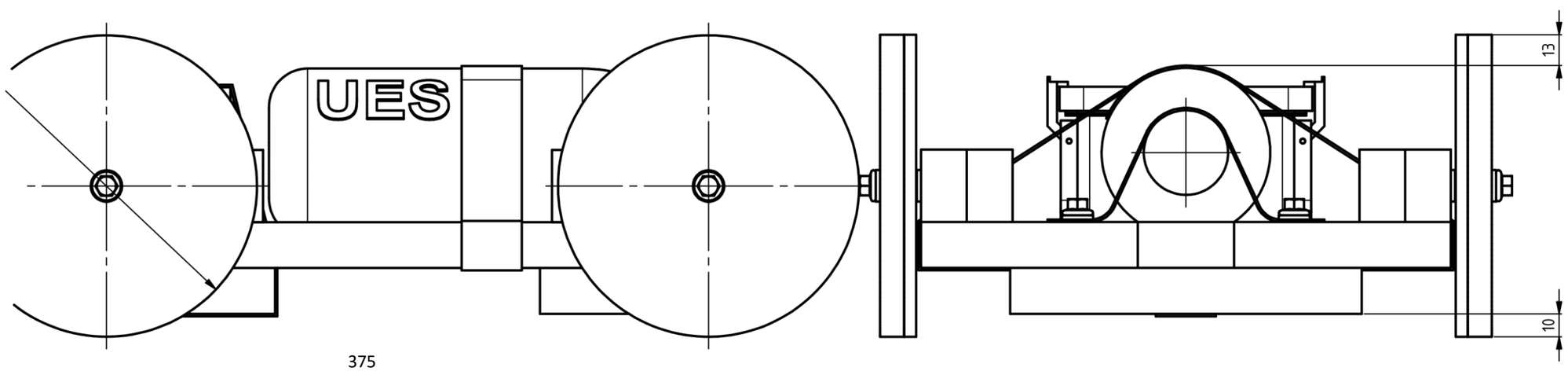

UES
13
10

ALL UNITS ARE IN MILLIMETERS

DO NOT SCALE PRINT	PROJECT MARS LANDER / ROVER
	TITLE CURTIN COLLEGE EFPC GROUP PROJECT

		B	ISSUED FOR TENDER	25-08-18	DK	SP	
		A	ISSUED FOR REVIEW	21-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

UES
United Engineering Solutions

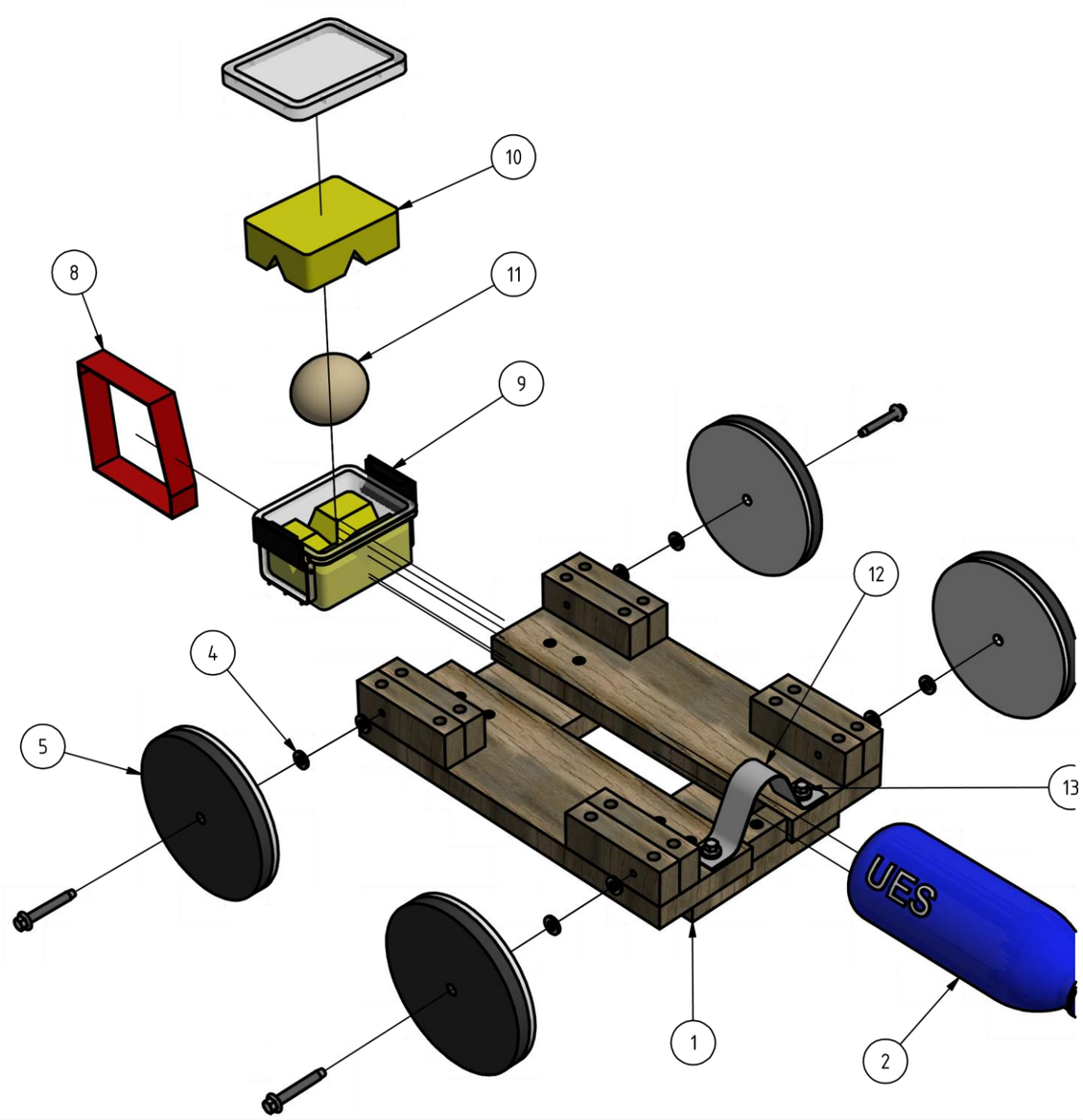
ONE STEP FOR MAN, ONE GIANT STEP FOR UES

GENERAL ARRANGEMENT
CONCEPTUAL VIEWS

SCALE	1 : 2	DRG No. DRAWING 1			B
DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER	A3
DATE	22-Aug-18				

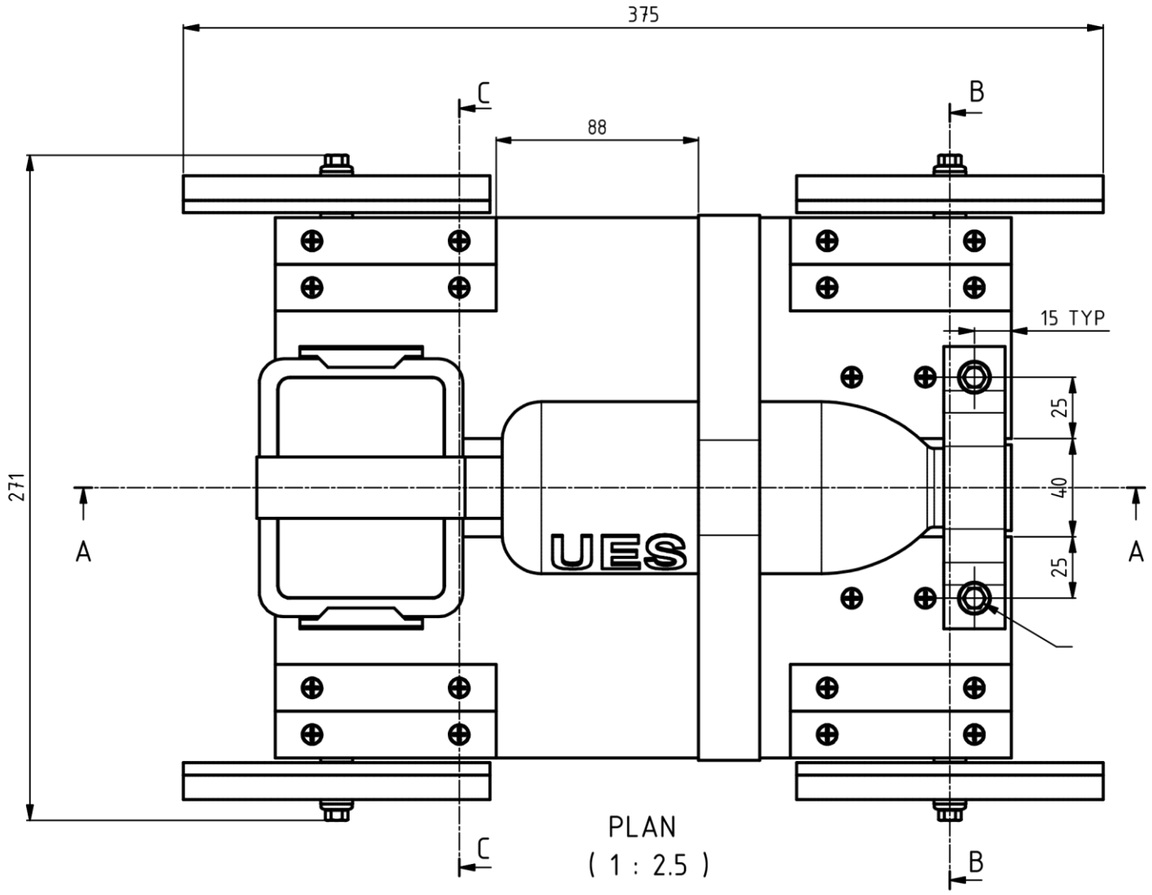
PARTS LIST

ITEM	QTY	PART NUMBER	COMMENTS
1	1	Chassis Assembly	Claymark 89 x 19mm x 1.2m Standard Grade Dressed Pine Sheet
2	1	Waterbottle	Margaret River 600ml
3	4	M6 x 50	Zenith M6 x 50mm Hot Dipped Galvanised Coach Screw
4	10	6 N	Zenith M6 Hot Dipped Galvanised Washer
5	4	Wheel	Felt Gard 125mm Heavy Duty Felt Pad - 4 Pack
7	1	Waterbottle Tie Down	Grunt 25mm x 1m Pull Tie Down Strap - 2 Pack
8	1	Egg Housing Tie Down	Grunt 25mm x 1m Pull Tie Down Strap - 2 Pack
9	1	Egg Storage Mini Box	Handy Storage 260ml Mini Storage Box 120 x 85 x 63mm
10	2	Sponge	Morgan Jumbo Sponge
11	1	Egg	
12	1	Waterbottle Spout Strap	Grunt 25mm x 1m Pull Tie Down Strap (off-cut)
13	2	M6 x 25	Zenith M6 x 25mm Hot Dipped Galvanised Coach Screw

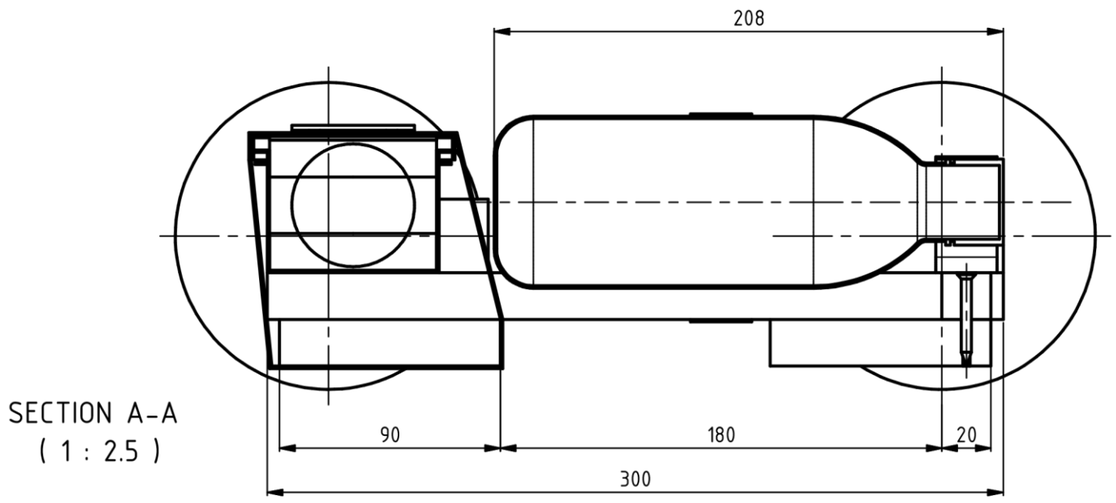


								DO NOT SCALE PRINT	PROJECT MARS LANDER / ROVER			
									TITLE CURTIN COLLEGE EFPC GROUP PROJECT MARKING PLAN ISOMETRIC VIEW			
		B	ISSUED FOR TENDER	25-08-18	DK	SP			SCALE 1 : 4	DRG No. DRAWING 2		B
		A	ISSUED FOR REVIEW	21-08-18	DK	SP			DRAWN Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER	A3
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP	ONE STEP FOR MAN, ONE GIANT STEP FOR UES	DATE 22-Aug-18			

UES
United Engineering Solutions



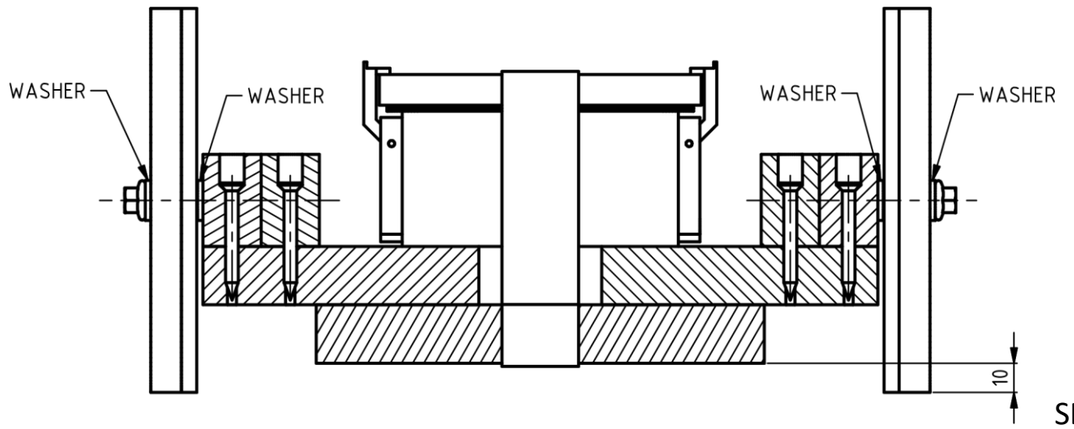
PLAN
(1 : 2.5)



SECTION A-A
(1 : 2.5)

GENERAL NOTES:

ALL UNITS ARE IN MILLIMETERS

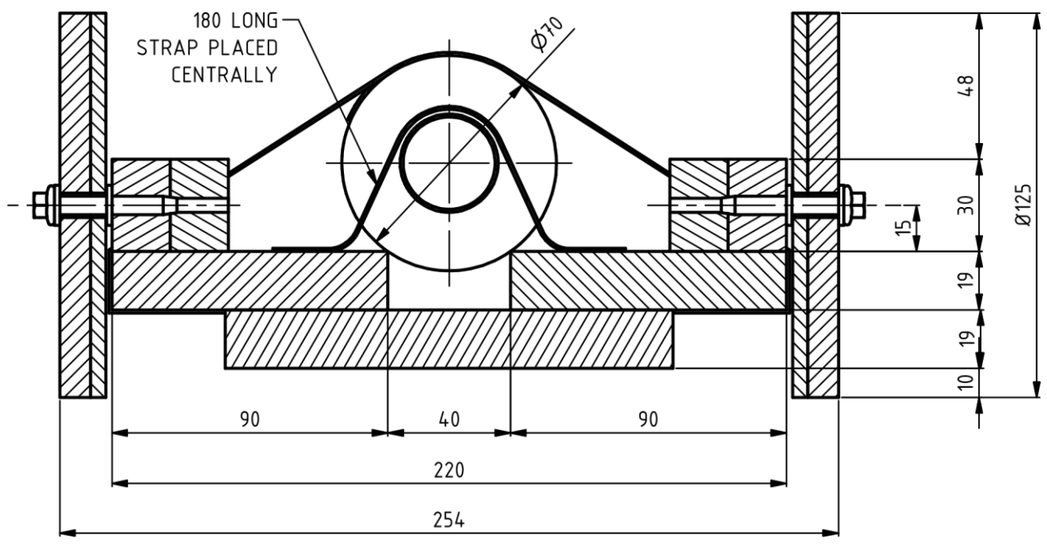


SECTION C-C

(1 : 2)

ENSURE WASHERS ARE INSERTED EITHER SIDE OF EACH WHEEL

WATERBOTTLE STRAP
SECURED WITH ONE
COACH SCREW EITHER SIDE



SECTION B-B

(1 : 2)

DO NOT SCALE PRINT	PROJECT MARS LANDER / ROVER
	TITLE CURTIN COLLEGE EFPC GROUP PROJECT

		B	ISSUED FOR TENDER	25-08-18	DK	SP	
		A	ISSUED FOR REVIEW	21-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

United Engineering Solutions

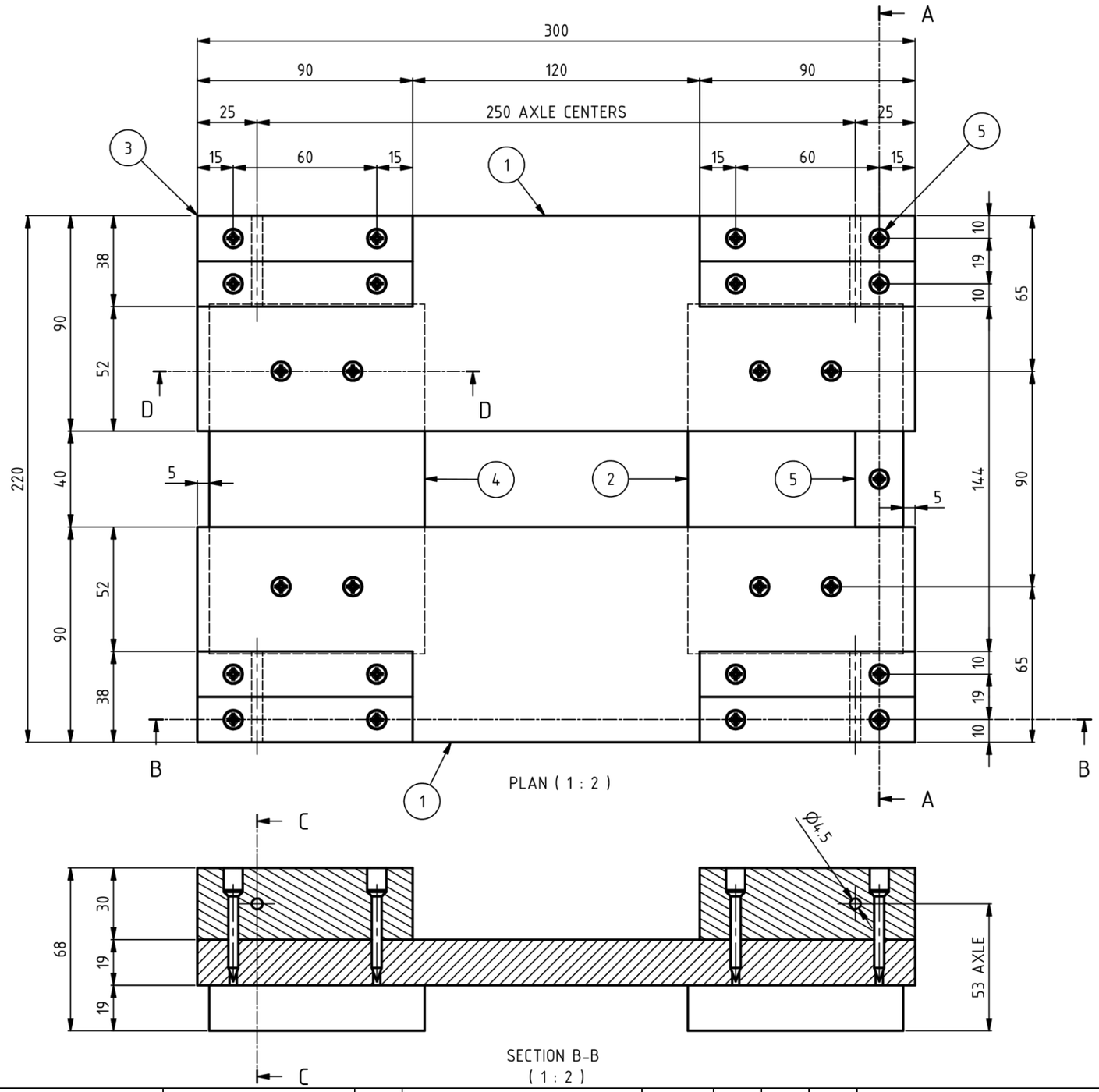
ONE STEP FOR MAN, ONE GIANT STEP FOR UES

ASSEMBLY DETAIL

SCALE	1 : 2.5	DRG No. DRAWING 3			B
DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER	A3
DATE	21-Aug-18				

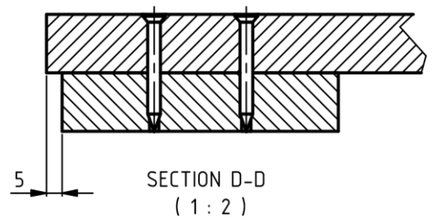
CHASSIS FRAME PARTS LIST

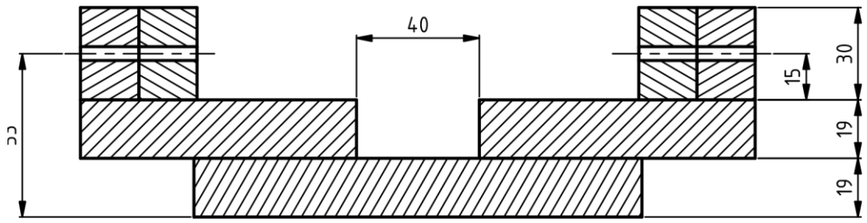
PART NUMBER	QTY	DESCRIPTION
1	2	Claymark 89 x 19mm Standard Grade Dressed Pine
2	1	Claymark 89 x 19mm Standard Grade Dressed Pine
3	8	Claymark 89 x 19mm Standard Grade Dressed Pine
4	1	Claymark 89 x 19mm Standard Grade Dressed Pine
5	1	Claymark 89 x 19mm Standard Grade Dressed Pine
SCREWS	25	Zenith 8 - 10g x 40mm Treated Pine Screw - 25 Pack

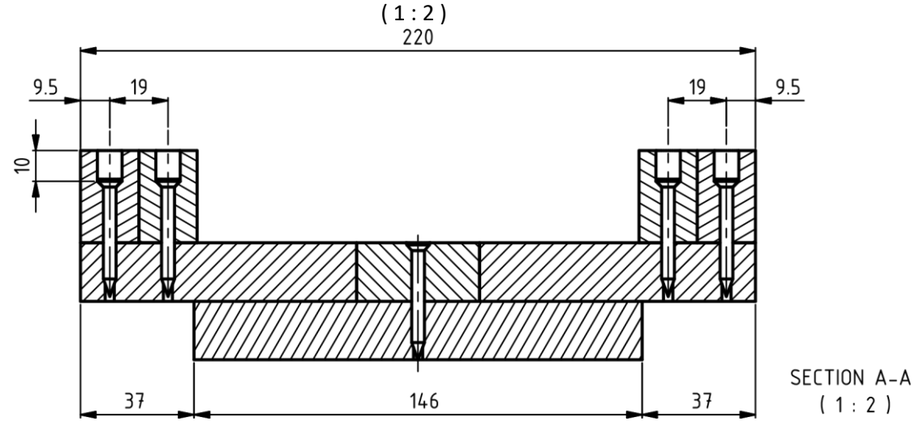


GENERAL NOTES:

ALL UNITS ARE IN MILLIMETERS







DO NOT SCALE PRINT	PROJECT MARS LANDER / ROVER
	TITLE CURTIN COLLEGE EFPC GROUP PROJECT CHASSIS FRAME ASSEMBLY DETAIL

		B	ISSUED FOR TENDER	25-08-18	DK	SP	
		A	ISSUED FOR REVIEW	21-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

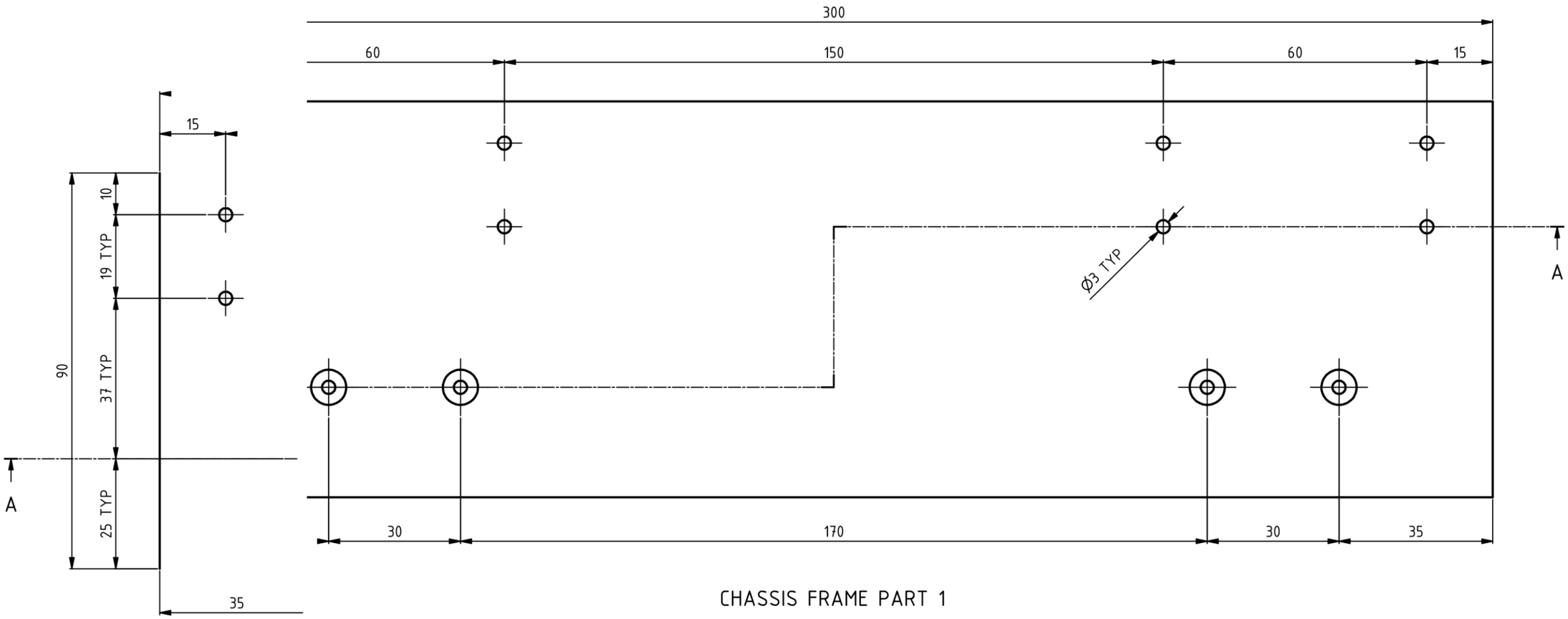
UES
United Engineering Solutions

ONE STEP FOR MAN, ONE GIANT STEP FOR UES

SCALE	1 : 2	DRG No. DRAWING 4		B
DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER
DATE	22-Aug-18			A3

GENERAL NOTES:

ALL UNITS ARE IN MILLIMETERS



CHASSIS FRAME PART 1

SECTION A-A

UES
United Engineering Solutions

DO NOT SCALE PRINT

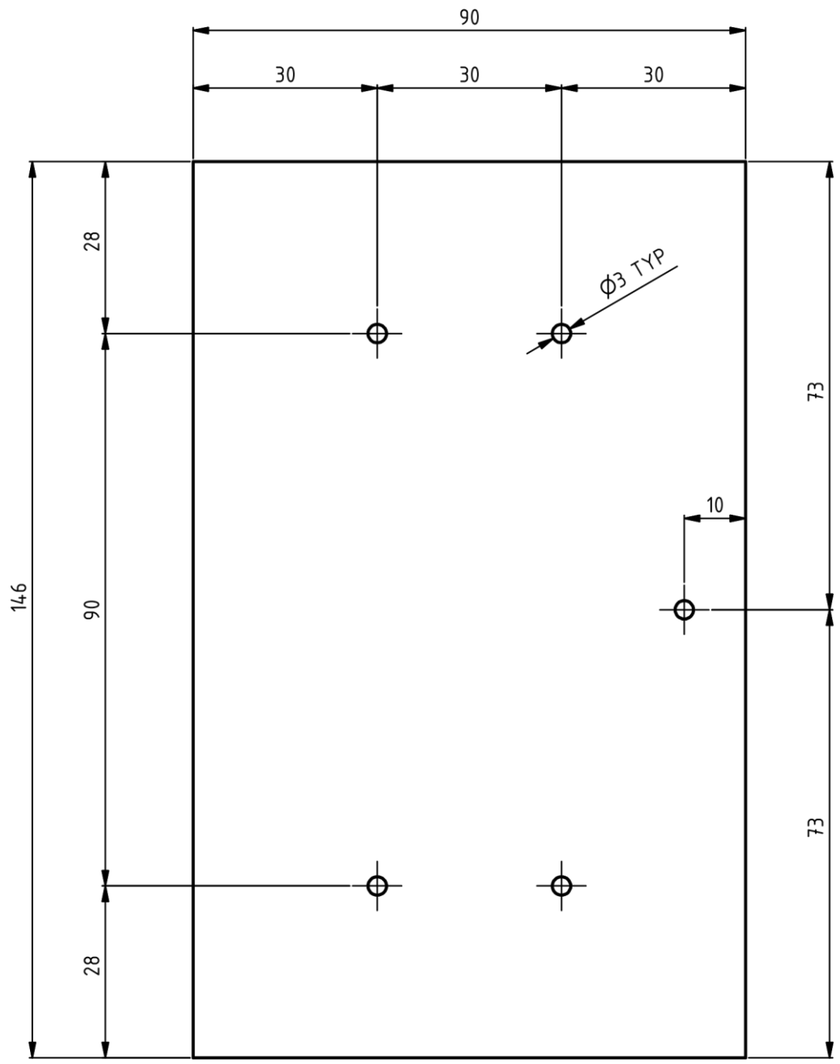
PROJECT MARS LANDER / ROVER

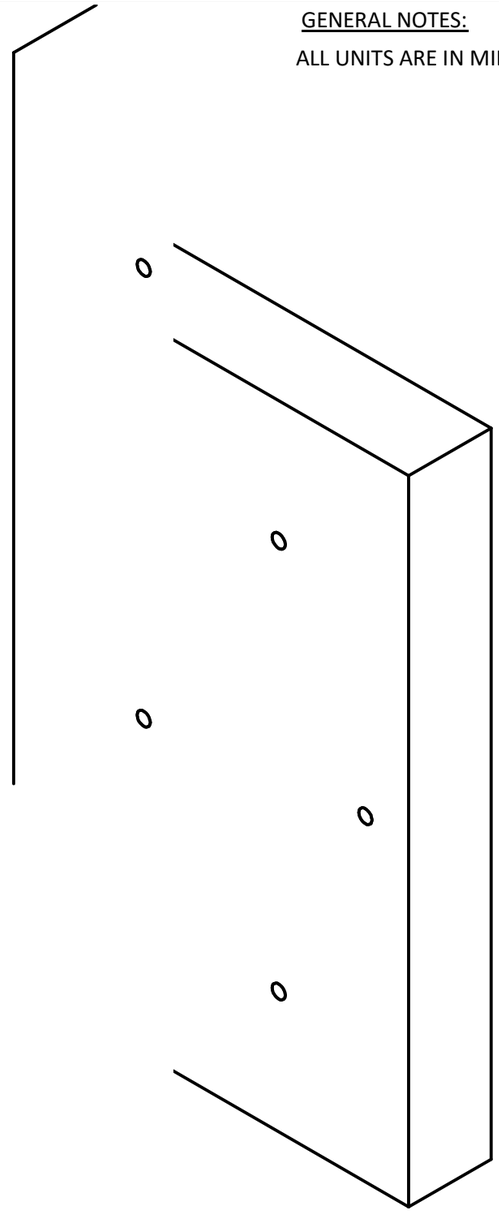
TITLE CURTIN COLLEGE
EFPC GROUP PROJECT
CHASSIS FRAME
PART DETAIL

		B	ISSUED FOR TENDER	25-08-18	DK	SP		ONE STEP FOR MAN, ONE GIANT STEP FOR UES	SCALE	1 : 1	DRG No. DRAWING 5			B
		A	ISSUED FOR REVIEW	21-08-18	DK	SP			DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER	A3
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP		DATE	22-Aug-18				

GENERAL NOTES:

ALL UNITS ARE IN MILLIMETERS





CHASSIS FRAME PART 2.ipt

DO NOT SCALE PRINT	PROJECT MARS LANDER / ROVER
	TITLE CURTIN COLLEGE EFPC GROUP PROJECT

		B	ISSUED FOR TENDER	25-08-18	DK	SP	
		A	ISSUED FOR REVIEW	21-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

UES
United Engineering Solutions

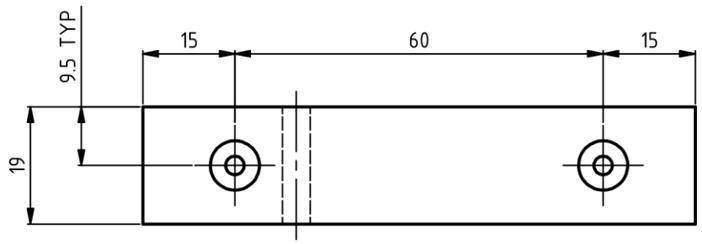
ONE STEP FOR MAN, ONE GIANT STEP FOR UES

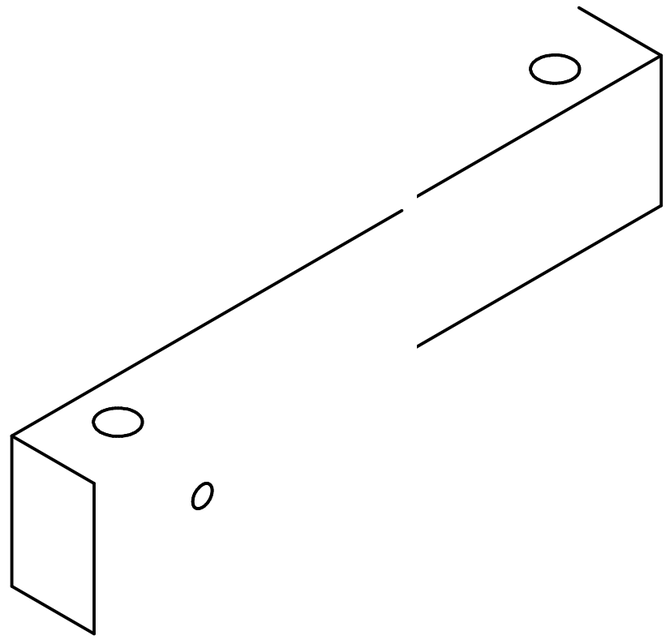
CHASSIS FRAME
PART DETAIL

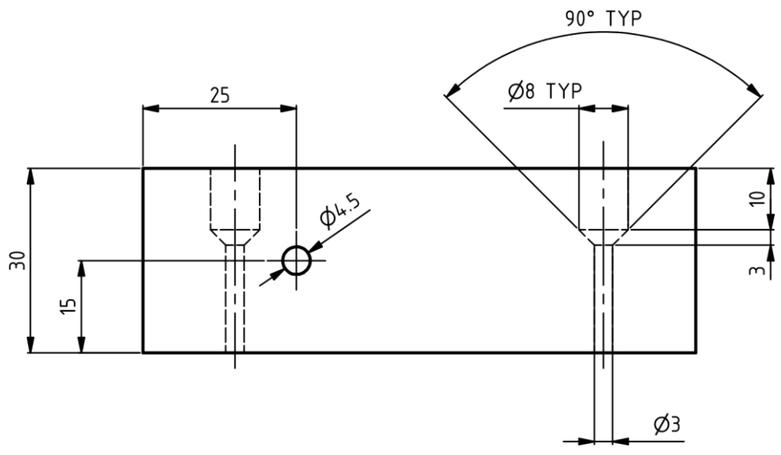
SCALE	1 : 1	DRG No. DRAWING 6			B
DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER	A3
DATE	22-Aug-18				

GENERAL NOTES:

ALL UNITS ARE IN MILLIMETERS







CHASSIS FRAME PART 3.ipt

DO NOT SCALE PRINT	PROJECT MARS LANDER / ROVER
	TITLE CURTIN COLLEGE EFPC GROUP PROJECT

		B	ISSUED FOR TENDER	25-08-18	DK	SP	
		A	ISSUED FOR REVIEW	21-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

UES
United Engineering Solutions

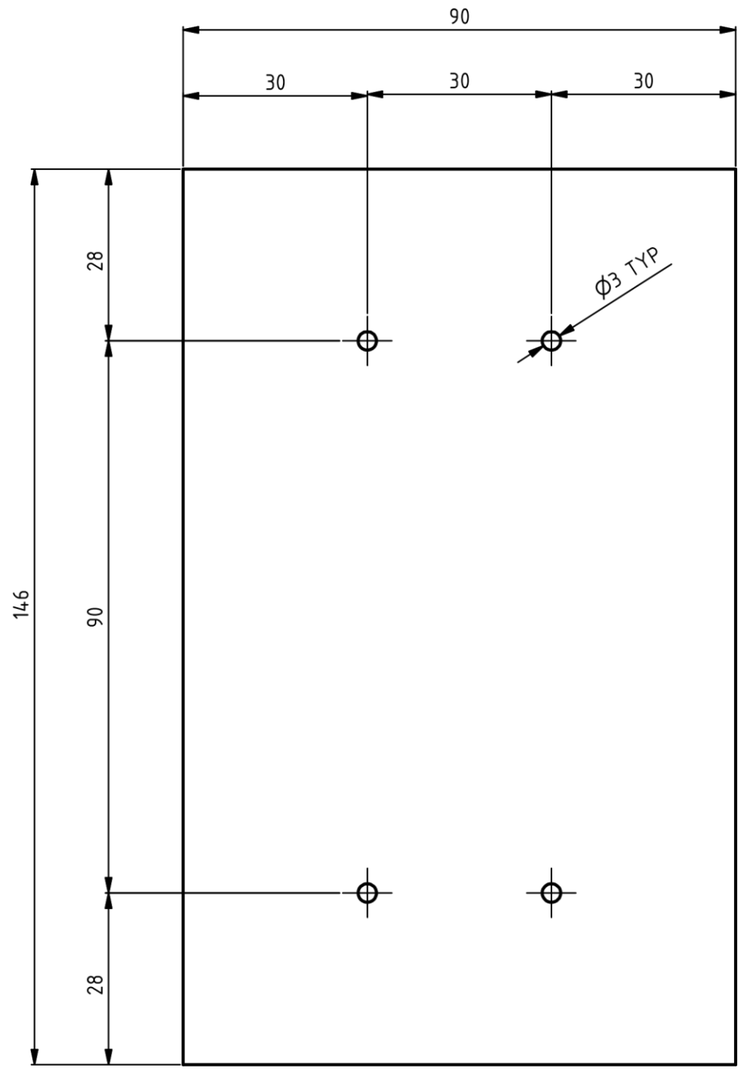
ONE STEP FOR MAN, ONE GIANT STEP FOR UES

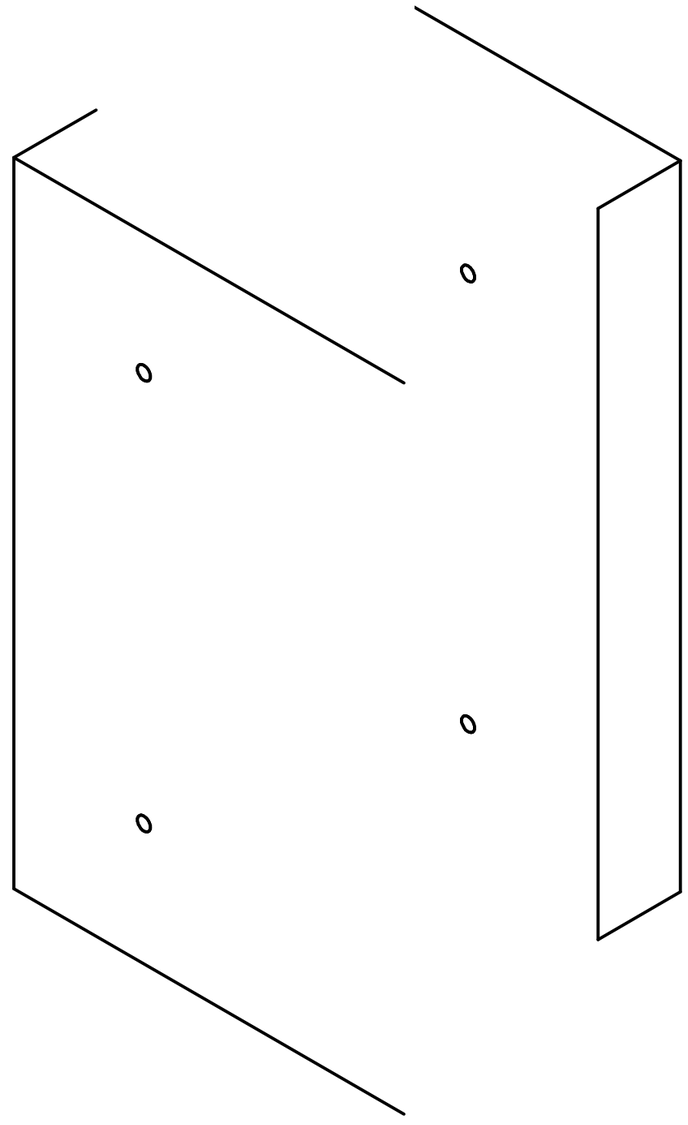
CHASSIS
FRAME PART
DETAIL

SCALE	1 : 1	DRG No. DRAWING 7		B
DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER
DATE	22-Aug-18			A3

GENERAL NOTES:

ALL UNITS ARE IN MILLIMETERS





CHASSIS FRAME PART 4.ipt

DO NOT SCALE PRINT	PROJECT MARS LANDER / ROVER
	TITLE CURTIN COLLEGE EFPC GROUP PROJECT

		B	ISSUED FOR TENDER	25-08-18	DK	SP	
		A	ISSUED FOR REVIEW	21-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

UES
United Engineering Solutions

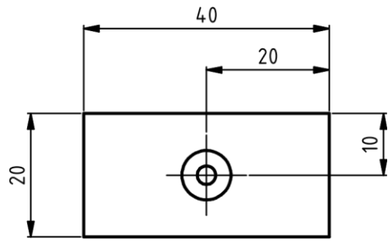
ONE STEP FOR MAN, ONE GIANT STEP FOR UES

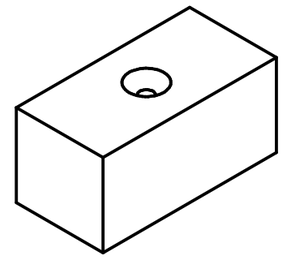
CHASSIS
FRAME PART
DETAIL

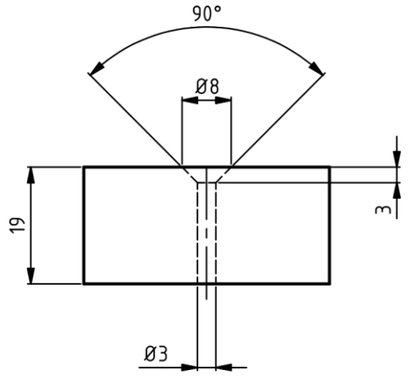
SCALE	1 : 1	DRG No. DRAWING 8		B
DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER
DATE	22-Aug-18			A3

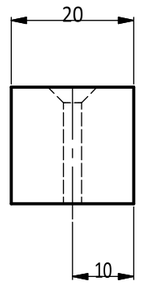
GENERAL NOTES:

ALL UNITS ARE IN MILLIMETERS









CHASSIS FRAME PART 5.ipt

DO NOT SCALE PRINT	PROJECT MARS LANDER / ROVER
	TITLE CURTIN COLLEGE

		B	ISSUED FOR TENDER	25-08-18	DK	SP	
		A	ISSUED FOR REVIEW	21-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

UES
United Engineering Solutions

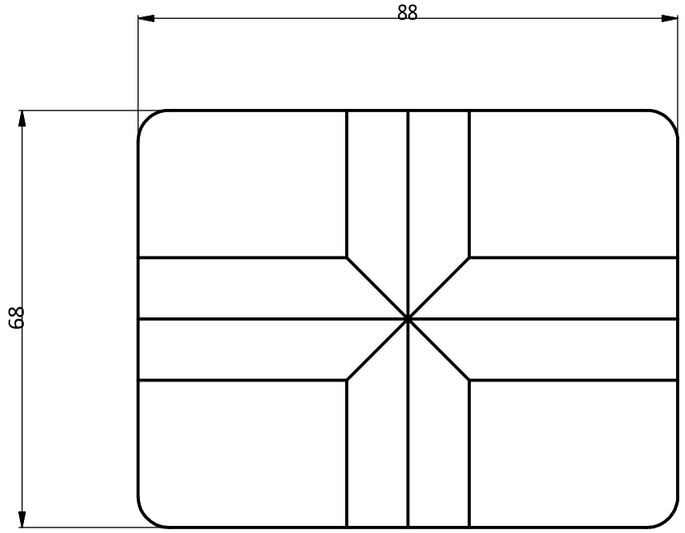
ONE STEP FOR MAN, ONE GIANT STEP FOR UES

EFPC GROUP PROJECT
CHASSIS FRAME
PART DETAIL

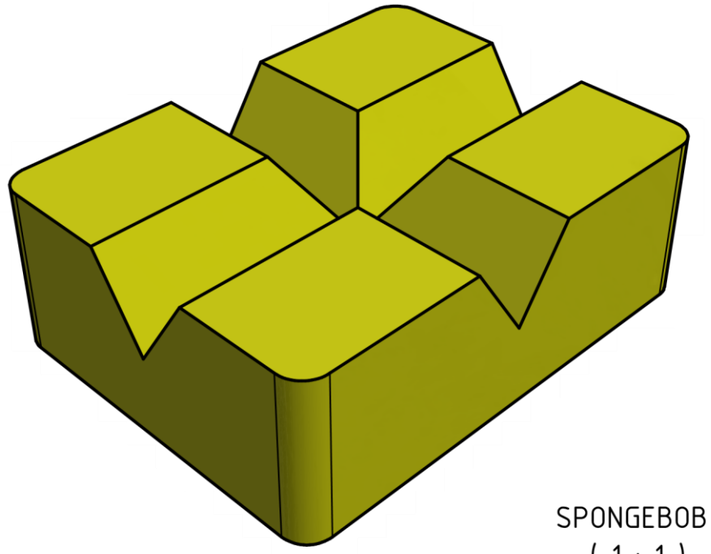
SCALE	1 : 1	DRG No. DRAWING 9			B
DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER	A3
DATE	22-Aug-18				

GENERAL NOTES:

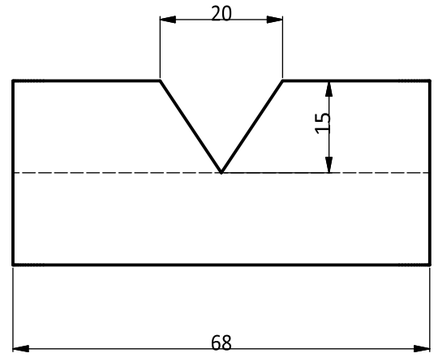
ALL UNITS ARE IN MILLIMETERS

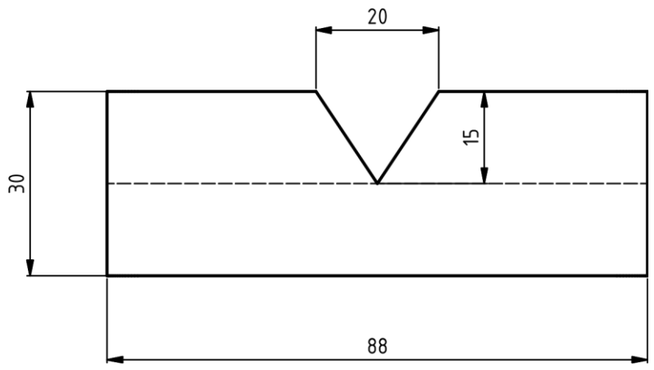


Container Sponge.ipt



SPONGEBOB
(1 : 1)





		B	ISSUED FOR TENDER	25-08-18	DK	SP	

United Engineering Solutions

ONE STEP FOR MAN, ONE GIANT STEP FOR UES

DO NOT SCALE PRINT		PROJECT MARS LANDER / ROVER	
		TITLE CURTIN COLLEGE EFPC GROUP PROJECT CRASH PROTECTION SPONGE DETAIL	
SCALE	1 : 1	DRG No. DRAWING 10	B

		A	ISSUED FOR REVIEW	25-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER
DATE	23-Aug-18			

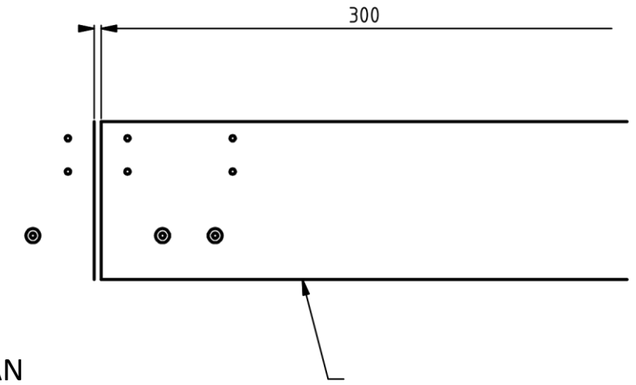
A3

GENERAL NOTES:

1200

PART NUMBER
1
2
3
4
5

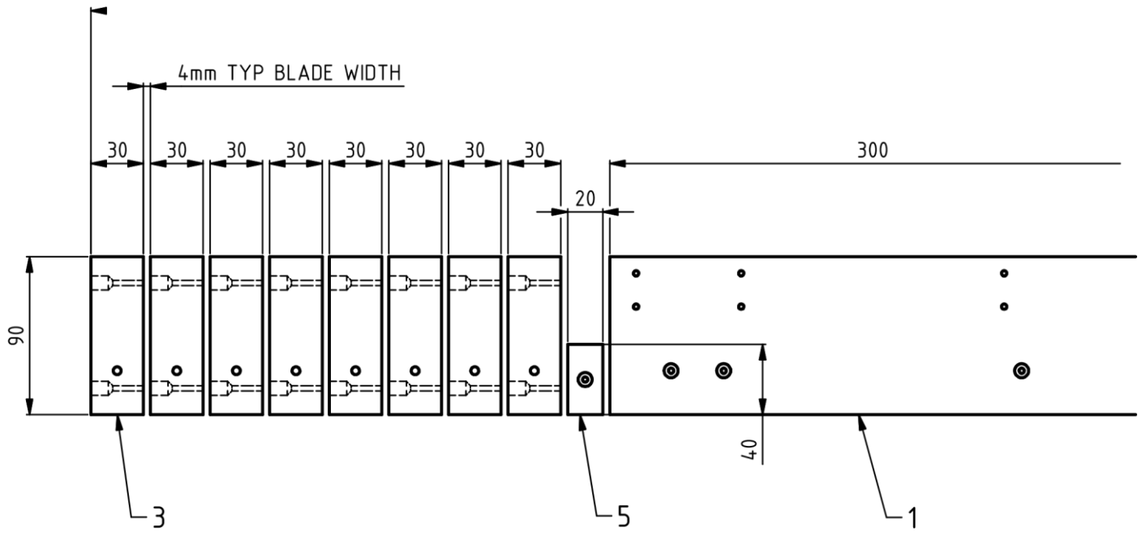
ALL UNITS ARE IN MILLIMETERS



CUTTING PLAN

(1 : 3.5)

1



		B	ISSUED FOR TENDER	25-08-18	DK	SP	
		A	ISSUED FOR REVIEW	25-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

UES
United Engineering Solutions

ONE STEP FOR MAN, ONE GIANT STEP FOR UES

DO NOT

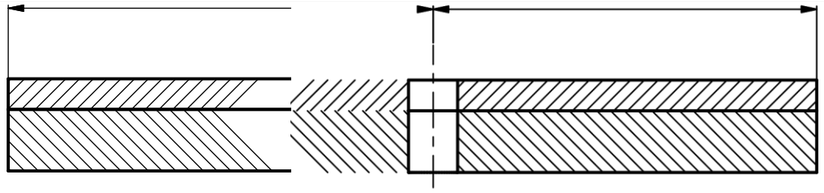
SCALE

DRAWN

DATE

GENERAL NOTES:

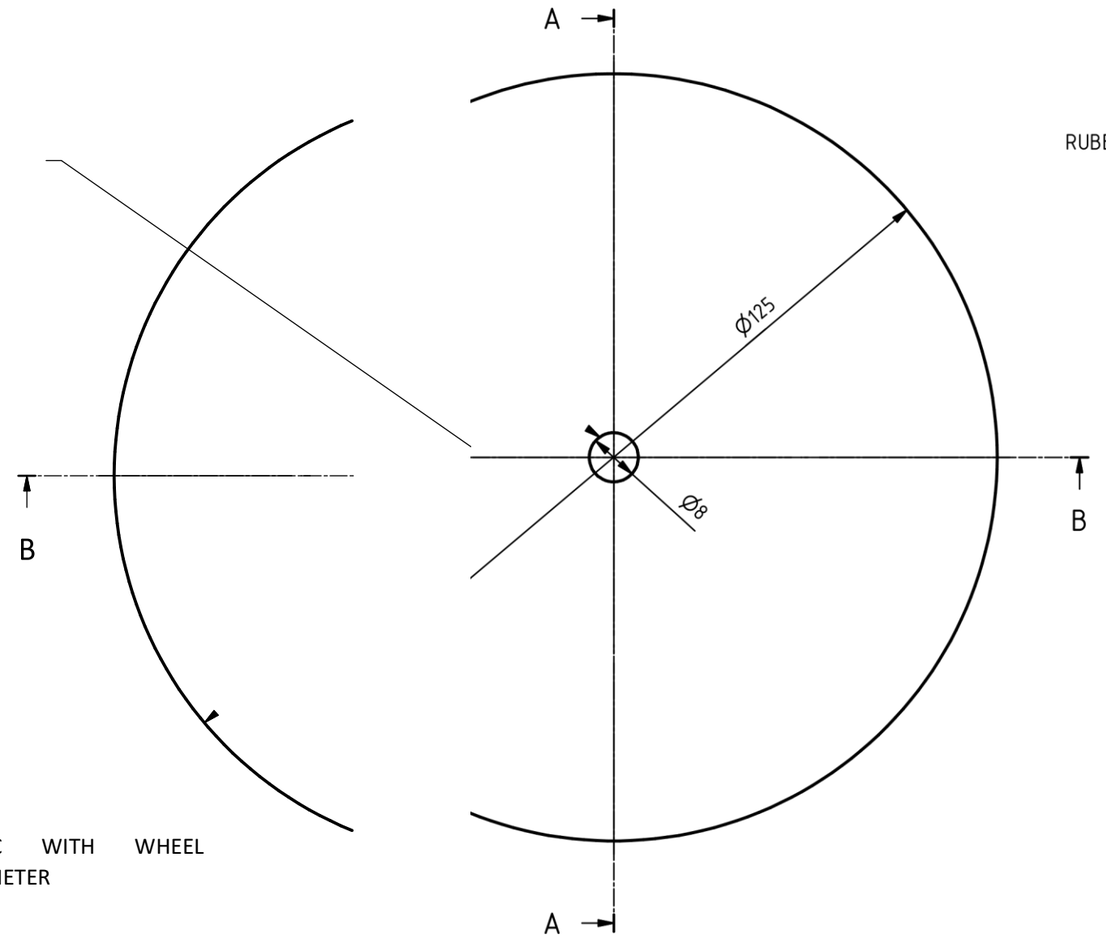
ALL UNITS ARE IN MILLIMETERS



SECTION B-B
(1 : 1)

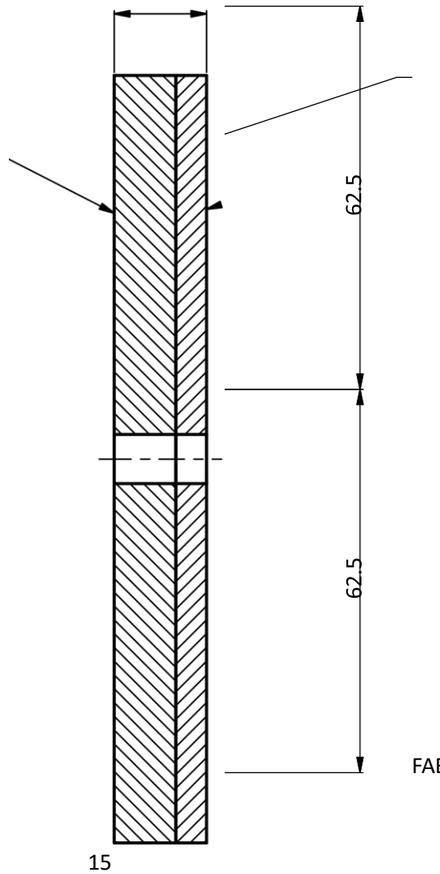
62.5

ENSURE HOLE IS DRILLED CENTRAL TO WITHIN ±0.5mm AND



CONCENTRIC WITH WHEEL OUTER DIAMETER

RUBBER SIDE



FABRIC SIDE

SECTION A-A
(1 : 1)

DO NOT SCALE PRINT	PROJECT MARS LANDER / ROVER
	TITLE CURTIN COLLEGE EFPC GROUP PROJECT

		B	ISSUED FOR TENDER	25-08-18	DK	SP	
		A	ISSUED FOR REVIEW	21-08-18	DK	SP	
REFERENCE DRAWING	DESCRIPTION	REV	DESCRIPTION	DATE	DRN	CHK	APP

UES
United Engineering Solutions

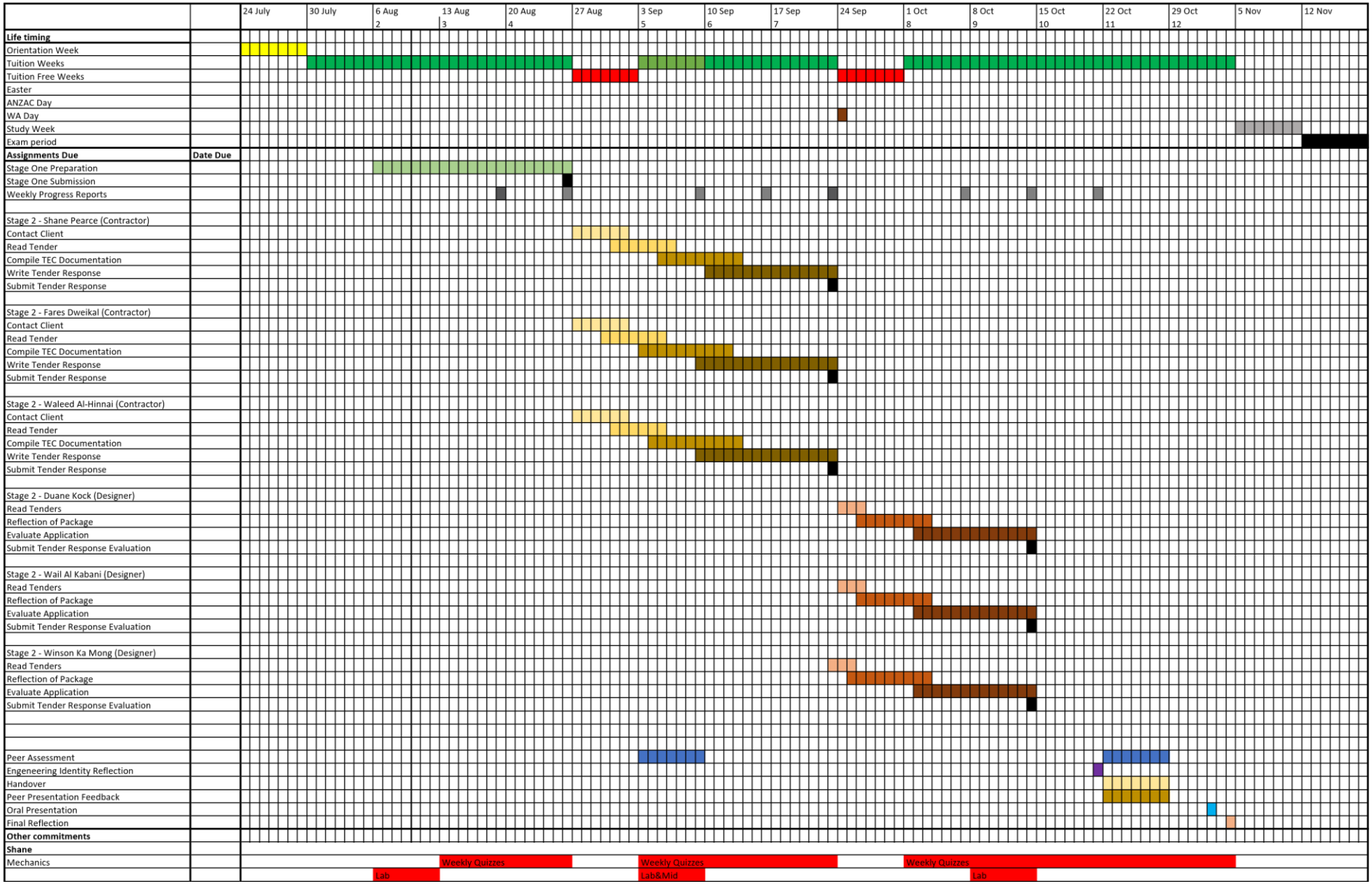
ONE STEP FOR MAN, ONE GIANT STEP FOR UES

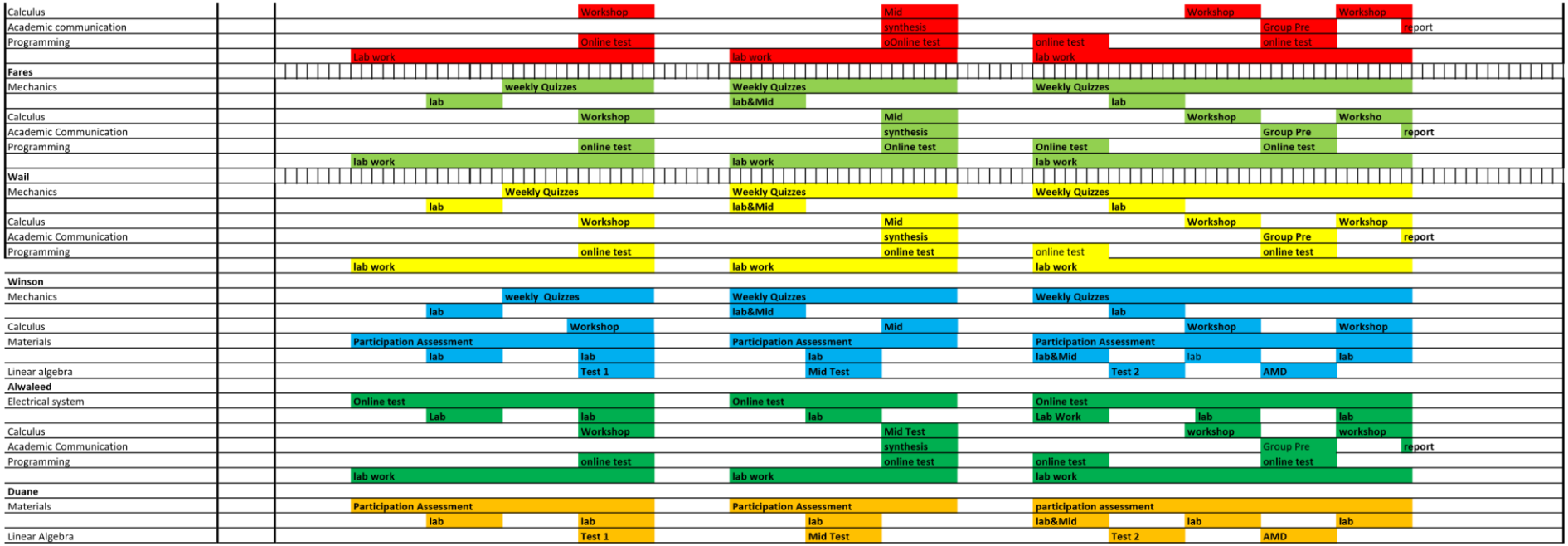
CHASSIS FRAME
WHEEL DETAIL

SCALE	1 : 1	DRG No. DRAWING 12			B
DRAWN	Duane Kock	CHECKED S.PEARCE	ENG. APPROVED	PROJECT MANAGER	A3
DATE	22-Aug-18				

APPENDIX B – GANT CHART

See next page.


24 July
30 July
6 Aug
2
13 Aug
3
20 Aug
4
27 Aug
3 Sep
5
10 Sep
6
17 Sep
7
24 Sep
1 Oct
8
8 Oct
9
15 Oct
10
22 Oct
11
29 Oct
12
5 Nov
12 Nov
Life timing
Orientation Week
Tuition Weeks
Tuition Free Weeks
Easter
ANZAC Day
WA Day
Study Week
Exam period
Assignments Due
Date Due
Stage One Preparation
Stage One Submission
Weekly Progress Reports
Stage 2 - Shane Pearce (Contractor)
Contact Client
Read Tender
Compile TEC Documentation
Write Tender Response
Submit Tender Response
Stage 2 - Fares Dweikal (Contractor)
Contact Client
Read Tender
Compile TEC Documentation
Write Tender Response
Submit Tender Response
Stage 2 - Waleed Al-Hinnai (Contractor)
Contact Client
Read Tender
Compile TEC Documentation
Write Tender Response
Submit Tender Response
Stage 2 - Duane Kock (Designer)
Read Tenders
Reflection of Package
Evaluate Application
Submit Tender Response Evaluation
Stage 2 - Wail Al Kabani (Designer)
Read Tenders
Reflection of Package
Evaluate Application
Submit Tender Response Evaluation
Stage 2 - Winson Ka Mong (Designer)
Read Tenders
Reflection of Package
Evaluate Application
Submit Tender Response Evaluation
Peer Assessment
Engeneering Identity Reflection
Handover
Peer Presentation Feedback
Oral Presentation
Final Reflection
Other commitments
Shane
Mechanics
Weekly Quizzes
Weekly Quizzes
Weekly Quizzes
Lab
Lab&Mid
Lab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Participation Assessment
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Test 2
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Test 2
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