Where Tomorrow



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Industrial Design 300, Open Window 2026



TECHNICAL RESEARCH REPORT

Where Tomorrow

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Figure 1: *Liam Cloete, Where Tomorrow, studio render, 2026.*

Introduction

A clock suits that question better than any other piece of furniture, because its whole job is to show time passing.

My family motto is Ubi cras, Latin for "where is tomorrow?". It appears on Cloete family seals from 1826, and the surname has been written at least four ways: Cloete, Kloete, Kloote and Kloeten. The old word kloot also means a ball. I started the heirloom from those three facts: an object that asks where tomorrow is every time someone looks at it. A clock suits that question better than any other piece of furniture, because its whole job is to show time passing. But I did not want a clock that only tells the time. I wanted it to keep a visible record of the years it has been used, so whoever inherits it can see how long it has been in the family.

The ID300 Project 4 brief asks for a personal future heirloom, made at full size (Open Window, 2026). It is framed around circular design, so the object has to be built to last using the lifespan-extension strategies the brief takes from Bakker et al. (2019). I chose three of them to lead with. The full brief is in Appendix A (Figures 41 to 62).

The result is Where Tomorrow, a wall clock with a single hour hand that is not attached to anything. The hand is a Ø16 mm steel ball resting on the front of a Ø490 × 1.6 mm half-hard copper face. A small stepper motor turns an arm once every 12 hours, and its magnet drags the ball round the face through the copper. In front of the copper sits a Ø406 mm glass veil, 4 mm thick. Its satin face softens the copper, and a clear 22° wedge lets you see the ball. Over the years the ball should polish a fine bright line into the copper while the rest of the face darkens, so the clock records its own use.

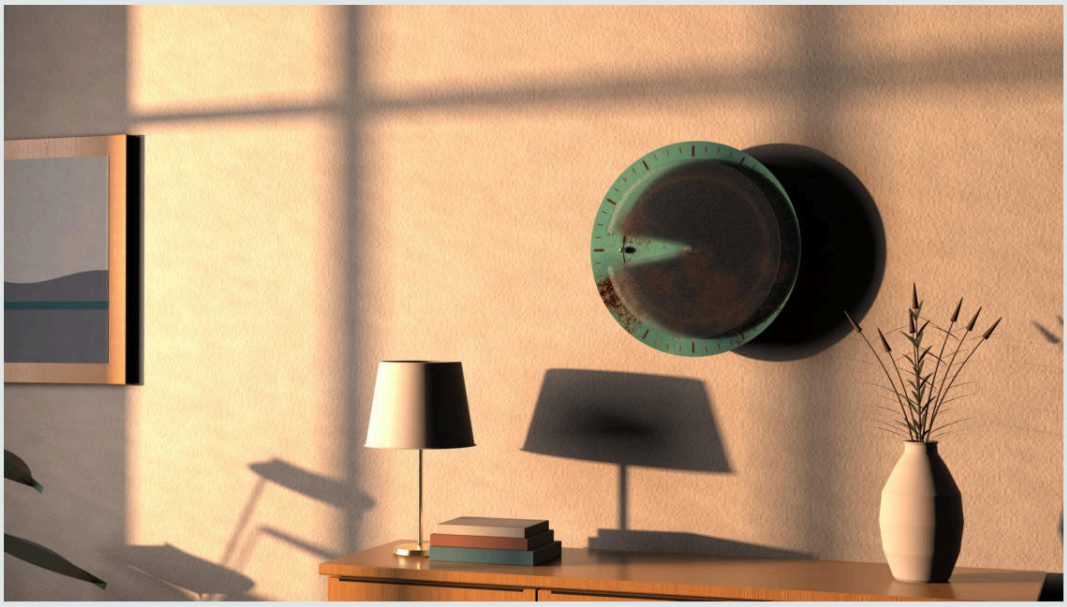


Figure 2: *Liam Cloete, Where Tomorrow on a living-room wall in the evening, render, 2026.*

Design Analysis / Methodology

The motto asks a question instead of stating a fact, and the four spellings of our surname suggest a family that moved and changed as it went. I wanted the clock to behave the same way: the ball wanders slowly round the face and leaves a trace of where it has been. My position is that patina is a record, not damage, and that a clock that shows its age honestly is worth more to the next keeper than one that still looks new. The project was called Palimpsest for a while, after a manuscript page scraped clean and written over. On 11 October I renamed it Where Tomorrow, the English of the motto.

I worked in the order research, ideas, concept choice, CAD, testing and build, with dates set by the class programme and by suppliers. One date cut across all of it: on 2 November, when I glued the drum on the former, the third ply cracked, so I repaired it with wood glue, steamed it and glued it again. The drum has three plies.

My early lead was UNSETTLED, a wandering brass hand on a dial. On 1 October I replaced it with the magnetic arm, because then the ball could move with no visible mechanism. Two more things changed along the way. The first drive was a bought quartz movement, but it stalled at about 20 to 30 mN·m, so I switched to a 28BYJ-48 stepper rated at about 29 to 34 mN·m. And on 19 October the drum went from four 1.5 mm plies with a veneer to three 2 mm plies with no veneer, finished only with oil.

My process loosely follows the human-centred design cycle in ISO 9241-210 (International Organization for Standardization [ISO], 2019): understand the context of use, specify what users need, produce design solutions, and evaluate them against those needs, repeating where necessary. The standard is written for interactive systems, so I use it as a frame for the order of my work and do not claim the clock complies with it.

I gathered information in five ways. The survey gave me the views of 19 people. I asked 15 suppliers for quotes, which is how the copper face came down from R4,560 (excluding VAT) for a 600 × 1,800 mm sheet to R920 for a circle cut to size. At the makerspace I cut perspex test strips on the K40 laser, and I drilled the copper face by hand. I measured parts myself, for example the shaft rod at 5.00 to 5.04 mm with a hand caliper. And I calculated what I could not yet test: the bending strain in the drum, the magnet pull, the motor torque and the wall loads. A separate design review on 26 October checked those calculations (see Appendix D).



Research and Information Synthesis

7 User Research: Survey
7 User Profile
8 Design Strategy: Lifespan Extension
8 Market Research: Precedents

User Research: Survey

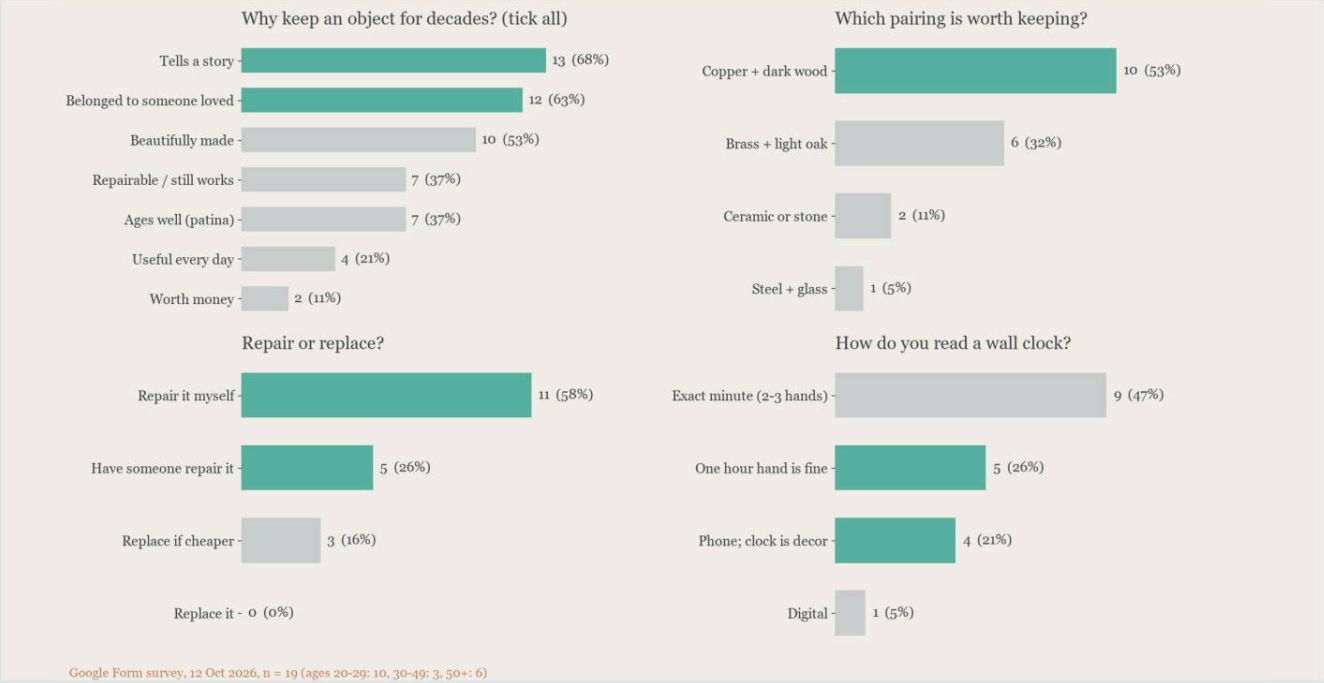


Figure 3: *Liam Cloete, Survey results, n = 19, 2026.*

To find out what makes people keep an object for decades, I ran a short Google Form survey on 12 October 2026. Nineteen people answered: ten aged 20 to 29, three aged 30 to 49 and six aged 50 and over. The questionnaire is in Appendix B and the results are in Figure 3 and Table 1.

Thirteen of the 19 keep an object because it tells a story, 12 because it belonged to someone they loved and 10 because it is beautifully made. Ten chose copper with dark wood as the pairing worth keeping, ahead of brass with light oak (6). Sixteen would repair a broken object, 11 themselves and 5 by paying someone else. Three would replace it if that were cheaper, and nobody chose to simply replace it. On reading the clock, nine wanted the exact minute. Nine others were happy with a single hour hand (5) or treat a clock as decoration and read the time on their phone (4).

Nineteen people is a small sample, and it is a convenience sample of people I could reach, so the numbers show a direction and prove nothing. In my 13 October presentation I said 63 % of people find that wear makes things more special. That was wrong: the 63 % (12 of 19) chose "belonged to someone loved". I have corrected it here. I also leave out the quiet-clock and willingness-to-pay figures from that presentation, because they are not on the survey chart.

The survey shaped three decisions. Story and family were the strongest reasons for keeping something (13 and 12 of 19), so I put the attachment into the object: the family motto, the polished path, and a handover ritual in which each new keeper can re-fume the copper. Copper with dark wood was the most chosen pairing (10 of 19), which backed the copper face and blackwood drum I was already leaning towards. And 16 of 19 would rather repair than replace, so parts that may need service are screwed rather than glued, and the motor, arm and electronics come off the back panel together.

User Profile

The main user is the keeper: a member of my family who hangs the clock in a living room, reads it in passing from across the room, looks after it, and will one day hand it on.

The second user is the repairer: whoever opens the clock in twenty or thirty years when the cell or the motor wears out.

The clock shows the time by position, not by colour or numerals: a polished steel ball on a Ø490 mm face, read against the tick marks. Someone with colour vision deficiency reads it in the same way as anyone else, because

the cue is a bright point against a darker, matt patina, not a change of colour.

Design Strategy: Lifespan Extension

The brief lists six strategies for extending a product's life, taken from Products that last (Bakker et al., 2019; Open Window, 2026). I led with attachment, durability and repair, because an heirloom has to survive changes in taste as well as years of wear. Mugge et al. (2005) argue that a strong bond between person and product can postpone replacement, especially when the product feels irreplaceable, which is what an heirloom depends on. Chapman (2005) makes a similar case for designing objects people stay emotionally attached to, and Bakker et al. (2014) look at product life extension through design more broadly. Table 2 maps all six strategies onto the clock.

For attachment, the clock carries the family motto and changes with use. For durability, the face is 1.6 mm copper, the drum is plies of blackwood bent and glued into a closed ring, and the veil is 4 mm glass. For repair, the motor, arm and electronics are screwed in place, and the bearings, spacers, screws and motor are standard parts that can be bought again (Table 4). Adaptability is the weakest: the firmware leaves room for a homing sensor that is not fitted, and nothing else is designed to be upgraded. I also have to be honest that some joints are permanent. Those parts are meant to last rather than to be taken apart.

Market Research: Precedents

The closest precedent I found is Troy Hawkins' magnetic wall clock, featured on the Arduino blog in 2020 (Arduino Team, 2020; Figure 4). It shows the mechanism works, so the magnet trick alone is not new. Where Tomorrow differs in four ways. The ball runs on copper instead of wood, so its path becomes a polished record. A glass veil softens the face and shows the ball through a clear wedge. There is only one hand. And the clock is built to be handed on, with a ritual for re-fuming the face.

The second precedent (Figure 5) is the Bradley timepiece by Eone (2013), a watch where two magnetically driven ball bearings, one on the face and one on the side, mark the minutes and hours so the time can be read by touch. It uses the same trick as my clock, a ball moved by a hidden magnet, for a different reason. Bradley is about reading without sight; mine is about a visible record of use. My presentation also named "Skål's Tempo", which I have dropped because I could not confirm a clock under that name.

People keep objects for the story they carry and the person they came from, and most of the people I asked would rather repair something than replace it, so a product lasts longest when it is both cared about and repairable. Copper ages slowly indoors, so a face that is fumed once and then polished by the ball over decades becomes a record that each keeper adds to. Hawkins' clock and the Bradley watch show that the mechanism already works; what my clock adds is the record and the ritual of handing it on.



Figure 4: *Troy Hawkins, magnetic wall clock, 2020. Image: Arduino Blog.*



Figure 5: *Eone, Bradley timepiece, 2013. Image: Eone.*

QUESTION	ANSWER	COUNT (N = 19)
Why keep an object for decades?	It tells a story	13
	It belonged to someone I loved	12
	It is beautifully made	10
	It is repairable and still works	7
	It ages well (patina)	7
	It is useful every day	4
	It is worth money	2
Which pairing would you keep?	Copper with dark wood	10
	Brass with light oak	6
	Ceramic or stone	2
	Steel with glass	1
Repair or replace?	Repair it myself	11
	Have someone repair it	5
	Replace it if that is cheaper	3
	Replace it	0
How do you read a wall clock?	I want the exact minute	9
	One hour hand is enough	5
	Decoration, I use my phone	4
	Digital	1

Table 1: *Survey answers (Google Form, 12 October 2026, n = 19). Respondents could tick more than one reason in the first question.*

STRATEGY	HOW THE CLOCK USES IT	STRENGTH
Attachment and trust	Family motto; copper darkens and the ball polishes a path, so no two clocks look alike after ten years	Strong (lead)
Durability	1.6 mm copper face, bent-laminated blackwood drum glued into a closed ring, 4 mm glass veil	Strong (lead)
Ease of maintenance and repair	Motor, arm and electronics screwed in and removable as one unit; standard parts	Strong (lead)
Standardisation and compatibility	625ZZ bearings, metric M3, M4 and M5 fasteners, a 28BYJ-48 stepper	Medium
Dis- and reassembly	The engine unbolts from the back panel; the veil and ball lift off	Medium
Adaptability and upgradability	Firmware leaves room for a homing sensor that is not fitted	Weak

Table 2: *The brief's six lifespan-extension strategies and where the clock uses them.*



Concept Analysis / Development

11 Ideation
11 Exploration and Iterations
13 Explanatory and Persuasive Sketch
13 Early Tests
13 CAD and Body Study
16 Renders and Posters
20 Final Product

Ideation

Ideation sheet 1 (Figure 6) shows what inspired me. I was drawn to the magnetic ball, and I noticed that with most of the clocks I looked at you have to interact with the clock to read the time; in one a person puts a finger into the clock, and that is the only way to read it. I wanted the time to take some effort to read, so that you make a conscious effort to work it out and it is not simply put into your head. In some of these clocks the time is hidden, and I liked that interactivity. I also liked the patina and the verdigris, because the colours contrast and yet occur naturally. I then looked at movement, at the Strandbeests and how their interlocking parts move together fluidly. Ideation sheet 2 (Figure 7) looks further at movement. At the top right is a black wall clock with a magnetic arm: one long magnetic arm, with many ball bearings racing on a track. The sheet also shows other ways of telling the time: a clock where the arm is a water level, a Zen clock where the arm is a rake dragging through sand, a wall clock where you remove the hours like fridge magnets, and a ring of LEDs that shine light towards the middle to show the hand. The Strandbeest appears again, along with how light plays a part in reading time. Copper with a patina and a ball bearing is where my idea first started to come from.

Exploration and Iterations

The exploration sheet (Figure 8) shows the patina in different forms and different ways of telling time. In the Horizon idea, time runs from sunrise to sunset, with the ball bearing as the sun rising and setting from left to right. In Count Balls, balls fall and the number collected at the bottom is the hour of the day. The Veil is the idea I took further. In Keepers, the ball rolls along, but family members can keep ball bearings for themselves and return them when needed. I also combined ideas with a Zen garden, with a magnetic ball tracking through sand, which gave me the idea of the steel ball dragging a path and leaving a polished path in the copper patina.

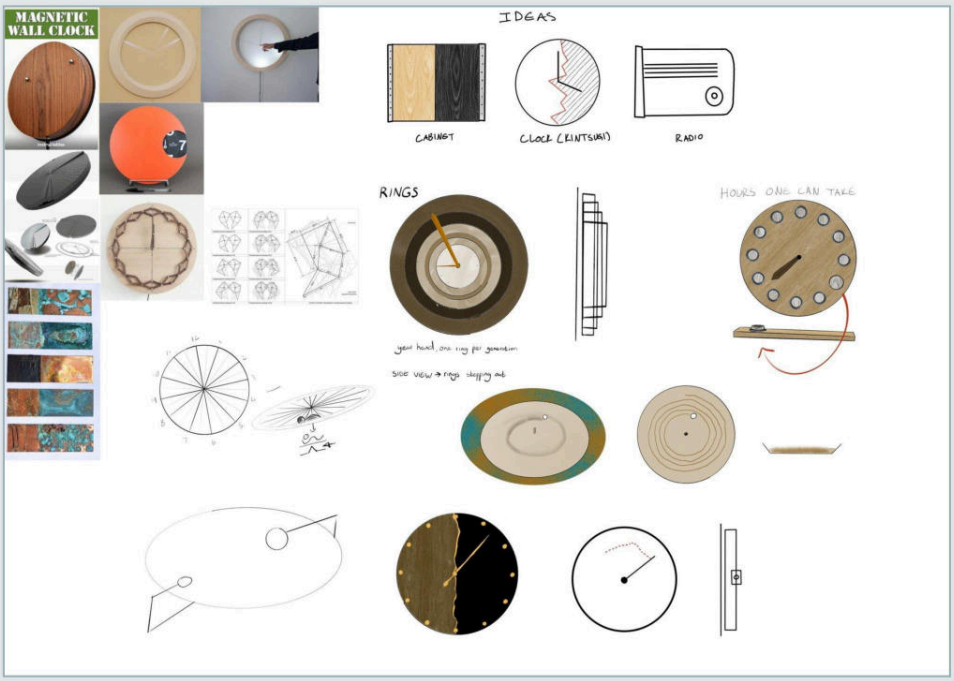


Figure 6: *Liam Cloete, Ideation sheet 1, 2026.*

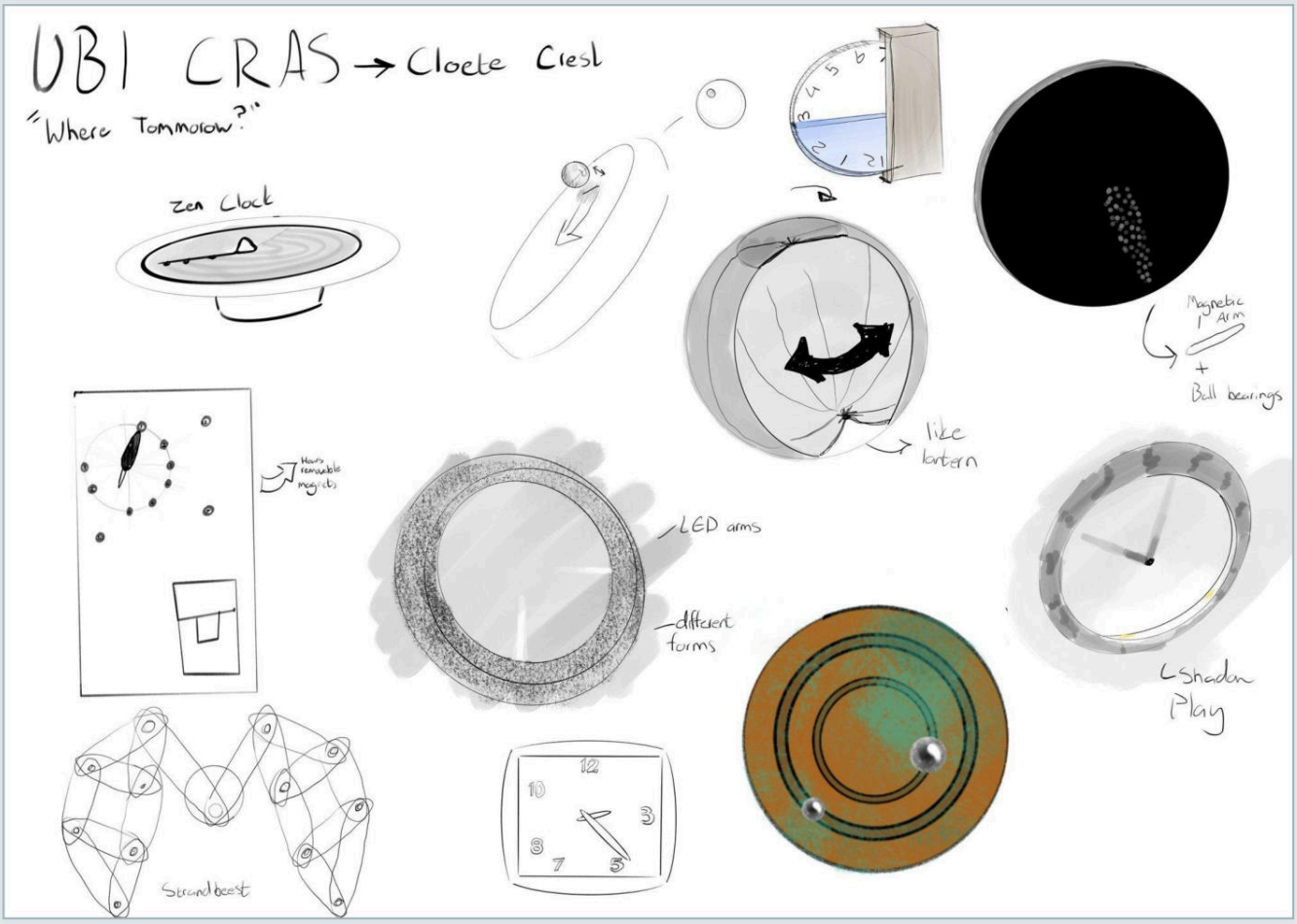


Figure 7: *Liam Cloete, Ideation sheet 2, 2026.*

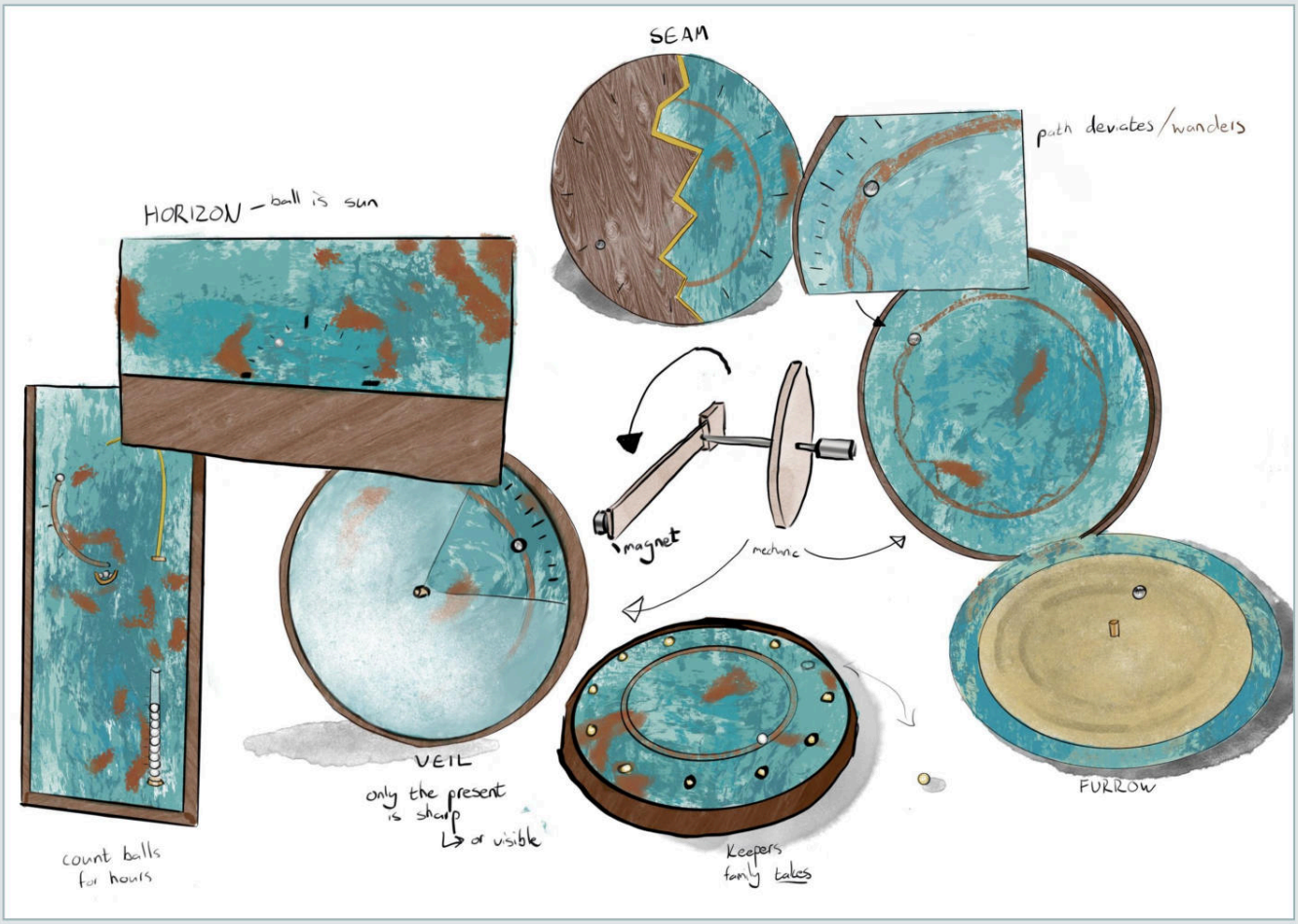


Figure 8: *Liam Cloete, Exploration sheet, 2026.*

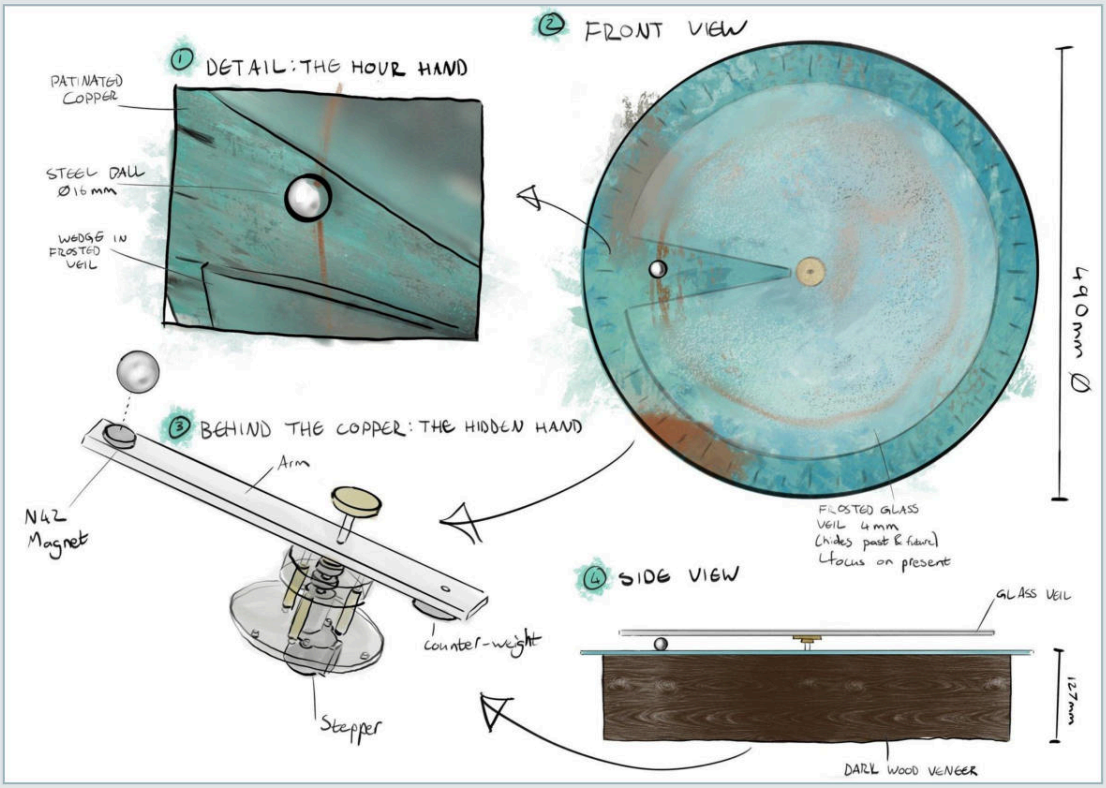


Figure 9: *Liam Cloete, Explanatory and persuasive sketch, 2026.*

CONCEPT ANALYSIS / DEVELOPMENT

Explanatory and Persuasive Sketch

The explanatory and persuasive sketch (Figure 9) shows the detail of the hour hand, the front view, what sits behind the patinated copper face, the mechanism and the side view. It shows the N42 magnet, the 16 mm ball, the overall dimensions, the stepper motor, the counterweight and how the clock looks from the side. The sketch labels the drum as a dark wood veneer; I later chose solid blackwood instead. It also shows the glass veil, the veil hub, the copper face and the overall width. The 4 mm frosted glass veil matters to me because it hides the past and the future and focuses on the present, which brings the heirloom back to the story of Where Tomorrow.

Early Tests

My first test used a quartz clock hand and a magnet, and it did not give the result I wanted. A high-torque quartz movement stalled too (see Material Testing). Figure 10 shows the laser-cut friction-fit test in acrylic for the bearing seat.

CAD and Body Study

I modelled the clock in SolidWorks. For the body study (Figure 11) I rendered ten bodies around the same engine and face under identical lighting, so that only the body changed between them. Once the Shadow drum was chosen, I checked 23 of its 24 parts in CAD against the shop listings of the parts I was buying; the only one not covered was the brass plaque, which I later dropped. The general assembly drawing is Figure 63 in Appendix C, and Figure 12 is the exploded render. The CAD also caught a clash: with the three motor posts at 60°, 180° and 300°, the nut on the 300° post overlapped the motor body by 2.4 mm, so I moved the posts to 30°, 90° and 150°.

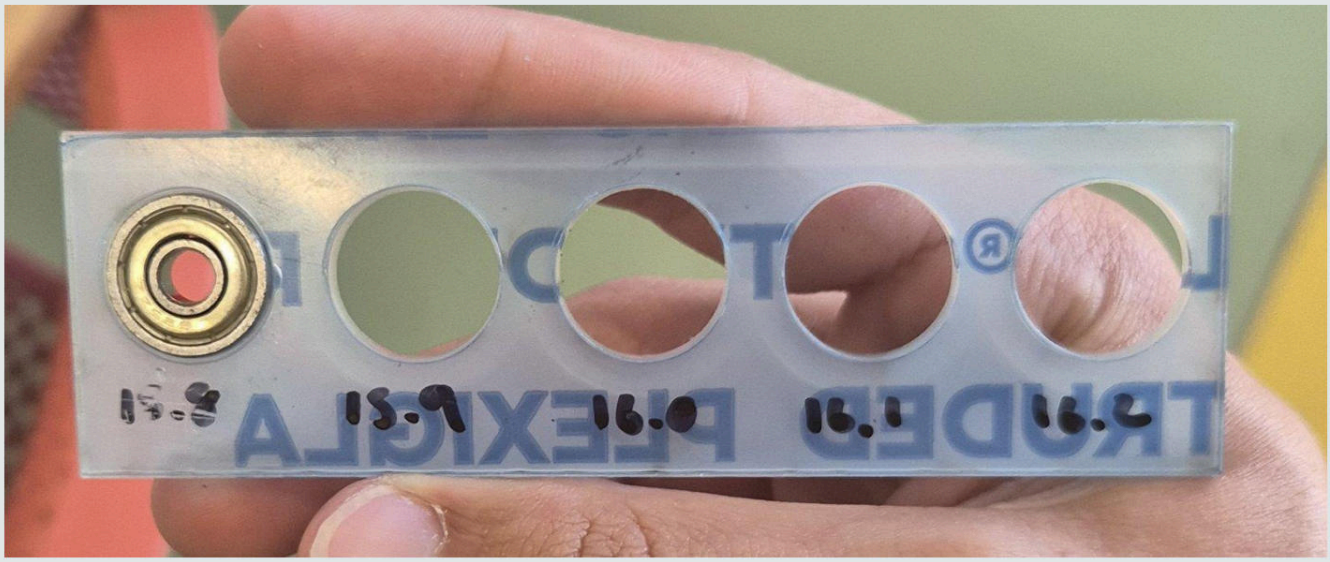


Figure 10: *Liam Cloete, Laser-cut bearing seat test strip with a 625ZZ bearing in the 15.8 mm hole, 2026.*

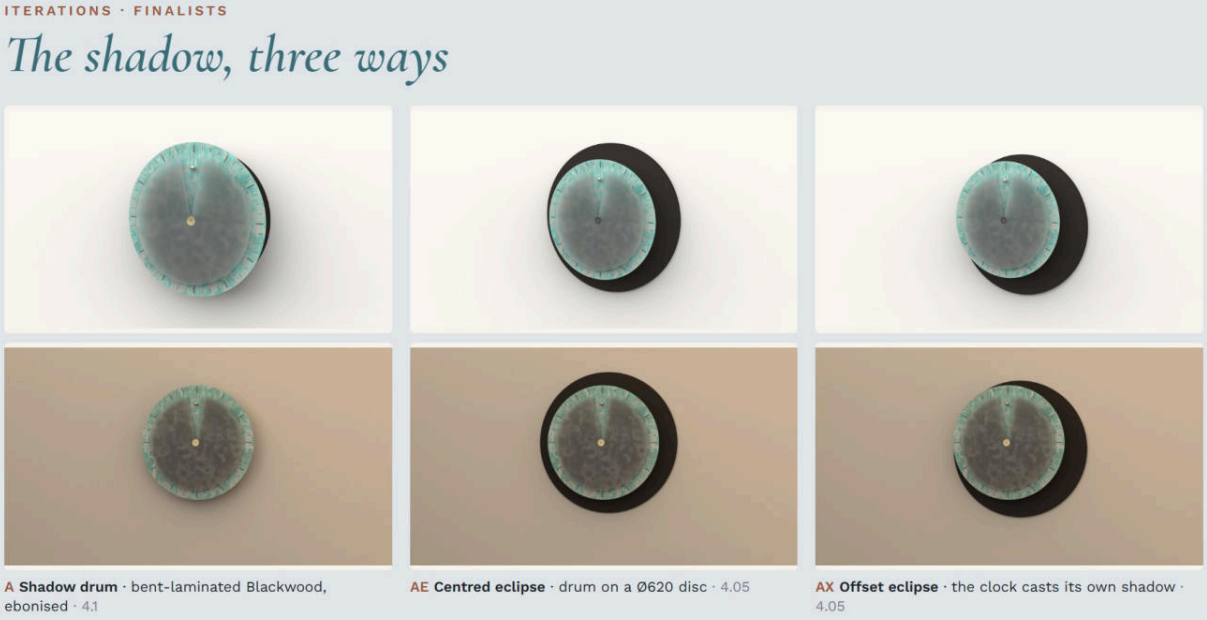


Figure 11: *Liam Cloete, Body study: finalists, 2026.*

The 4 mm frosted glass veil matters to me because it hides the past and the future and focuses on the present, which brings the heirloom back to the story of Where Tomorrow.

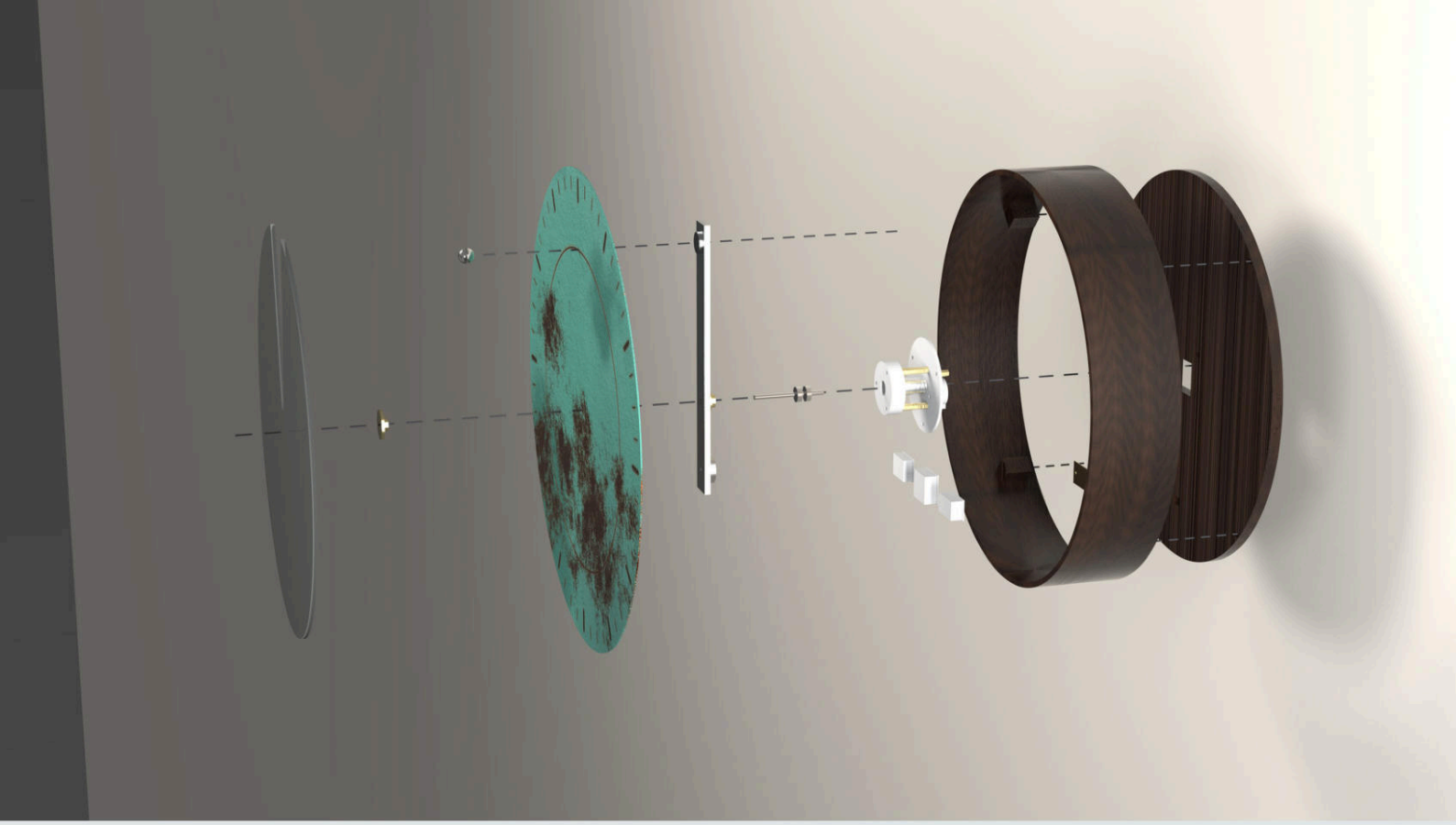


Figure 12: *Liam Cloete, Exploded view, render, 2026.*



Figure 13: *Liam Cloete, Studio render, three-quarter view, 2026.*

Renders and Posters

The studio renders (Figures 13 to 15) show the final design from different angles. Figure 13 shows the clock from a three-quarter angle, Figure 14 shows the layers from the side (veil, copper face, drum and the shadow line on the wall), and Figure 15 shows a close-up of the ball inside the clear wedge. Figure 16 shows the clock at eye level. The renders use a procedural patina texture, so the real fumed face will not match them exactly. The product poster (Figure 17) presents the clock to someone who might own it, and the technical poster (Figure 18) to someone who might make or repair it. The technical poster still calls the veil toughened glass; the delivered veil is annealed, and I will correct the poster. The poster in Figure 28 shows the clock at three ages, with the copper ring becoming more visible as it ages; it is a projection made with procedural textures, not a photograph.

Figure 14: *Liam Cloete, Side profile render showing the layers, 2026.*



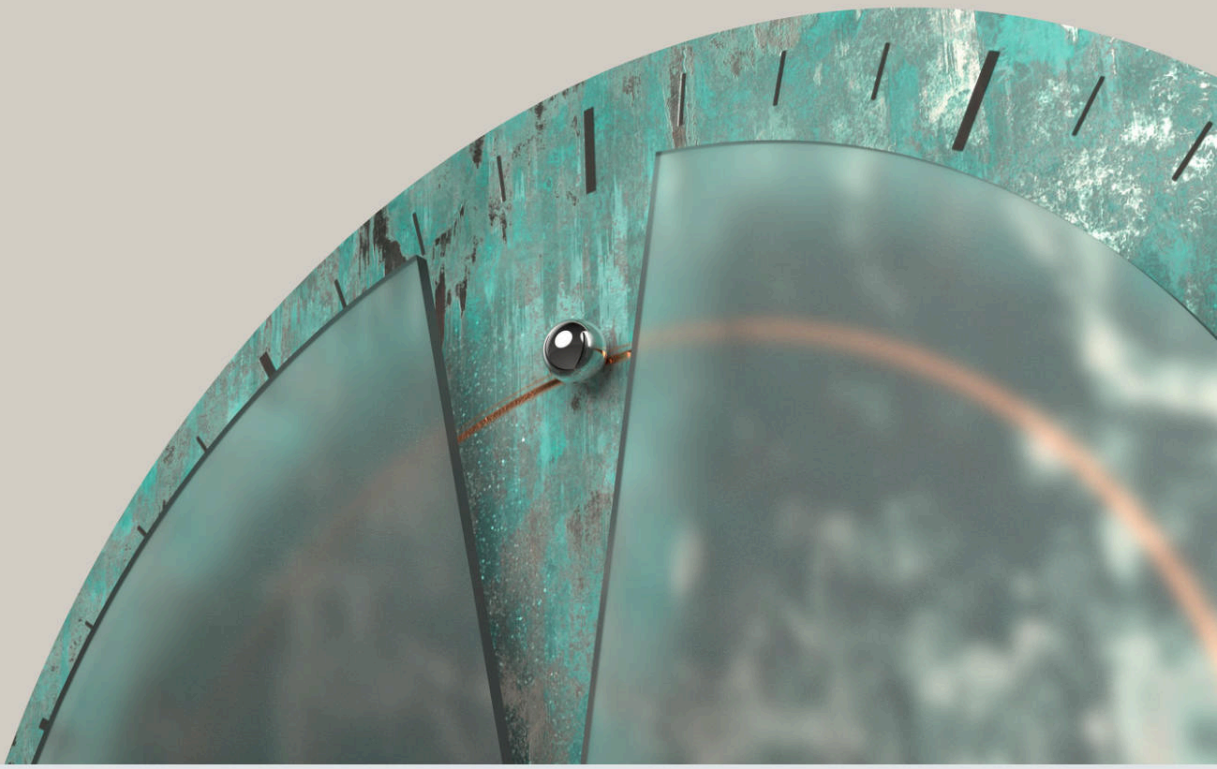


Figure 15: *Liam Cloete, Close-up render of the ball in the clear wedge, 2026.*

Figure 16: *Liam Cloete, Room render at eye level, 2026.*

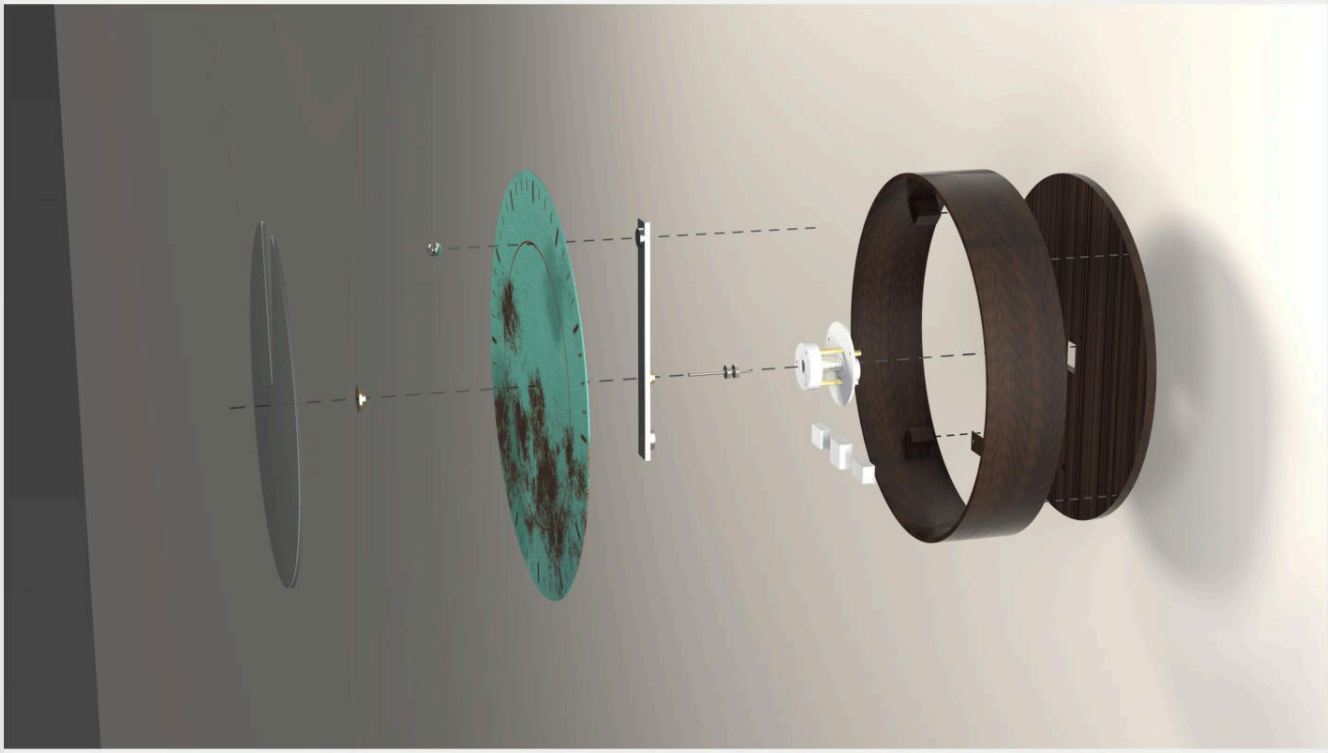




Figure 17: *Liam Cloete, Product poster, in situ, 2026.*

WHERE TOMORROW

TECHNICAL



GLASS VEIL
TURNS WITH THE BALL

STEEL BALL
THE HOUR HAND

COPPER FACE
PATINA KEEPS AGEING

MAGNET ARM
BEHIND THE COPPER

BLACKWOOD DRUM
BENT, NOT CUT

ENGINE
SCREWED: REPAIRABLE

SIZE	Ø490 face × 125 mm deep, 6.0 kg
CASE	Blackwood drum, 3 bent plies, teak oil + wax
HAND	Ø16 steel ball, pulled by an N42 magnet

FACE	1.6 mm copper, fumed patina, 48 scribed ticks
VEIL	4 mm satin glass with a clear 22° wedge
DRIVE	Stepper + real-time clock, 18650 battery

WHERE TOMORROW

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Figure 18: *Liam Cloete, Technical poster, 2026.*



Figure 19: *Liam Cloete, Where Tomorrow, finished clock from the front, studio photograph, 2026.*

CONCEPT ANALYSIS / DEVELOPMENT

Final Product

The clock was assembled and running on 5 November. Figures 19 to 22 are studio photographs of the finished clock. The drum is blackwood from Ticktin Timbers, who supplied four strips of 1.7 m by 100 mm by 2 mm, one more than the three plies need.

I glued the first two plies round the skin and they went on fine. On 2 November I added the third ply and it cracked, because it was dry. I put wood glue in the crack, steamed the strip in a bag with a steamer for 10 minutes, folded it back round the former and glued it with Titebond. That worked. The drum is three plies with a wall of about 6 mm, as designed, and about 100 mm deep instead of 94.5 mm, because there is a little space between the layers. Glued and cut round, the back panel measures Ø421 to 422 mm and sits inside the drum, held by the corner blocks. The four back-panel boards were a frustration. The blackwood veneers I had seen were beautiful, dark and finely grained, but the thicker planks I paid for as blackwood arrived as white blackwood, a subspecies, so they look different. At least the back panel is hidden against the wall.

I epoxied the copper face to the drum with Bostik Super Epoxy. My first attempt let go after about an hour because I had not sanded the copper, so I sanded it and glued it again with more epoxy. Four corner blocks are glued into the drum and the back panel is screwed to them, so the screws can come out and the clock can be opened again. A 60 mm cork disc is laser-engraved with WHERE TOMORROW, LIAM CLOETE and 2026. I cut it at Belgium Campus because our laser cutter was broken. Figure 23 shows the back panel disc on the bench and Figure 24 the drum strapped on the former.



Figure 20: *Liam Cloete, Where Tomorrow, three-quarter view showing the blackwood drum, studio photograph, 2026.*



Figure 21: *Liam Cloete, Where Tomorrow, angled view of the whole clock, studio photograph, 2026.*

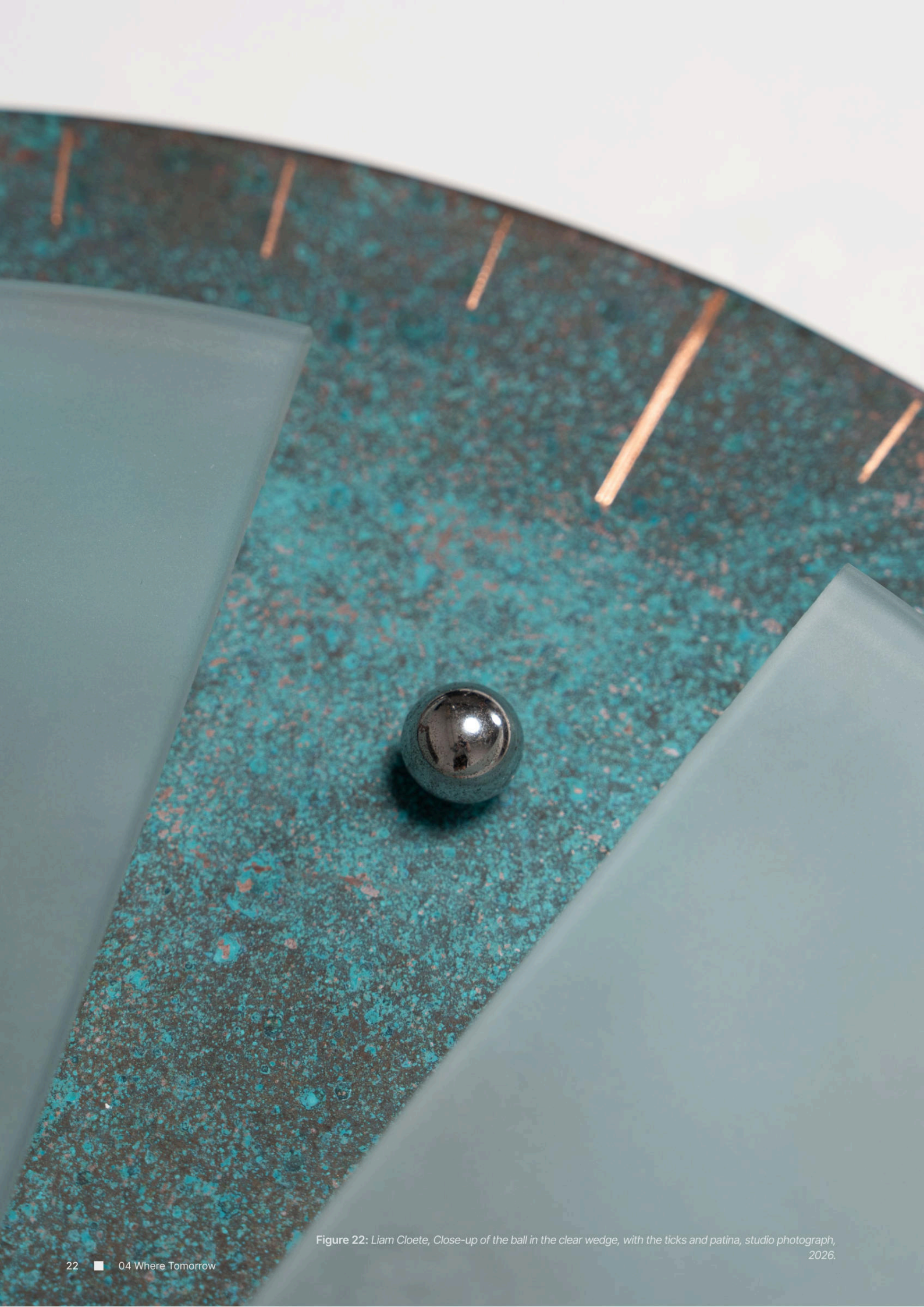


Figure 22: *Liam Cloete, Close-up of the ball in the clear wedge, with the ticks and patina, studio photograph, 2026.*



Figure 23: *Liam Cloete, Back panel disc cut from the edge-glued blackwood boards, 2026.*



Figure 24: *Liam Cloete, Drum strapped on the bending former, 2026.*

Ergonomic Analysis

A wall clock is read from across a room, by someone standing or sitting, so the questions are how high to hang it and how far away it can still be read. Anthropometric sources such as Pheasant and Haslegrave (2006) and Panero and Zelnik (1979) give eye heights by percentile, and Bridger (2009) covers how body size feeds into design. Average standing eye height is about 1.5 m for women and 1.6 m for men. With the centre of the clock at 1,500 mm, the face runs from 1,255 mm to 1,745 mm, which sits around standing eye height and is still in view from a chair (Figure 25). The 16 mm ball covers about 27.5 minutes of arc at 2 m, about 18.3 at 3 m and about 11.0 at 5 m, so it gets harder to see as you move away. Because the ball moves only 21.6 mm in a quarter of an hour on its 165 mm radius, the reader judges the time from where the ball sits against the ticks, not from seeing it move.

The finished clock is estimated at 5.9 to 6.1 kg: the drawing gives 5.91 kg and the electronics add about 0.15 kg. At about 6 kg, held out at arm's length against a wall while finding two screws, the clock is awkward for one person, so I recommend that two people hang it: one lifts and the other guides the keyholes onto the screws. The clock hangs on two keyholes 200 mm apart. With its centre of mass 76 mm out from the wall, each screw carries about 30 N downwards and 6.6 N pulling out, which are small loads. I do not claim a safety factor for the fixing, because I have no calculation that supports one. A keeper should be able to open the clock with ordinary tools. The motor, arm and electronics are fixed with M3 and M4 screws, and the whole engine unbolts from the back panel as one unit. Figure 26 shows the mechanism behind the copper with the back panel removed, and Figure 27 is the parts identification sheet from my dry-assembly book, which names the parts in the order they go together. Spare parts were bought with the clock (seven spare bearings, three balls and a second arm), so the first repairs do not depend on a supplier still stocking the parts.

When it changes hands, the new keeper can either deepen the old patina or strip it back and start again. To re-fume, the ball and veil come off, the wax is removed with white spirit, and the face is washed, dried, fumed, left to cure and waxed again. The veil is annealed, not toughened, because Nelson Glass could not toughen a disc with the wedge cut out of it, so if it breaks it leaves large, sharp pieces. The ball should be taken off when moving the clock, because it comes away from the magnet if pushed more than about 26 mm.

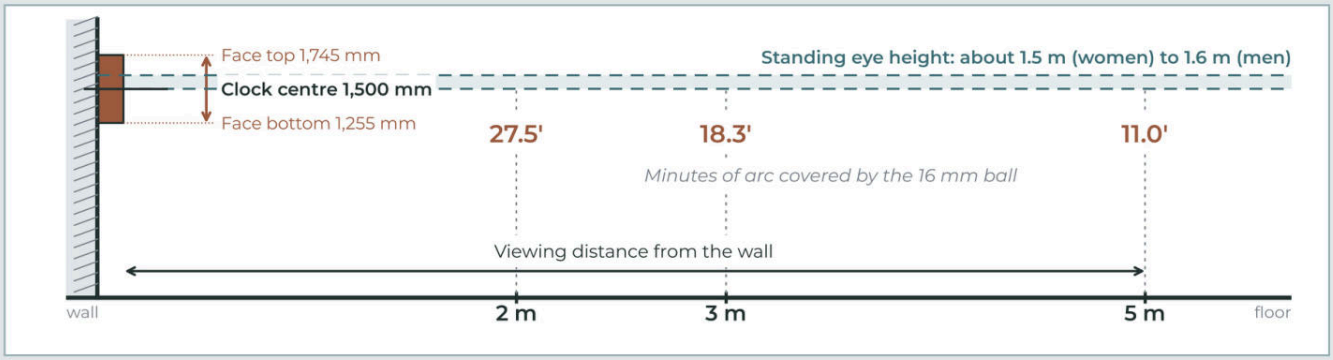


Figure 25: *Liam Cloete, Hanging height and viewing distance, 2026.*

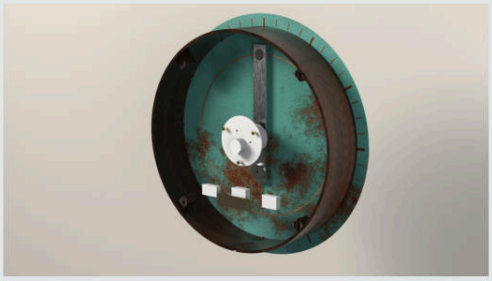


Figure 26: *Liam Cloete, Rear mechanism with the back panel removed, render, 2026.*

Where Tomorrow: parts ID sheet

Tick the box when you have found it · page 1 of 3

Communica order

8 part types



Shop photo

☐ **x6**

Brass spacer V6257, 15 mm

Hex tube, 15 mm long. A thread stud on one end, a threaded hole on the other. 2 screwed together = 1 post. (8 bought, so 2 spare.)



Shop photo

☐ **x3**

Brass spacer V6257, 10 mm

Same look as the 15 mm one, but shorter (10 mm). Goes between motor plate and back panel.

Shop shows the same photo for both sizes



Shop photo

☐ **x4 + x4**

M3 x 16 cheese-head screw

Small slotted round-head screw, 16 mm long. 4 stay whole (arm hub). 4 get cut to about 10.5 mm (veil hub).



Shop photo

☐ **x8**

M3 nut

Small hex nut for the M3 screws. 4 for the arm hub, 4 for the veil hub.



Shop photo

☐ **x10**

M4 washer

Flat round washer with an M4 hole. Goes under every M4 screw head.

Communica pack was 8: check you have 10



Shop photo

☐ **x5**

M4 nyloc (lock) nut

Hex nut with a nylon ring inside. 3 for the posts, 2 for the motor lugs.

Check the pack: steel with a nylon ring, not all nylon (?4)



Shop photo

☐ **x4**

M4 screw for the corner blocks

Slotted cheese-head M4. Book says the length is still to check (Communica bought M4 x 25).

Length to check (?12)



Generic photo

☐ **x3**

M4 x 10 cheese-head screw

Short slotted M4 screw, 10 mm. Goes through the motor plate into the 10 mm spacers.

Shop not clear in the files. Photo is a similar screw (?5)

Builders (hardware store)

3 part types



Generic photo

☐ **x5**

M4 x 20 cheese-head screw

Slotted round-head M4, 20 mm long, from the pack that came with nuts. 3 for the block bolts, 2 for the motor lugs.

Builders / Eureka pack. Photo is a similar screw



Generic photo

☐ **x1**

M5 stud, 30 mm + 2 nuts

A 30 mm piece cut from the M5 threaded rod, plus 2 M5 nuts. This is the counterweight bolt.

Cut from the M5 rod bought at Builders



Generic photo

☐ **x8**

Washer 18 x 5.3 x 1.5

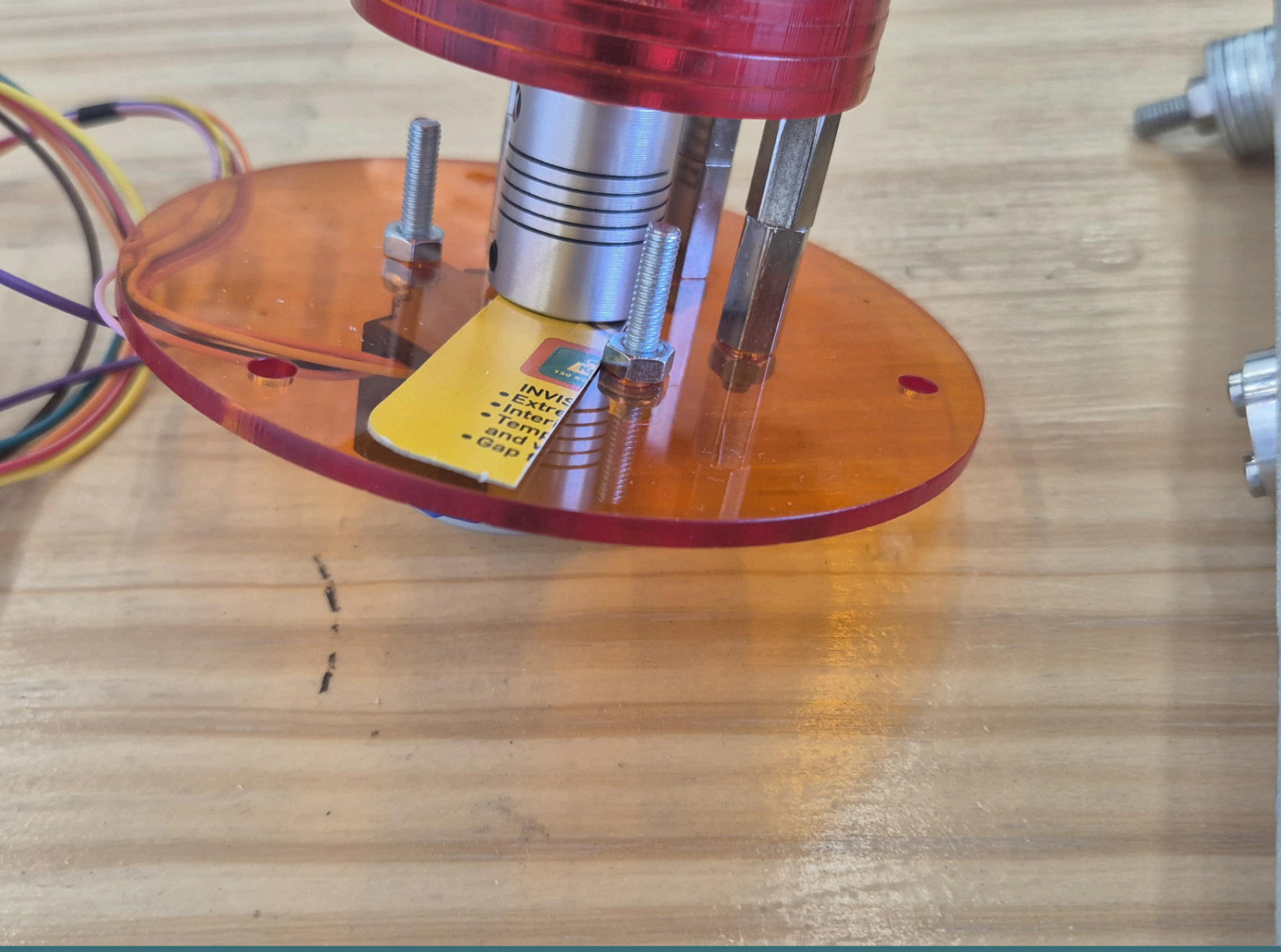
Big flat washer: 18 mm wide, 5.3 hole, 1.5 thick. Start with 8 on the counterweight.

Builders / Eureka 40-pack. Photo is a plain washer

Sizes come from the dry assembly book (pages 1 to 4). ?N = open question on the last page of the book.

Liam Cloete · ID300 · dry fit, nothing glued

Figure 27: *Liam Cloete, Parts identification sheet, 2026.*



Technical Analysis

27 Material Research
29 Manufacturing Processes
34 Specification of Standard Parts
36 Cost Analysis
37 Material Testing

Material Research

I chose copper because it changes slowly and visibly.

I chose copper because it changes slowly and visibly. In air, copper first forms a thin red-brown layer of cuprite (Cu2O), and the green layers people associate with old roofs come much later. The chemistry of these atmospheric patinas has been studied in detail (Graedel et al., 1987). Nassau et al. (1987) found cuprite and the green mineral brochantite in all of their outdoor samples, which ranged from 1 to 100 years old, and Chang et al. (2017) describe historic roof patinas as a thin inner layer of cuprite under a thicker outer layer of brochantite. Outdoors the green takes about 5 to 7 years to appear in industrial or coastal air and 10 to 14 years in rural air (Copper Development Association, n.d.), while indoors copper corrodes roughly a hundred times more slowly than outdoors (Rice et al., 1980). For my clock this means that the colour of the face is set mainly by the ammonia fuming I do at the start, and that natural change indoors will be very slow. Figure 28 shows how I expect the face to age, but it is a projection made with rendered textures, not a measurement. Copper is also non-magnetic, which is what allows the magnet to pull the steel ball through it.

For the wood I chose Australian blackwood (*Acacia melanoxylon*). In South Africa it is a listed invasive species: the 2020 lists under the National Environmental Management: Biodiversity Act place it in Category 2, with an exemption for existing plantations, and dead material such as sawn boards needs no permit (Department of Environment, Forestry and Fisheries [DEFF], 2020). My argument is that using blackwood puts an unwanted tree to good use, instead of a protected indigenous timber such as stinkwood or yellowwood, which I ruled out for that reason. Its dark colour also matches the pairing most people chose in the survey.

Table 3 lists the materials of the main parts. The face is a Ø490 × 1.6 mm half-hard copper circle, cut to size by Copalcor. The veil is 4 mm extra-white glass, Ø406 mm, with a satin face and a clear 22° wedge with an R5 inner corner. Nelson Glass confirmed on 13 October that it would be annealed, because toughening would break a disc with this cut-out. The arm is 6 mm aluminium 6082, waterjet cut by Extreme Technical. The small parts, the bearing block rings, the motor plate and the veil hub discs, are laser-cut from 3 mm perspex I already owned, which keeps 3D printing out of the final clock.

PART	MATERIAL	SIZE	MADE BY
Face	Half-hard copper	Ø490 × 1.6 mm	Copalcor, cut to size
Drum	Australian blackwood, oiled; 3 plies	Designed Ø440 × 94.5 mm, 6 mm wall; as built about 100 mm deep, 6 mm wall	Bent lamination, by me
Back panel	Blackwood, four edge-glued boards (sap wood)	Ø421 to 422 × 12 mm (measured)	By me
Veil	Extra-white glass, annealed	Ø406 × 4 mm, 22° wedge	Nelson Glass
Arm	Aluminium 6082	6 mm	Extreme Technical, waterjet
Shaft	Stainless steel linear rod	Ø5, cut to about 69 mm, filed to about 68.5 mm	Cut by me
Magnet	N42 neodymium	Ø22 × 10 mm	Bought
Ball	Steel bearing ball (16.4 g)	Ø16 mm	Bought
Bearing block, motor plate, veil hub	Clear and green perspex	3 mm	K40 laser, by me

Table 3: *Materials of the main parts.*



Figure 28: *Liam Cloete, Passage-of-time poster: the copper ring at year 1, year 10 and year 25 (projection), 2026.*

Manufacturing Processes

The Ball Path and the Magnet: Figure 28 shows how the ball is expected to polish its path. All the numbers behind it are calculated, not measured. At a 4.5 mm air gap the magnet pulls the ball onto the copper with about 5.2 N, roughly 32 times the ball's weight of 0.161 N, and sideways it can hold about 8.1 times the ball's weight, so the ball does not slide off. The peak contact pressure of about 474 MPa sits at the lower end of the range that half-hard copper can carry without grooving (460 to 640 MPa), which is what I want: a slow burnish, not a rut.

Drum manufacture by bent lamination: this is the new manufacturing method in the project. The design uses three 2 mm blackwood strips bent dry round a Ø428 mm former and glued into a closed ring, which is then trimmed to 94.5 mm deep, giving an outside diameter of about 440.4 mm. Figure 29 is the laser-cut file for a bending former disc, Figure 30 shows me assembling the former and Figure 31 the finished former with the straps. The main risk is that the wood cracks as it bends. The bending strain in the inner ply is half its thickness divided by the radius of its centre line, 1 mm ÷ 215 mm, or 0.465 % (calculated). Published values for blackwood's strength and stiffness (Meier, n.d.) put the breaking strain at about 0.70 %, so the margin is about 1.50 on average and about 1.11 for a weak strip at the 5th percentile. On 31 October I tested this on the spare strip (Figure 32): it bent round the former without cracking or creaking.

Each ply is cut to a different length because each sits at a different radius: 1,350.9, 1,364.1 and 1,377.3 mm, with the butt joints staggered about 120° apart. I glued the plies with Titebond wood glue because I had it, although a slow epoxy or a urea-formaldehyde glue would creep less.

On 2 November I strapped the plies around the former with ratchet straps and taped the seams. The third ply cracked as it went around, which was something the 5th-percentile margin of 1.11 had indicated could happen with a weaker strip. I repaired the crack with wood glue, steamed the strip in a bag for 10 minutes and carefully bent it back around the former. I then left the drum strapped for 24 hours. Figure 33 shows the drum taped on the former.

Copper face marking and patina: The copper face carries the ticks that the ball is read against. The layout has 48 ticks, one every 7.5°: 12 hour ticks from r205 to r243 mm, 2 mm wide, and quarter-hour ticks from r225 to r243 mm, 1 mm wide, all outside the edge of the veil at r203 so that the satin glass does not hide them. The 30° tick template, cut in sections that fit the laser bed, is shown in Figure 36. The patina is made by ammonia fuming in a sealed box, with the face propped clear of the liquid. It took several hours: I sprayed the face with salt water, sealed the box shut and checked it every half hour to hour. The face will be waxed with a clear paste wax only after the ticks are cut and the patina has cured, and a ring on the back from r210 to r224 is kept bare so that the epoxy bonding the face to the drum grips clean copper. Figure 34 shows the face sanded before fuming, Figure 35 the spotted blue-green patina after fuming, and Figure 36 the template laid on the face with the veil.

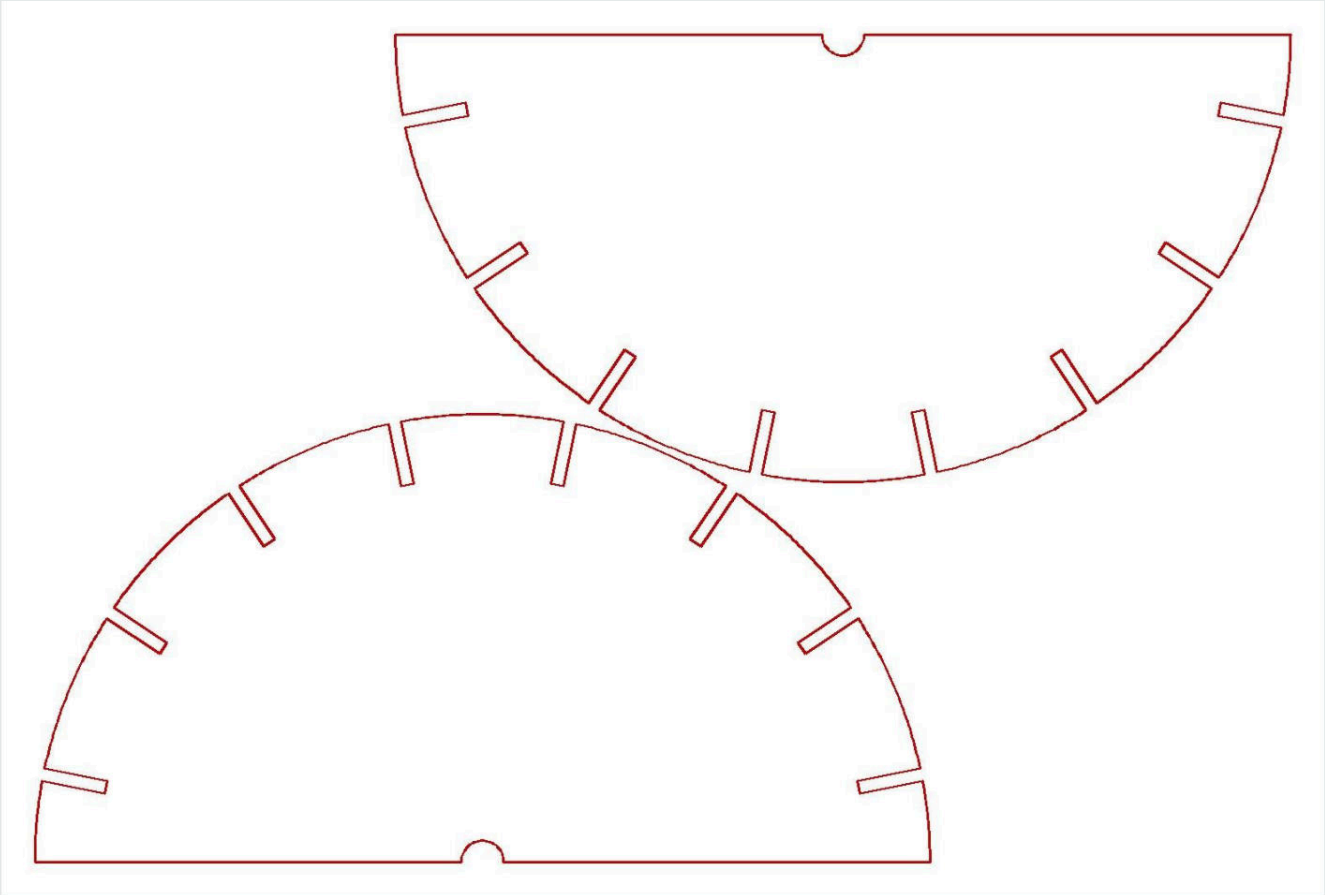


Figure 29: *Liam Cloete, Laser-cut DXF of a bending former disc, 2026.*



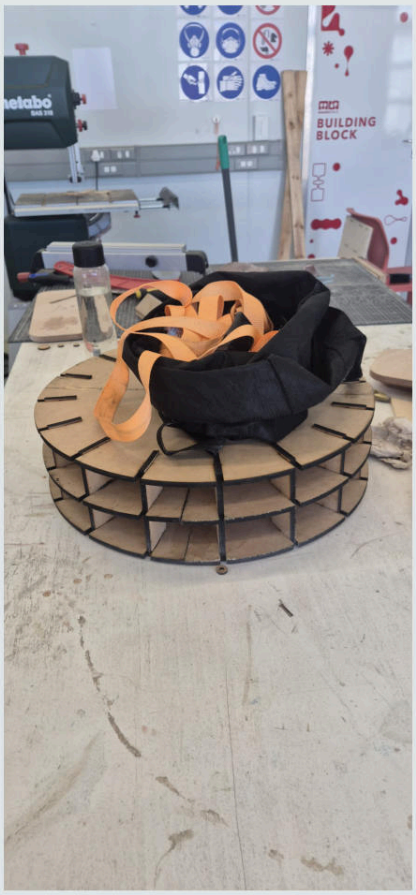


Figure 30: *Liam Cloete, Assembling the laser-cut MDF bending former, 2026.*

Figure 31: *Liam Cloete, Bending former of stacked laser-cut MDF discs, with ratchet straps, 2026.*



Figure 32: *Liam Cloete, Spare blackwood strip bent round the former (bend test T06), 2026.*



Figure 33: *Liam Cloete, Drum taped on the former, side view, 2026.*



Figure 34: *Liam Cloete, Copper face sanded, with the centre hole drilled, 2026.*



Figure 35: *Liam Cloete, Copper face after ammonia fuming, 2026.*

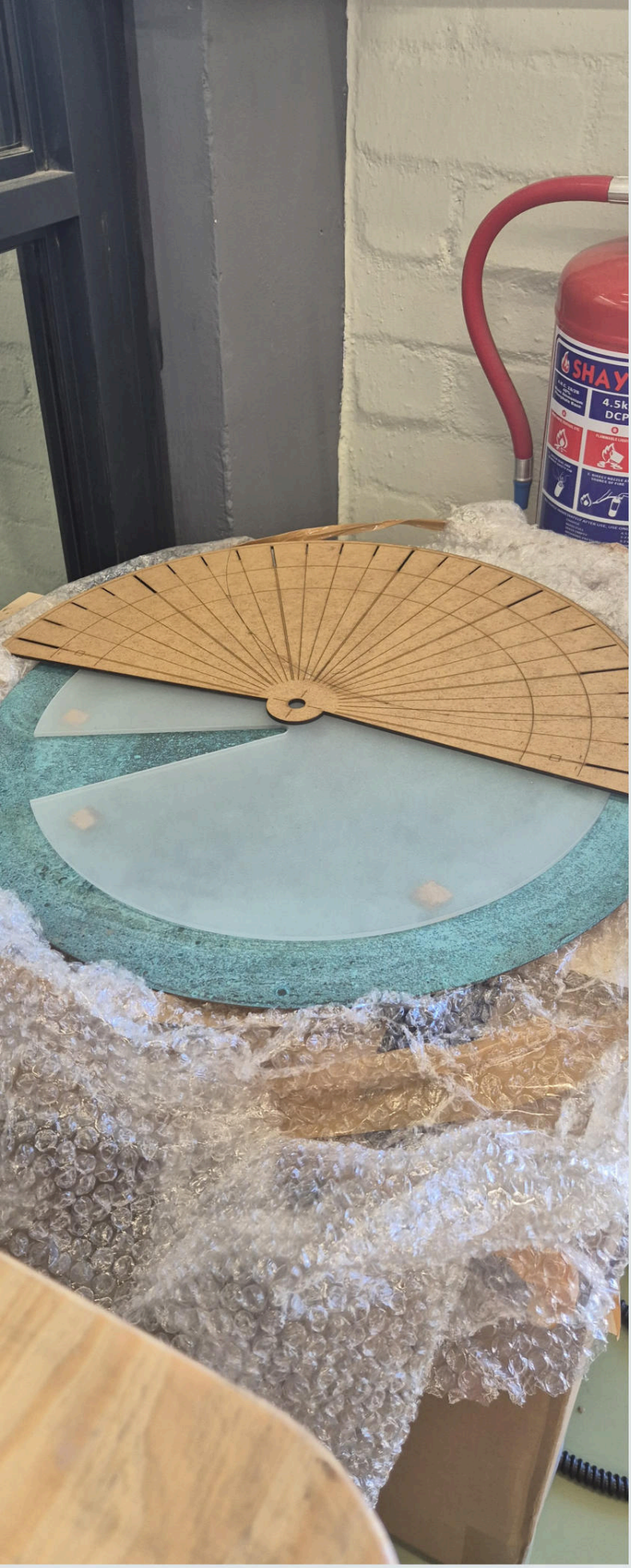


Figure 36: *Liam Cloete, MDF tick template laid on the copper face, with the glass veil, 2026.*



Figure 40: *Liam Cloete, Cutting the stainless shaft to length, 2026.*

Specification of Standard Parts

Table 4 lists the standard parts in the engine. A C0505 flexible coupler joins the motor shaft to the clock shaft, which runs in two 625ZZ bearings (5 × 16 × 5 mm) pressed into laser-cut perspex seats drawn at 15.8 mm. The worst load on a bearing is about 200 N against a static rating of 380 N, a factor of 1.9. Figure 37 shows the engine prototype, Figure 38 the veil hub discs, Figure 39 the arm with its magnet and counterweight washers, and Figure 40 the shaft being cut.

The weak point is torque. The motor gives about 29.4 mN·m, and the clock needs between 13 and 57 mN·m depending on the inertia of the glass veil and on drag in the ball, which I could not calculate. The margin is only about 0.5 to 2.3 times. Below 1 the motor would lose steps, and with no homing sensor the clock would then show the wrong time with no warning.

Using standard parts is itself one of the brief's lifespan strategies (Table 2), because a future keeper can buy a replacement without a drawing. The two 625ZZ bearings have a 5 mm bore, a 16 mm outside diameter and a width of 5 mm, which is a size in the ISO general plan for radial bearings (ISO, 2017), so any bearing supplier can replace them. The Ø16 hour ball is a standard bearing ball, and steel balls for rolling bearings are specified in ISO 3290-1 (ISO, 2014). All fasteners are metric (M3, M4 and M5), so they are easy to buy in South Africa. My drawings give a general tolerance of ±0.2 mm in the title block. ISO 2768-1 (ISO, 1989) is the standard way to state general tolerances, and referring the title blocks to it is one of the fixes for the final drawing set. Finally, the 18650 lithium cell sits inside a timber drum for years, so it should come from a maker that certifies its cells to IEC 62133-2, the safety standard for portable lithium cells (International Electrotechnical Commission, 2017).

Electronics and firmware: A LOLIN S2 Mini (ESP32-S2) controls the motor, and a DS3231 real-time clock keeps time, backed up by a CR2032 coin cell. The stepper motor turns the shaft through a coupler, and the shaft carries the aluminium arm, which has the neodymium magnet at its end. The arm moves clockwise. A DS3231 clock module with a small coin battery keeps the time. To set the clock, I hold the 0 button on the board and the arm runs round; I let go when it is at twelve, the clock takes that position as twelve, and it then walks the arm round to the current time. If the battery goes flat or something goes wrong, the time can be set again in the same way and the arm catches up to the real time. Power comes from an 18650 cell through a TP4056 charger and an MT3608 boost converter to 5 V. The TP4056 must be charged only from its own micro-USB socket, because feeding it from the S2 Mini's USB supply would let the boost converter charge the cell from itself. The DS3231 is powered from 3.3 V, because the common ZS-042 module tries to charge its coin cell at 5 V.

PART	SPECIFICATION	QTY
Stepper motor	28BYJ-48 with ULN2003 driver	1
Shaft coupler	C0505 flexible coupler, 5 to 5 mm	1
Bearings	625ZZ, 5 × 16 × 5 mm	2 (7 spare)
Post spacers	V6257, 15 mm	6
Hubs	Pololu 1203 hub pair	2
Controller	LOLIN S2 Mini (ESP32-S2)	1
Clock module	DS3231 with CR2032 backup	1
Power	18650 cell, TP4056 charger, MT3608 boost to 5 V	1 set
Fasteners	Metric M3, M4 and M5 screws, nuts and washers	as drawn

Table 4: *Standard parts.*

The weak point is torque.

Figure 39: *Liam Cloete, Aluminium arm with magnet, hub and counterweight washers, 2026.*



Cost Analysis

Table 5 breaks down the cost. By 28 October I had spent R6,335.11 on 17 orders, but only about R4,256.77 of that is in the clock. The rest is spares, leftover stock, a failed part and items for other uses. The materials in the clock therefore cost about R4,200 at their cheapest (the costing sheet gives R4,256.77 for the parts used). Add shipping, fuel, travel and the testing of parts, and my total spend is about R7,300, so the cost is no longer black and white. None of these figures price my own time. The overspend has clear causes. Three made-to-order items, the copper face (R920.00), the glass veil (R836.84) and the blackwood (R930.31), take 42 % of the spend. The quartz movement that failed its stall test cost R390.00. I bought spares on purpose (R652.49), packs and lengths of material leave stock behind (R840.59), R116.44 was for another project and R77.21 went on a part I did not use. The split of mixed orders between parts is an estimate.

In my 13 October presentation I said the clock would cost about R3,700 to R4,100, inside the R5,000 limit. That is no longer true, and I would rather explain the difference than hide it.

Table 6 estimates wastage by comparing the material I bought with the material in the clock. Cutting a Ø420 disc from four 440 × 110 mm boards wastes about 29.4 % of the board, or 26.9 % if the corner blocks are cut from the offcuts. The plan for the blackwood strips wasted about 24.2 %, mostly in length, because each strip is 1,700 mm long and the plies need only 1,351 to 1,377 mm; buying strips of about 1,400 mm would bring this down to about 8 %. As built, the waste is higher: three strips are in the drum, the fourth became the skin of the former, and the third ply cracked.

CATEGORY	AMOUNT (R, INCL. VAT)
Copper face (Copalcor)	920.00
Glass veil (Nelson Glass)	836.84
Blackwood strips and boards (Ticktin)	930.31
Quartz movement (failed stall test)	390.00
Spares bought on purpose	652.49
Leftover stock from packs and lengths	840.59
Other project	116.44
Part not used	77.21
Total spent, 17 orders	**6,335.11**
In the clock	**4,256.77**
Total spend to hand-in (approximate)	**7,300**

Table 5: *Cost breakdown, orders to 28 October 2026 (R, including VAT). Where one order holds several items, the in-the-clock share is split equally between them. The categories overlap with the other orders, so they do not add up to the total.*

MATERIAL	BOUGHT	USED	WASTAGE
Blackwood boards, 440 × 110 × 12 mm	4	Ø421 to 422 back panel	29.4 % (26.9 % with corner blocks)
Blackwood strips, 1,700 × 100 × 2 mm	4	3 plies of 1,351 to 1,377 mm; the fourth strip, too short for a ring, became the release skin	24.2 % (about 8 % at 1,400 mm)
Copper	Circle cut to size	Ø490 face	Offcut kept by supplier
Perspex, 600 × 400 × 3 mm	1 sheet	Bearing block, motor plate, hub discs	About 91 % kept as stock

Table 6: *Material wastage (estimates from nesting).*

Material Testing

Table 7 lists the material and fit tests, with what each one measures and what counts as a pass.

For T02, the bearing seat fit (20 October), I laser-cut a strip of 3 mm extruded perspex with holes from 15.8 to 16.2 mm (Figure 10), at 10 mm/s and the laser's panel power set to 75 in a single pass, and pressed a 625ZZ bearing into the holes. This passed, and I changed the bearing seat in the drawings from 16.05 mm to 15.8 mm.

For T13, the copper face centre hole (20 October), I drilled the centre of the copper face by hand with a step drill, with the face taped and clamped, to Ø12 mm instead of the Ø10 mm in the CAD.

The quartz movement stall test in early October was the first real failure: the movement stalled at about 20 to 30 mN·m, which is why the clock is now driven by a stepper. I also tried a high-torque quartz movement, and that stalled too. The bend test on the spare blackwood strip (T06) passed at R214: it bent round the former without cracking.

For T07b, the copper-to-wood epoxy bond, my first attempt let go after about an hour, because the copper was not sanded and the epoxy had not had enough time; the second, sanded and left to cure, held. The arm balances with its counterweight (T05), and the clock has keyholes for wall fixing (T10).

TEST	WHAT IT MEASURES	PASS MARK	STATUS
T02	Bearing seat fit in perspex	Snug press fit, no wobble	Passed (15.8 mm)
T13	Copper face centre hole	Ø12 mm, clean	Passed
T06	Blackwood strip bent to R214	No cracks	Passed at R214; the dry third ply cracked, then bent after steaming
T01	Laser kerf and bed size	Three estimates within 0.05 mm	Not run
T07a	Three-ply glued coupon	Relaxes to R255 or less	Not run
T07b	Copper-to-wood epoxy bond	Wood or epoxy tears first	First attempt let go after about 1 h; the second held
T08	Patina coupons	Even colour, repeatable	Not run; I fumed the face directly
T14	Rotor drag torque	12 mN·m or less	Run on the quartz movement only
T05, T16, T17, T10	Balance, veil run-out, veil mass, wall fixing	As in the plan	T05 and T10 passed; T16 and T17 not measured

Table 7: *Material and fit tests. Pass marks come from the calculations in my design review and drum lamination procedure, not from standards.*

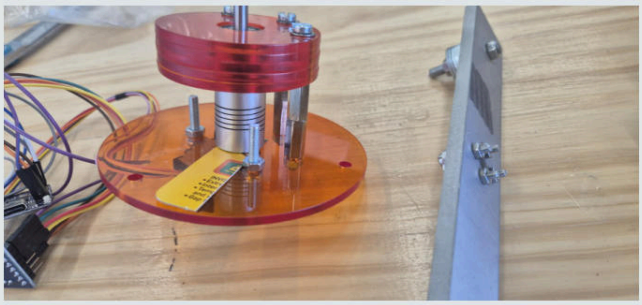


Figure 37: *Liam Cloete, Engine prototype: flexible coupler and posts on the motor plate, 2026.*

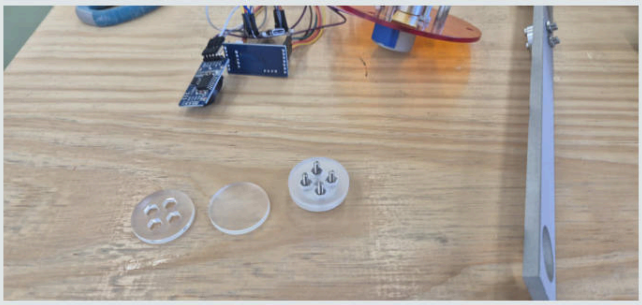


Figure 38: *Liam Cloete, Veil hub discs in clear perspex with nut pockets, 2026.*



Evaluation

39 Peer and User Testing
39 Evaluation Against the Brief
39 What Failed and What I Would Change

Peer and User Testing

I collected feedback from other people at four points. First was the concept crit on 5 October, where I presented three directions and went forward with Palimpsest. Second was lecturer feedback on 6 October. My lecturers said the acrylic veil looked cheap for an heirloom and the drum looked too much like a tube. I went back to glass, which had been my first intent, and the tube comment led to the body study of 11 October, where I compared ten bodies and chose the Shadow drum. Third was the survey of 19 people on 12 October, which tested values and preferences rather than the product itself (Figure 3). Fourth was the concept presentation on 13 October, which went well and confirmed the direction.

No one else has read the time off the finished clock yet, though I find it easy to read. The next test is to hang it at home and ask three to five people of different ages to read the time from about 3 m. I will note how long they take and whether they are within a quarter of an hour, and record what they say about the copper, the veil and the ball. A second check is whether a family member can take the engine off the back panel by following the dry-assembly instructions alone.

Evaluation Against the Brief

Measured against the brief, the clock meets most of what was asked. It is a personal heirloom at full size that carries the Ubi cras motto, records its own use in the patina and has a handover ritual. Its circular-design case rests on attachment, durability and repair (Table 2). The bent-lamination drum is the manufacturing method that is new to me, and the finished drum has three plies. No MDF, chipboard, OSB or melamine is in the product, because the MDF is used only for the bending former, which is a tool, and 3D printing is not the final method, because every small part is laser-cut from perspex. The name is laser-engraved on a cork disc on the back panel (Task 8). Costing and wastage are in Tables 5 and 6, the technical drawings are 14 A3 sheets from the as-built CAD (Appendix C), and the studio photographs of the finished clock were taken on 6 November. Two requirements are only partly met: the budget of R2,000 to R5,000, where the materials would cost about R4,200 at their cheapest, but the total spend including shipping, fuel, travel and testing is about R7,300, and material testing, where T02, T13, T06, T05 and T10 passed and the rest were not run or not measured. Against the R5,000 budget I went over, but with good reason: the extra spend paid for experiments and precautions that made sure the clock came out as it did. With what I know now, or if the clock were made in quantity, the cost would be much closer to R4,000.

What Failed and What I Would Change

Several things failed or changed during the project, and each one taught me something. The quartz movement failed its stall test and cost R390.00, but it led me to replace it with a stepper motor that is silent between movements and can be controlled more precisely. The veil also went through several changes. The acrylic mock-up did not have the finish I wanted for an heirloom, 3 mm glass was unavailable, and the wedge was eventually narrowed from 30° to 22°. The wedge also meant that the glass had to be annealed rather than toughened. Even that did not go to plan: the third ply cracked during the glue-up on 2 November, so I repaired it, steamed it and glued it again.

If I made the clock again, I would change three things. First, I would fit a homing sensor, a small 3 V Hall switch and a second magnet, so that the clock could find twelve o'clock on its own and correct lost steps; at present a single stall means the wrong time with no warning. Second, I would bend every ply dry round the former before the glue-up, and order the strips at about 1,400 mm with two spares instead of 1,700 mm with one, which also cuts the waste per strip from about 24 % to about 8 %. Third, I would test the motor torque before committing to the design rather than after, because the margin of 0.5 to 2.3 times is the biggest risk left in the clock.

No one else has read the time off the finished clock yet, though I find it easy to read.



Conclusion

42 Summary of Findings
42 Product Success

Summary of Findings

I learned most from the things that went wrong.

I learned most from the things that went wrong. The stalled quartz movement taught me to test the riskiest part first, before building around it. The laser seat strip taught me that a drawn size is not a cut size, and that one cheap test strip saves remaking a part. Sourcing taught me that asking suppliers the right question changes the price, as when the copper went from a R4,560 sheet to a R920 circle cut to size. I also learned to keep what I have calculated apart from what I have measured, and to say which is which. The cracked ply showed me that a calculated margin of 1.11 for a weak strip leaves very little room.

Product Success

Where Tomorrow is a wall clock in which a steel ball, dragged by a hidden magnet, travels round a copper face once every 12 hours and slowly polishes a record of its own use. At hand-in the clock is finished and running. People who have seen it said it looks just like the renders. The arm holds the ball against the copper perfectly when the clock is set upright, and the veil sits right by the arm and moves with it as the arm turns. The clock is easy to take apart and harder to put back together, which I accept because it is an heirloom that is not meant to be assembled over and over; it is rechargeable, sturdy and beautiful. I am happy with the staining and with bent lamination as a new manufacturing method, and with the copper patina, because neither outcome can be predicted and both came from testing. The frosted glass turned out well; it is not smudge resistant, but it looks as expected. The scribed ticks look even more beautiful than I imagined, and having the clock in my hands is far more exciting than seeing the render. I am happy with the product and I can't wait to show it to people.

The next steps are to finish the tests, weigh the clock, have other people read the time from it, and replace every calculated figure that a test can confirm. After that, the clock needs a homing sensor and a handover kit: the tick template, the fuming instructions and a keeper's record on the back board. The one thing I want remembered is that this clock is meant to look older every year, and that its wear is the point.

The one thing I want remembered is that this clock is meant to look older every year, and that its wear is the point.



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Appendix A: Project Brief

The ID300 Project 4 brief (Open Window, 2026) is included in full below as Figures 41 to 62, one figure per page.



SCHOOL OF
CREATIVE TECHNOLOGIES
ID 300

SUSTAINABLE DESIGN

S2 - PROJECT 4 | BRIEF

14 SEPTEMBER 2026

LECTURER
WELMARIÉ MOMBERG
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JUAN TALJAARD
juan@openwindow.co.za

OPEN WINDOW

IMAGE REFERENCE: https://za.pinterest.com/pin/106897166160658519/

Figure 41: *Open Window, ID300 Project 4 brief, page 1, 2026.*



WELCOME BACK!

INTRODUCTION

For half a century Industrial economies were characterized and underpinned by a throwaway culture. It is only recently that governments started to consider the short lifespan of consumer goods, with the EU who will ban single-use plastic for fruit and vegetables, condiments in fast food restaurants, thin plastic bags and mini cosmetic bottles in hotels in 2030. Businesses in the UK needs to pay plastic packaging tax since April 2022.

This creates quite a challenges for many companies whom will need to change their current business models. It would not be an easy task to bring about this mind-set change. In future models the intrinsic quality of goods and services will be the drivers for profit. The world needs to change from a linear to a circular economy because we can no longer ignore the consequences we might have on the environment over the next 50 years.

Let's analyse our current assumptions and envision possible long term opportunities. As designers we can explore new directions and express ideas inline with a circular model. As entrepreneurs we can redefine our responsibility and form new partnerships that will contribute to sustaining long term product value.

Images: We have produced 8000 tonnes of space debris.

Figure 42: *Open Window, ID300 Project 4 brief, page 2, 2026.*



WELCOME BACK!

INTRODUCTION

A "business model" is the rationale of the processes driving a company. When considering a circular business model one would also take into account the system around the product rather than the product itself. Cooperation with different partners that will be responsible for different life cycle segments could enhance the circular business.

When it comes to Circular Design the designer would create products and services that do not have a lifecycle with a beginning, a middle, and an end. In short, sustainability should actually assimilate lifespan extension strategies.

There are 6 defined strategies. They are:

- Design for attachment and trust.
- Design for durability.
- Design for standardization and compatibility.
- Design for ease of maintenance and repair.
- Design for adaptability and upgradability.
- Design for dis-and reassembly.

GUIDING THE FUTURE OF DESIGN

DEFINITION

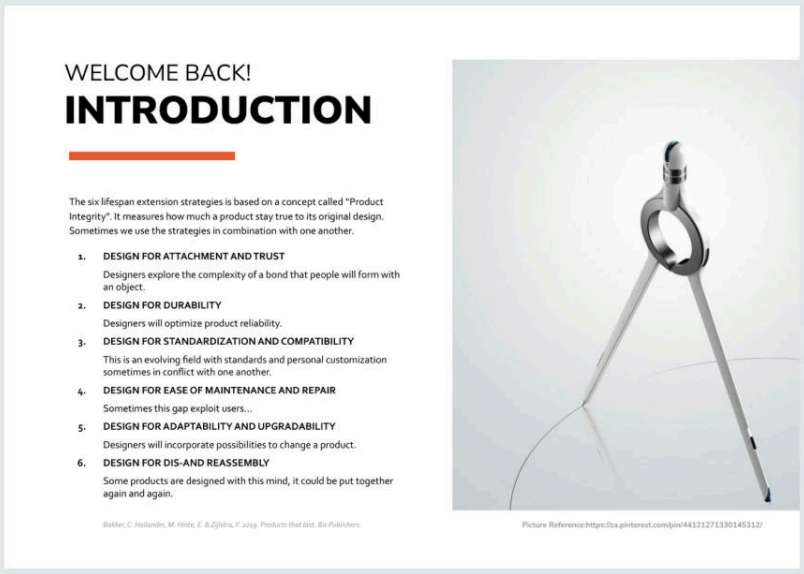
CIRCULARITY

CREATING PRODUCTS THAT LAST LONGER AND ARE DESIGNED WITH THE END IN MIND.

PRINCIPLES

001 002 003 004 005

Figure 43: *Open Window, ID300 Project 4 brief, page 3, 2026.*



WELCOME BACK!

INTRODUCTION

The six lifespan extension strategies is based on a concept called "Product Integrity". It measures how much a product stay true to its original design. Sometimes we use the strategies in combination with one another.

1. **DESIGN FOR ATTACHMENT AND TRUST**
   Designers explore the complexity of a bond that people will form with an object.
2. **DESIGN FOR DURABILITY**
   Designers will optimize product reliability.
3. **DESIGN FOR STANDARDIZATION AND COMPATIBILITY**
   This is an evolving field with standards and personal customization sometimes in conflict with one another.
4. **DESIGN FOR EASE OF MAINTENANCE AND REPAIR**
   Sometimes this gap exploit users...
5. **DESIGN FOR ADAPTABILITY AND UPGRADABILITY**
   Designers will incorporate possibilities to change a product.
6. **DESIGN FOR DIS-AND REASSEMBLY**
   Some products are designed with this mind, it could be put together again and again.

Bakker, C. Hollander, M. Hinte, E. & Zijlstra, Y. 2014. Products that last. Bis Publishers.

Picture Reference:https://za.pinterest.com/pin/441212713301453 12/

Figure 44: *Open Window, ID300 Project 4 brief, page 4, 2026.*



WELCOME BACK!

INTRODUCTION

WHAT YOU WILL LEARN:

- Systems thinking in action. The tangible and intangible product attributes that promote sustainability.
- To measure creativity through uniqueness and value.
- How to design with a sustainable future in mind.
- Costing (estimate on design, production, logistics and marketing).
- Model building, user testing and evaluation.
- How to apply design in a Real world-synthesis.

Picture Reference: https://za.pinterest.com/pin/772226667361894277/

Figure 45: *Open Window, ID300 Project 4 brief, page 5, 2026.*

TERM 4 OUTLINE

THE BRIEF

Students will be required to apply a circular business and design model to furniture design or a future heirloom piece.

You are invited to use your free-spirited thinking and innovative flair to create an object or furniture piece that fully encapsulates the themes of sustainability, longevity and quality. How can we foster a sense of thoughtful, intentional and holistic design in an increasingly fast-paced world? We are moving away from creating things that are produced and sold just to become waste after a few years to products with value that can cultivate during longer periods of time.

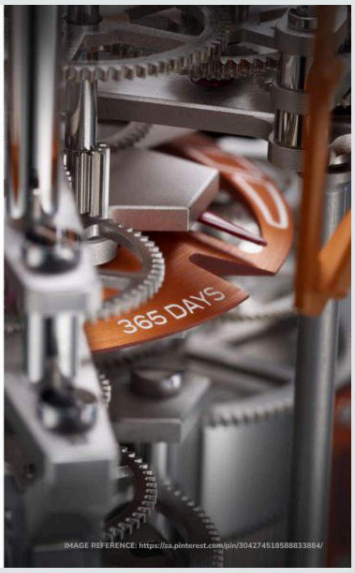


Figure 46: *Open Window, ID300 Project 4 brief, page 6, 2026.*

TERM 4 OUTLINE

THE BRIEF

Furniture Designers have the pleasure of combining innovation, aesthetic appeal, comfort and functionality. It could add style and personality to a space. Furniture has evolved and changed over the years. It sometimes also has a distinct cultural reference or heritage. Think about the difference of Scandinavian furniture versus Victorian furniture and/ or traditional Cape Dutch furniture. In the early 19th Century, new materials such as steel, plywood and moulded plywood and new methods came together in innovative ways. More economical methods of manufacturing furniture became the relevance of the day. Since that time, the shift was to design for the available manufacturing methods. It was only very recently that boundaries were pushed within this industry. Furniture designers were forced to grow manufacturer process skills and even steer systems/ line production around this knowledge.

If you decide to design and manufacture something else we would like you to consider the same principles than mentioned above.

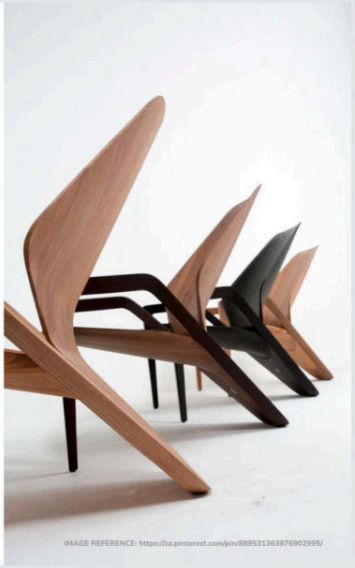


Figure 47: *Open Window, ID300 Project 4 brief, page 7, 2026.*

TERM 4 OUTLINE

THE BRIEF

Students are required to design and manufacture a "personal" furniture piece or a future heirloom piece.

You are required to do in depth research around circular design and the six lifespan expansion strategies. You need to highlight what combination of strategies will be applied to your design and how.

You will have a choice of five furniture items (A chair, a lounge coffee table, a storage solution unit, a studio desk or an outside furniture piece), or a future heirloom piece. It should be made from any material or combination of materials. (Wood, steel, string, leather, plastic, cement, upholstery or any other material in combination with one another). You are allowed to print on it should you wish too. The piece could be self-supported, glued or fastened with fittings. The piece could be CNC-Routered (2 to 5-axis), laser-cut, turned by lathe as part of the process, bent or hand-crafted to name a few methods...

The piece should be finished as if by a master craftsman. It should be a personal piece that could be passed on to generations to come... You need to fasten a small plate to the piece engraved with your name and year of manufacturing.

This is your ULTIMATE MASTERPIECE with which you will conclude your studies. So let's celebrate this unusual opportunity!



Figure 48: *Open Window, ID300 Project 4 brief, page 8, 2026.*

TERM 4 OUTLINE

THE BRIEF

Students are required to design and manufacture a "personal" furniture piece or a future heirloom piece.

You are **NOT** allowed to use the following materials or methods for this project:

- MDF (Medium Density Fiberboard).
- Chipboard.
- OSB (Oriented Strand Board).
- Melamine Faced Board.
- 3D-Printing as a final manufacturing method (It could however form part of the process for instance 3D-Printing in wax for casting).

You are required to use at least one new method of manufacturing. This does not include finishing.



Figure 49: *Open Window, ID300 Project 4 brief, page 9, 2026.*

TERM 4 OUTLINE

THE BRIEF

THE FOLLOWING WOULD BE REQUIRED TO BE CREATED FOR THIS PROJECT:

TASK 1: Research and Information synthesis.

TASK 2: A Set of drawings for each phase in development.

TASK 3: Mock-up models and physical piece.

TASK 4: Digital Media (CAD, renderings and posters).

TASK 5: A cost analyses.

TASK 6: A complete set of technical drawings.

TASK 7: Photographic reference documentation of your work.

TASK 8: An Engraved name plate or engraving.

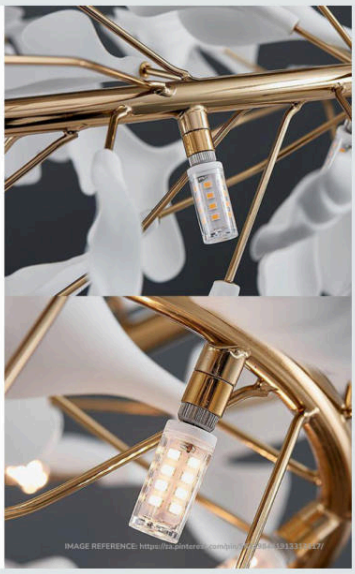


Figure 50: *Open Window, ID300 Project 4 brief, page 10, 2026.*

TERM 4 OUTLINE

PHASE BREAKDOWN



A more detailed breakdown of each component can be found on the project rubric attached to the back of your brief.

1. **RESEARCH**

SOURCES & INFLUENCES OF INSPIRATION (INSPIRATION/ MOOD BOARDS)

- 360° Space Awareness/ Precedent Products (Could include history, brand awareness, competitive landscape, circular design analyses, goals and attributes to move forward).
- Visual Inspiration/ Stylistic direction (This could come from anywhere).
- Technical. (Details on material, components, manufacturing, assembly etc.)

RESEARCH AND INFORMATION SYNTHESIS

- Questionnaire/ Survey Feedback & Infographics.
- Manufacturing.
- Materials.
- User.

2. **CREATIVE VISION**

It is time to create the unique visual DNA for your product. Place the user in the center and give meaning, connection and value to the possible end-concept. Take into account which elements would be requested to include in the design/ final product. Ideation and conceptual exploration through:

- Concept Drawings.
- Explorative Drawings.

3. **DEVELOPMENT**

This phase is about the technical and visual foundation and the refinement of this. The development phase gives validation to an idea. Workability, ergonomics, flow and user-interaction could be tested in this phase.

- Explanatory sketches.
- Material Testing.
- Rapid Validation Mock-ups (before or after digital creation).
- CAD Development.
- An Engraved plate with name and year of manufacturing.

Figure 51: *Open Window, ID300 Project 4 brief, page 11, 2026.*

TERM 4 OUTLINE

PHASE BREAKDOWN



4. RENDERINGS

- 1-3 Renderings with a clean background. Different angles, details..
- Environmental/ Context render.
- One rendering with main dimensions (for technical poster).
- Exploded view rendering (for technical poster).

5. ENGINEERING DATA

This would imply the correct file choice for the correct choice of manufacturing. Nesting, layout, size conversion, depth measurement routing and increasing the speed of manufacturing by incremental changes to the system or product.

- The digital creation or conversion to production ready files.
- Nesting/ Layout.
- Specification of standard parts.
- Material Use & Wastage.
- Costing.
- Technical Poster/ Flow diagram.

ENGINEERING DRAWINGS

- General Assembly.
- Exploded View
- Detail

6. PRODUCTION

It is the keypoint where all the thoughts, ideas, imagery and sketch-work generated are transferred into a three-dimensional reality. In short it encapsulates phases 1 to 6. This might involve a great deal of building, finishing and assembly.

7. EVALUATION PHASE

- User Testing and Evaluations (Peer Testing).

8. LAUNCHING THE HEIRLOOM PIECE

It is the point in time where all the work that has been done gets a chance to be shared.

- Explanatory Sketches.
- Process Poster/ In Situ Poster/ Features & Benefits Poster.
- Assembly instructions (if needed).
- Photography.
- Product Video.
- Presentation.

Figure 52: *Open Window, ID300 Project 4 brief, page 12, 2026.*

PROJECT 4 OUTLINE

TIMELINE



Figure 53: *Open Window, ID300 Project 4 brief, page 13, 2026.*

TERM 4 OUTLINE

OUTCOMES

- The ability to communicate and present an original concept.
- To generate new insights and a fresh approach around sustainability in product design.
- Assimilating lifespan strategies in product design.
- To manage goal and expectations agreements with suppliers, manufacturers and assistants.
- To promote environmental and socially responsible projects.



IMAGE REFERENCE: https://za.pinterest.com/pin/551198441914340215/

Figure 54: *Open Window, ID300 Project 4 brief, page 14, 2026.*



TERM 4 HAND IN

DELIVERABLES

WEEKLY TASKS & PRESENTATIONS

Students should refer to Google Classroom or CANVAS weekly to download the task or challenge for that week. Each week will feature a deliverable and different practical projects to illustrate the themes and material handled in class.

YOU WILL NEED TO HAND IN:

RESEARCH AND INFORMATION SYNTHESIS

- Mood/ Inspiration Boards (Pdf Documents, Landscape Format)
- Research (Pdf Documents)

INDUSTRIAL DESIGN DRAWINGS

- 4X Phases of drawings (Scanned as JPG's).

RENDERINGS

- 5 High Quality Renders (renders should be at least 300 dpi, render in the highest quality, renders should not be smaller than 1920x1080)

ENGINEERING DATA

- PDF Documents (Landscape)

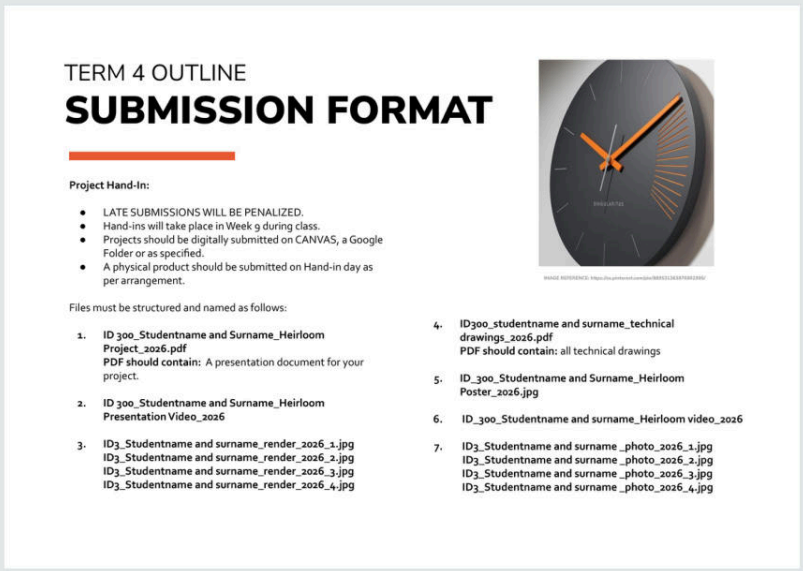
DIGITAL MEDIA

- Product & Process photos, Posters, Product Video

PHYSICAL MODEL

- Scale Model (1:1 Heirloom Piece)

Figure 55: *Open Window, ID300 Project 4 brief, page 15, 2026.*



TERM 4 OUTLINE

SUBMISSION FORMAT

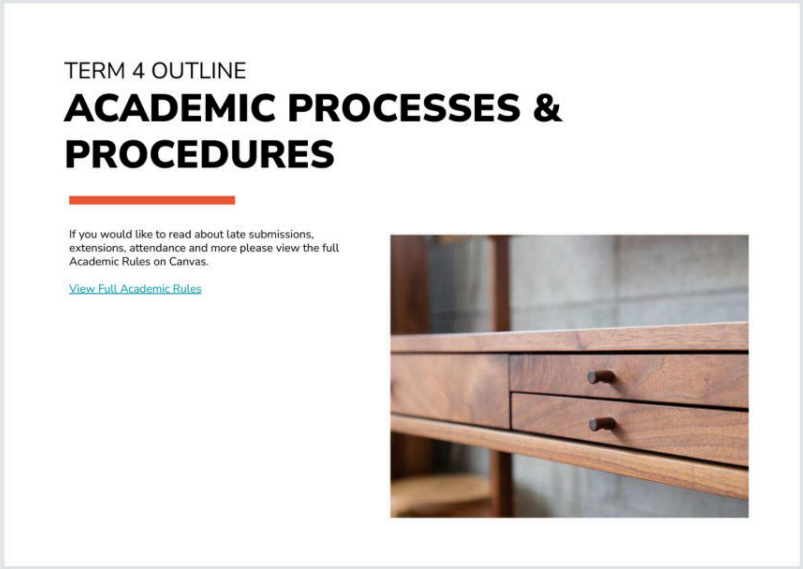
Project Hand-In:

- LATE SUBMISSIONS WILL BE PENALIZED.
- Hand-ins will take place in Week 9 during class.
- Projects should be digitally submitted on CANVAS, a Google Folder or as specified.
- A physical product should be submitted on Hand-in day as per arrangement.

Files must be structured and named as follows:

1. **ID 300_Studentname and Surname_Heirloom Project_2026.pdf**
   PDF should contain: A presentation document for your project.
2. **ID 300_Studentname and Surname_Heirloom Presentation Video_2026**
3. **ID3_Studentname and surname_render_2026_1.jpg**
   ID3_Studentname and surname_render_2026_2.jpg
   ID3_Studentname and surname_render_2026_3.jpg
   ID3_Studentname and surname_render_2026_4.jpg
4. **ID300_studentname and surname_technical drawings_2026.pdf**
   PDF should contain: all technical drawings
5. **ID_300_Studentname and Surname_Heirloom Poster_2026.jpg**
6. **ID_300_Studentname and surname_Heirloom video_2026**
7. **ID3_Studentname and surname _photo_2026_1.jpg**
   ID3_Studentname and surname _photo_2026_2.jpg
   ID3_Studentname and surname _photo_2026_3.jpg
   ID3_Studentname and surname _photo_2026_4.jpg

Figure 56: *Open Window, ID300 Project 4 brief, page 16, 2026.*



TERM 4 OUTLINE

ACADEMIC PROCESSES & PROCEDURES

If you would like to read about late submissions, extensions, attendance and more please view the full Academic Rules on Canvas.

View Full Academic Rules

Figure 57: *Open Window, ID300 Project 4 brief, page 17, 2026.*

TERM 4 OUTLINE

INDEMNITY

Please note that this project might require you to work with various hand-tools and or bigger equipment/ stationary tools for manufacturing and assembly.

It is at all times extremely important that you respect the safety requirements within the classroom and Workshop. Please make yourself aware of the Workshop rules.

View Workshop Rules

Although we have trained First Aiders on Campus, we can't take responsibility if you are not abiding by the rules. Please make safety a priority at all times.



IMAGE REFERENCE: https://za.pinterest.com/pin/551198441910783957/

Figure 58: *Open Window, ID300 Project 4 brief, page 18, 2026.*

TERM 4 OUTLINE

CRITERIA FOR ASSESSMENT

MARK BREAKDOWN

SUSTAINABLE RESEARCH	10%
PROOF OF MATERIAL TESTING	05%
COSTING	10%
PHYSICAL PRODUCT	30%
PROMOTIONAL/ PROCESS VIDEO	10%
PRODUCT POSTER	10%
PRODUCT PHOTOGRAPHY	10%
CLASS PRESENTATION	15%



IMAGE REFERENCE: https://za.pinterest.com/pin/551198441914337378/

Figure 59: *Open Window, ID300 Project 4 brief, page 19, 2026.*

TERM 4 OUTLINE

RESEARCH & RESOURCES

PRESCRIBED BOOKS:

Bakker, C. Hollander, M. Hinte, E. & ZijlstraY. 2019. *Products that last. Product Design For Circular Business Models.* Amsterdam: Bis Publishers.

RECOMMENDED BOOKS:

Boeijen, A. Daalhuizen, J. & Zijlstra, J. (2020). *DELFT DESIGN GUIDE: Perspectives- Models- Approaches- Methods.* Amsterdam: BIS Publishers.

Heufler, G. & Lanz, M & Prettenthaler, M. (2019). *Design Basics: From Ideas to Products.* BS Media Group: Niggli.

Lawson, S. (2013). *Furniture Design: An introduction to Development, Materials and Manufacturing.* London: Laurence King Publishing Ltd.

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Yudina, A. (2015) *Furnitecture: Furniture that transforms space.* New York: Thames & Hudson.

Figure 60: *Open Window, ID300 Project 4 brief, page 20, 2026.*

TERM 4 OUTLINE

TERM SCHEDULE

WEEKLY BREAKDOWN

WEEK 1: 14 September 2026	
DESCRIPTION: - Introduction & Briefing. - Visual,user focused and circular design research. - Discussion and Feedback.	**HOMEWORK:** - Task 1 Challenge
WEEK2: 21 September 2026	
DESCRIPTION: - Discussion and feedback. - Data analysis. - Ideation Sketches. - Explorative Sketches.	**HOMEWORK:** - Task 2 Challenge
WEEK 3: 28 September 2026	
DESCRIPTION: - Mock-up Models.	**HOMEWORK:** - Task 3 Challenge

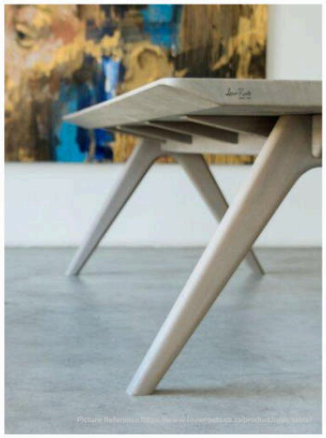

Figure 61: *Open Window, ID300 Project 4 brief, page 21, 2026.*

WEEK 4: 5 October 2026	
DESCRIPTION: - Present 3 concept directions in class, alongside development models. - Start with CAD	**HOMEWORK:** - Task 4 Challenge
WEEK 5: 12 October 2026	
DESCRIPTION: - Presentation	**HOMEWORK:** - Task 5 Challenge
WEEK 6: 19 October 2026	
DESCRIPTION: - Renderings - Engineering Data	**HOMEWORK:** - Task 6 Challenge
WEEK 7: 26 October 2026	
DESCRIPTION: - Renders - Digital media - Final model	**HOMEWORK:** - Task 7 Challenge
WEEK 8: 2 November 2026	
DESCRIPTION: Full submission	

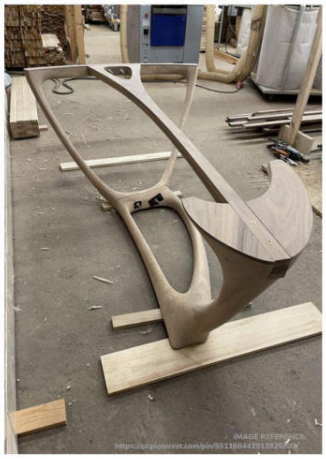

Figure 62: *Open Window, ID300 Project 4 brief, page 22, 2026.*

Appendix B: Questionnaire

The survey was a Google Form completed by 19 people on 12 October 2026. The questions and the counts are below.

1. Why would you keep an object for decades? (tick all that apply) It tells a story: 13. It belonged to someone I loved: 12. It is beautifully made: 10. It is repairable and still works: 7. It ages well (patina): 7. It is useful every day: 4. It is worth money: 2.
2. Which material pairing would you most want to keep? Copper with dark wood: 10. Brass with light oak: 6. Ceramic or stone: 2. Steel with glass: 1.
3. If it broke, would you repair or replace it? Repair it myself: 11. Have someone repair it: 5. Replace it if that is cheaper: 3. Replace it: 0.
4. How do you read a wall clock? I want the exact minute: 9. One hour hand is enough: 5. A clock is decoration, I use my phone: 4. Digital: 1.

Age groups: 20 to 29, 10 people; 30 to 49, 3 people; 50 and over, 6 people.

Appendix C: Engineering Drawings

The drawing set has 14 A3 sheets: the general assembly, a section with details, the exploded view and one sheet for each of the 11 made parts (Figures 63 to 76). It was drawn in SolidWorks, with each drawing named after its part in capitals and a general tolerance of ±0.2 mm.

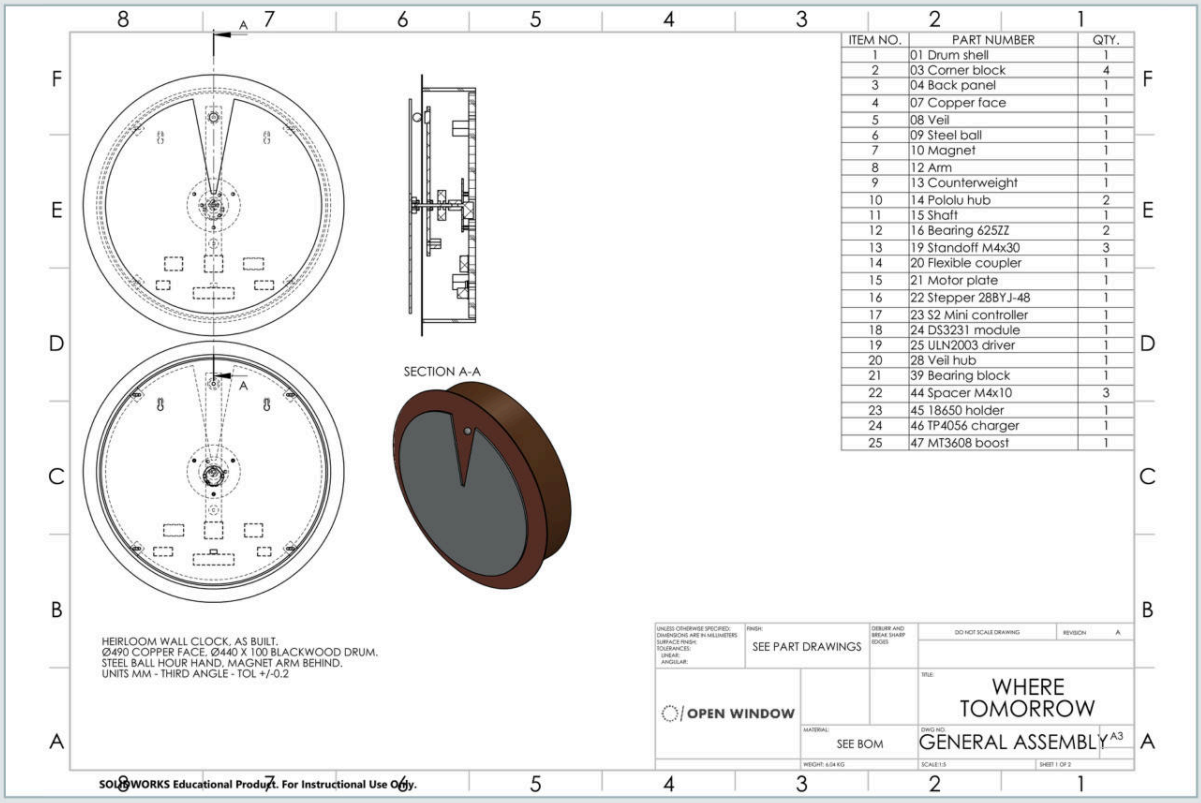

Figure 63: *Liam Cloete, General assembly, engineering drawing, 2026.*

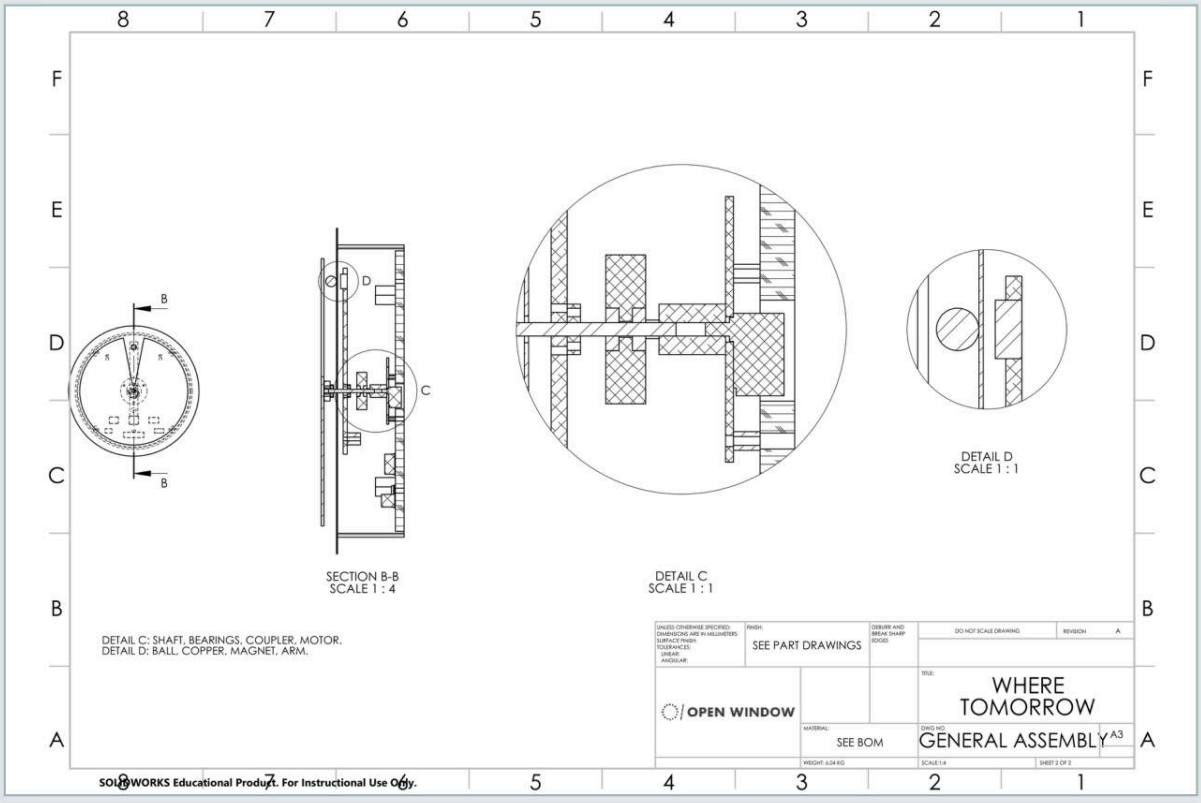

Figure 64: *Liam Cloete, Section B-B and details, engineering drawing, 2026.*

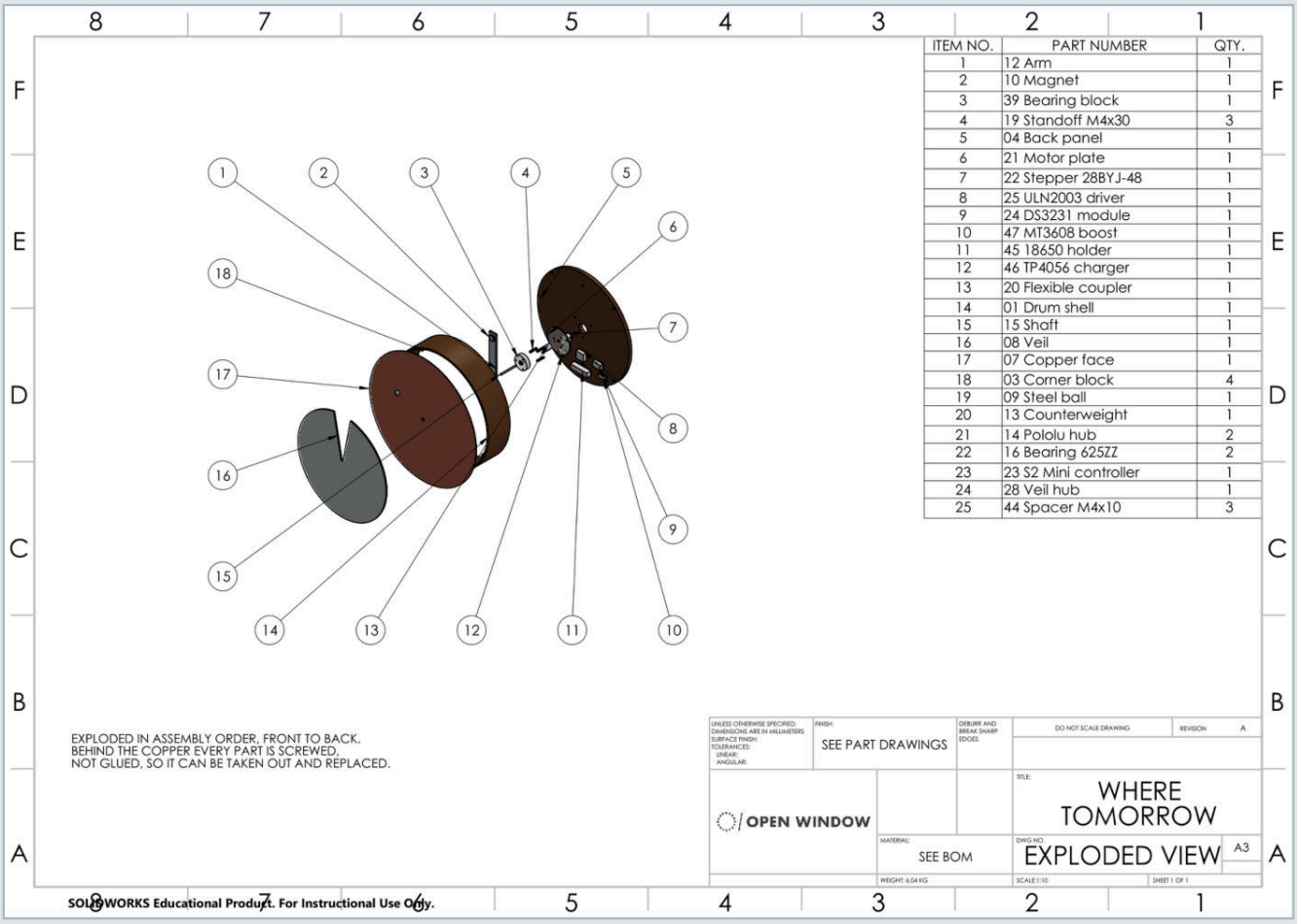

Figure 65: *Liam Cloete, Exploded view, engineering drawing, 2026.*

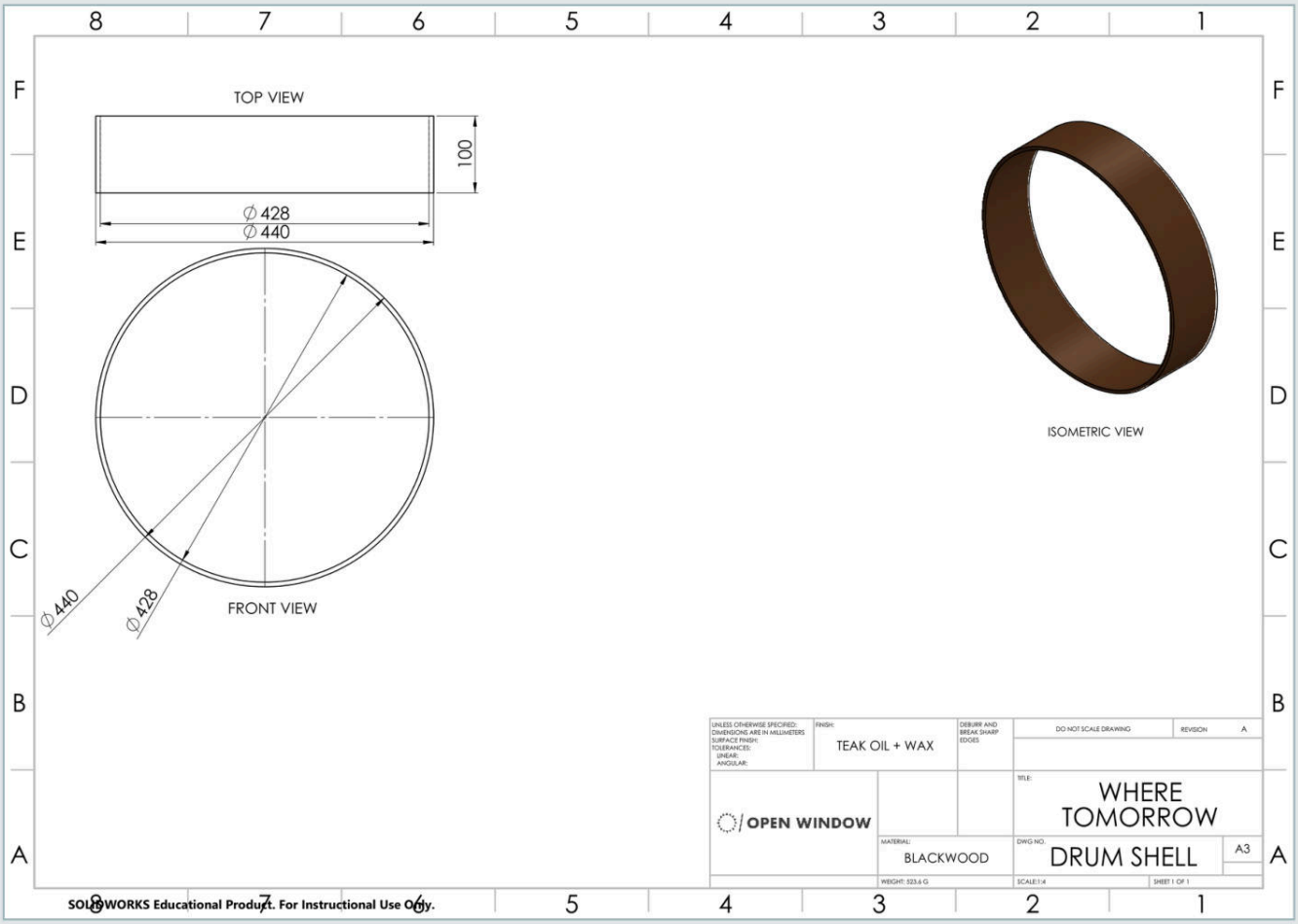

Figure 66: *Liam Cloete, Drum shell, engineering drawing, 2026.*

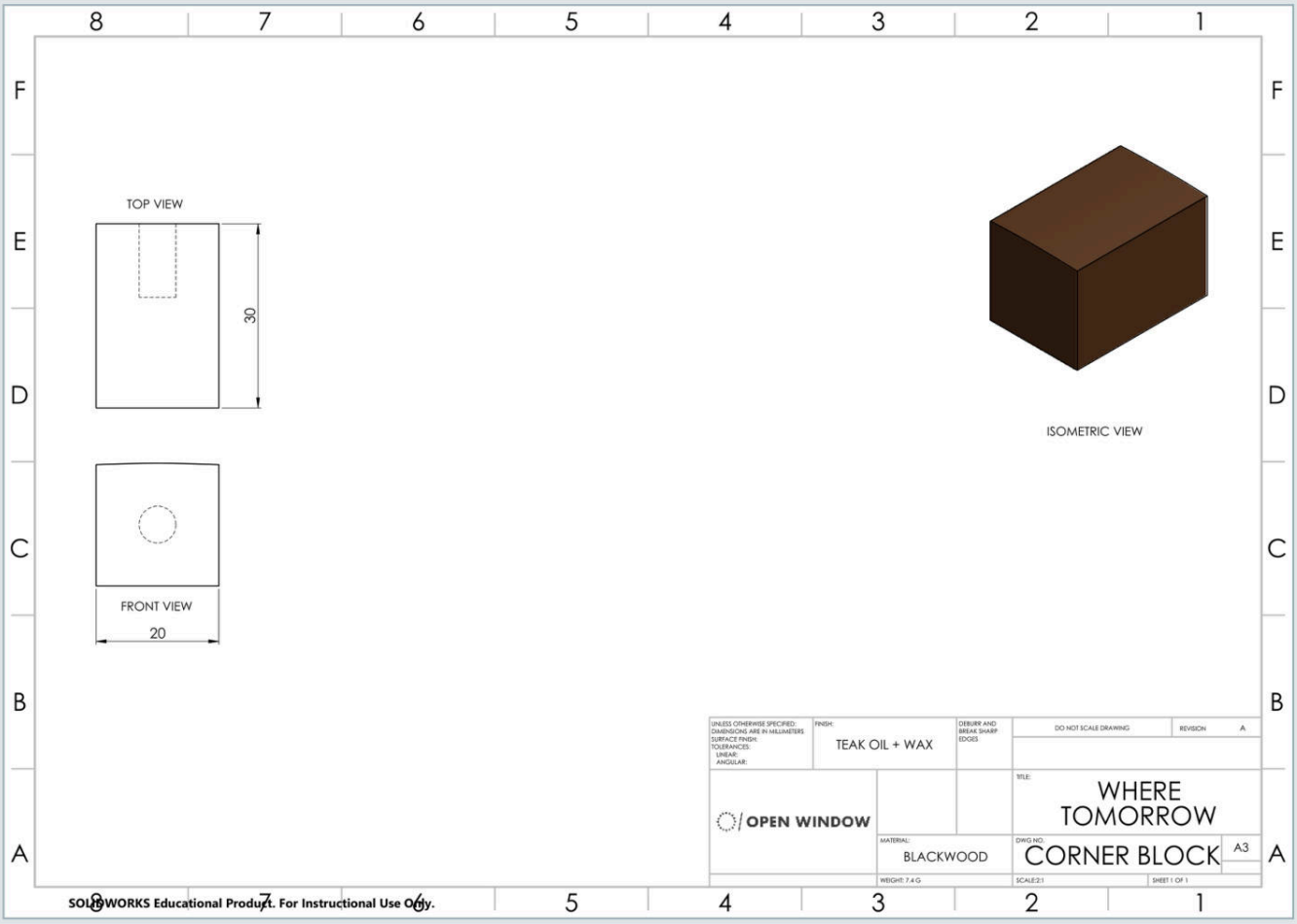

Figure 67: *Liam Cloete, Corner block, engineering drawing, 2026.*

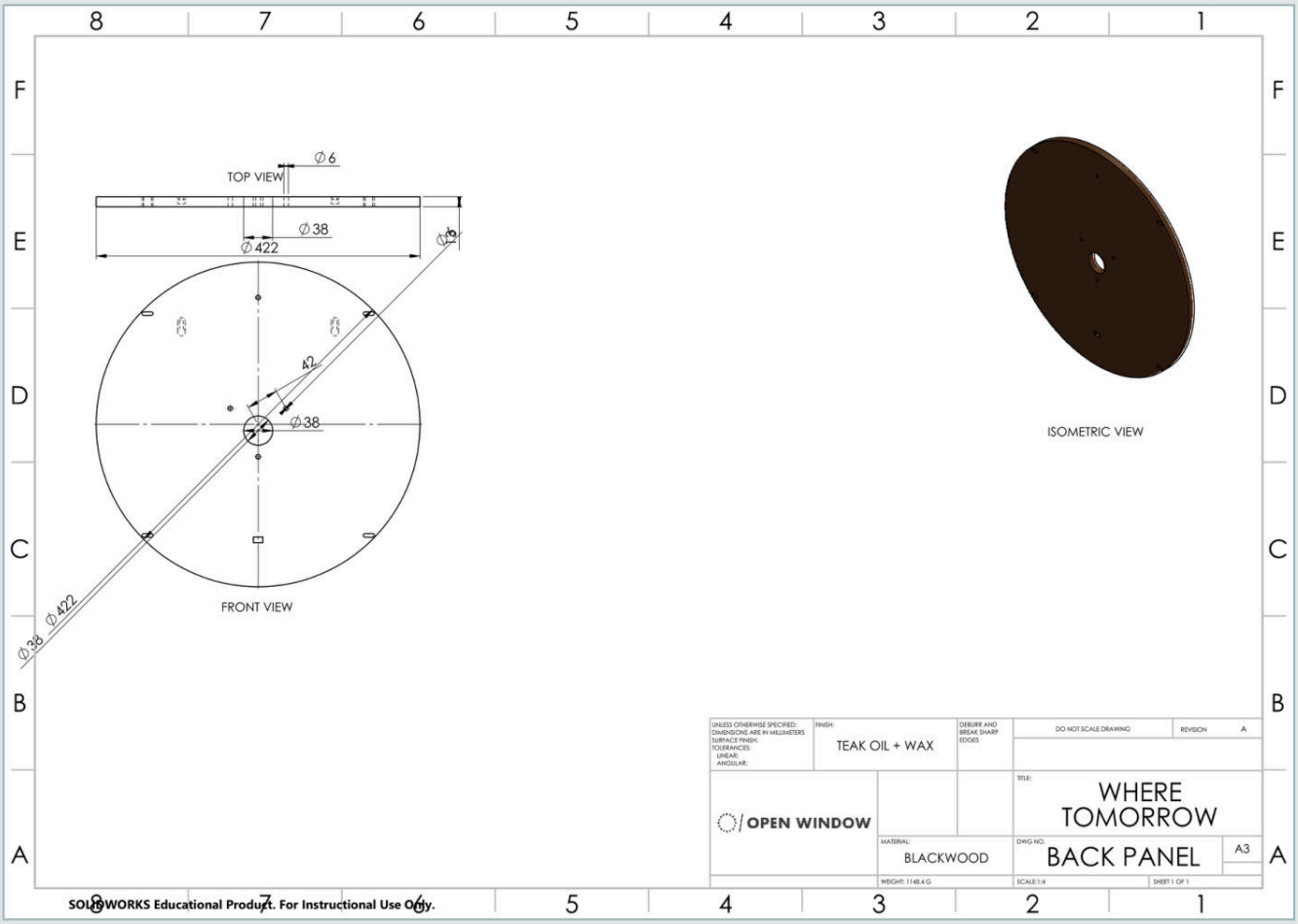

Figure 68: *Liam Cloete, Back panel, engineering drawing, 2026.*

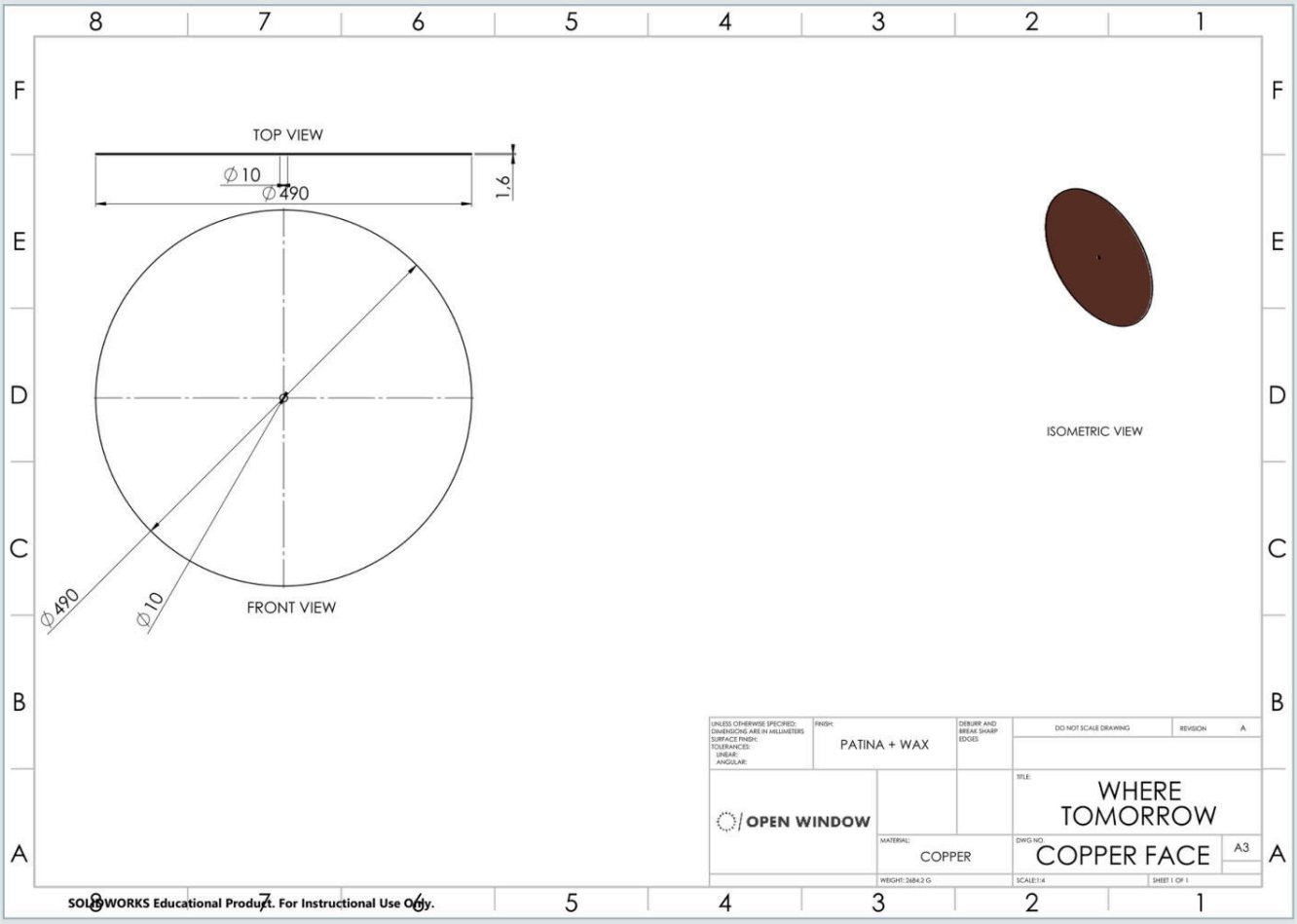

Figure 69: *Liam Cloete, Copper face, engineering drawing, 2026.*

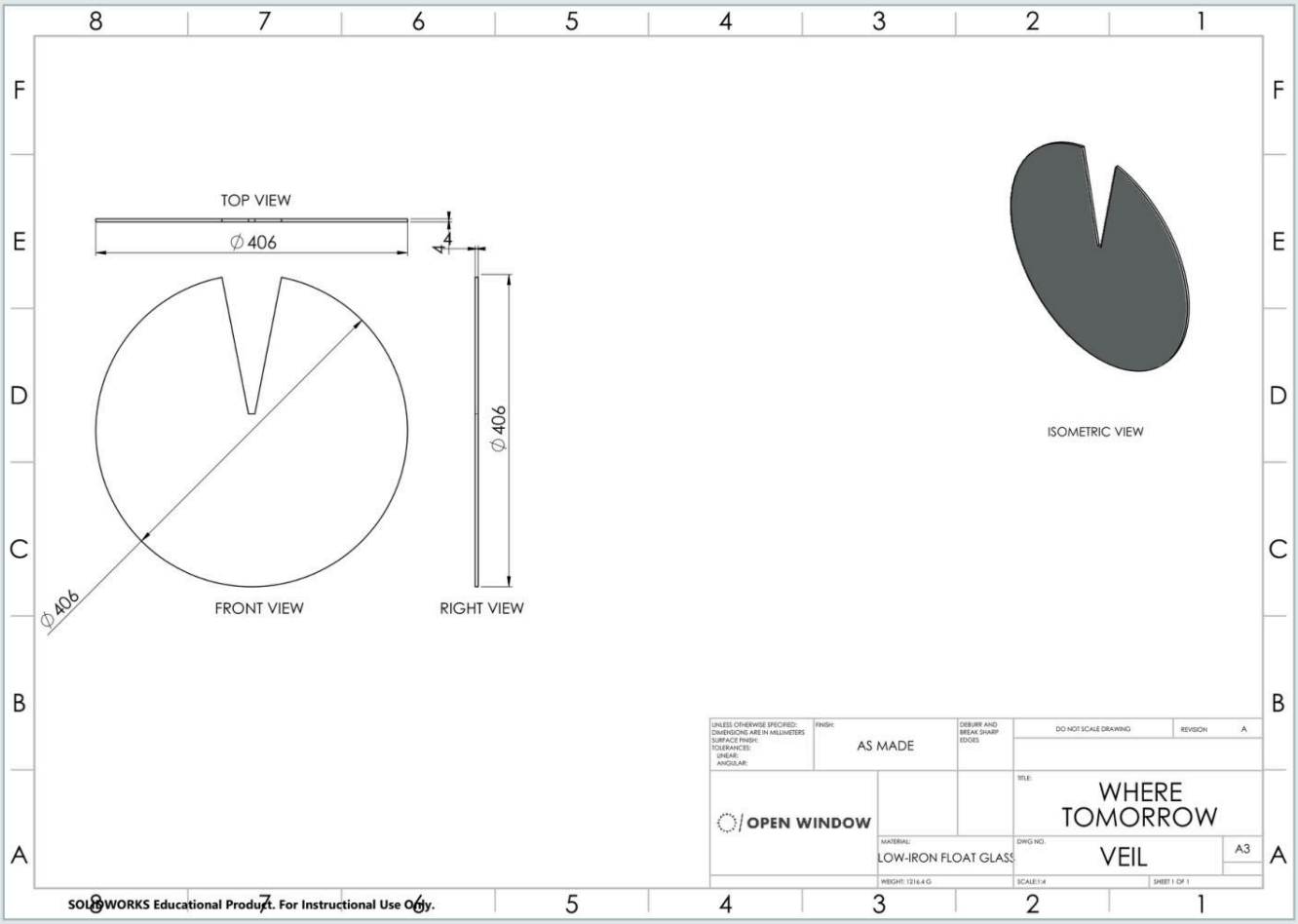

Figure 70: *Liam Cloete, Veil, engineering drawing, 2026.*

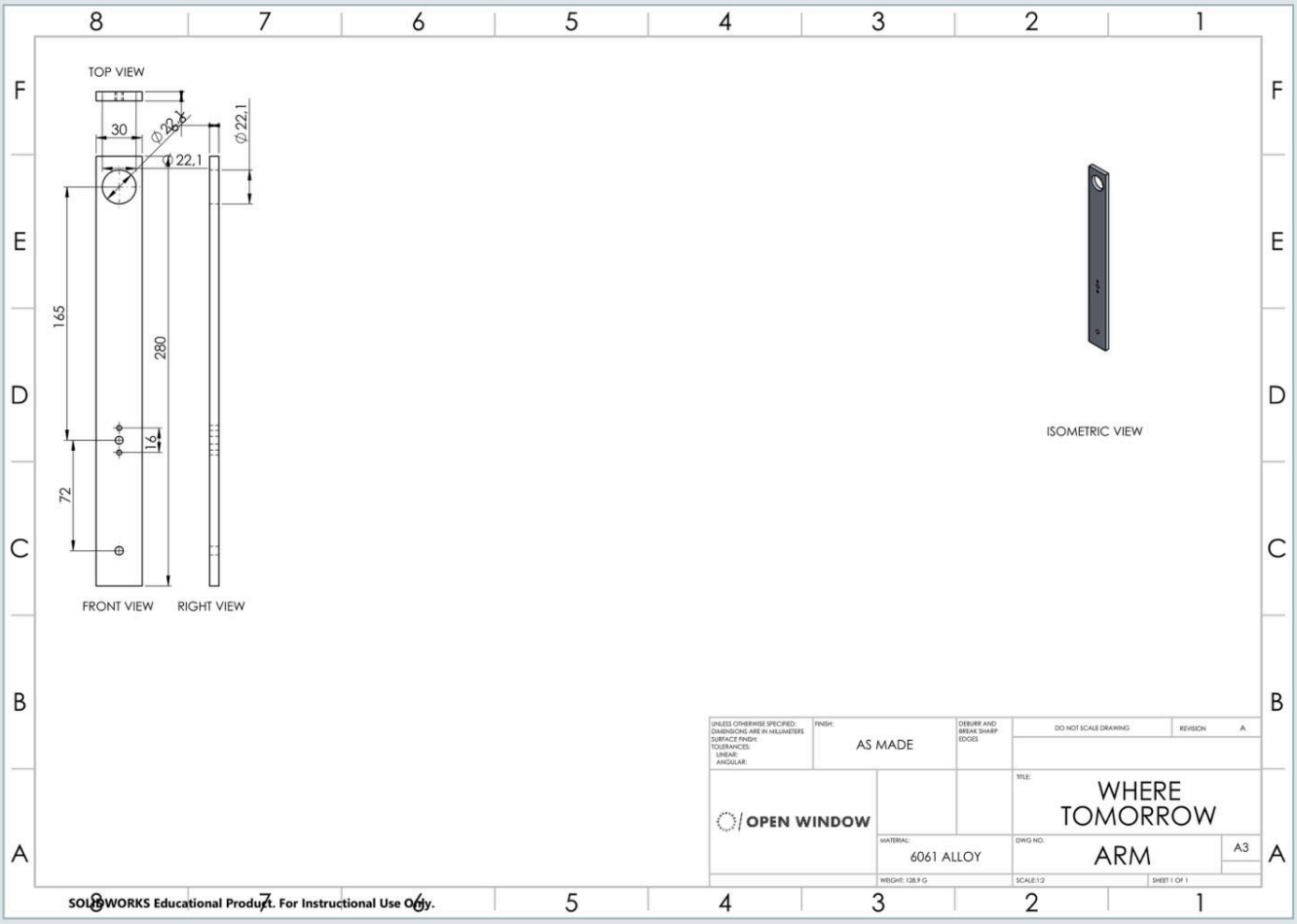

Figure 71: *Liam Cloete, Arm, engineering drawing, 2026.*

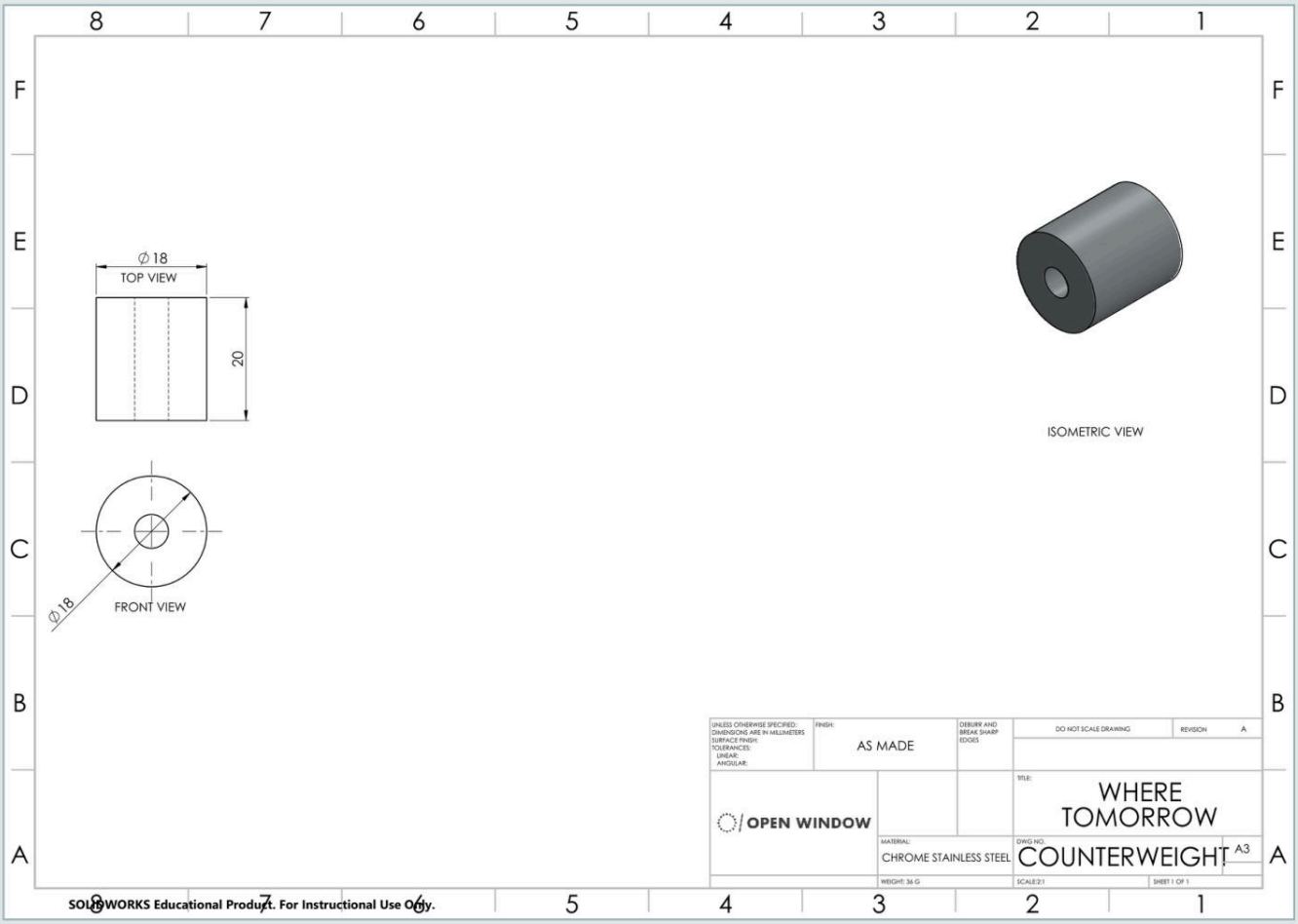

Figure 72: *Liam Cloete, Counterweight, engineering drawing, 2026.*

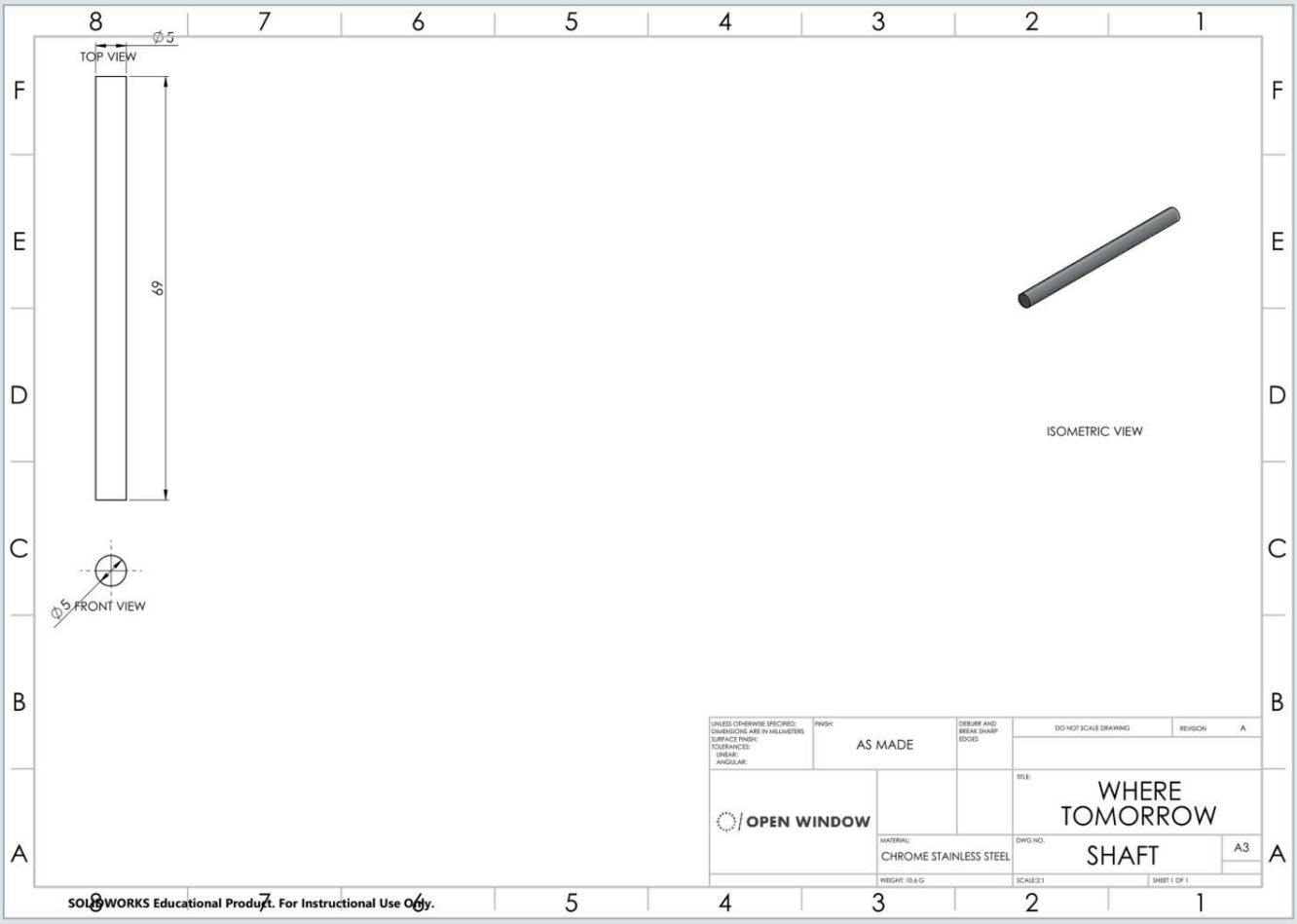

Figure 73: *Liam Cloete, Shaft, engineering drawing, 2026.*

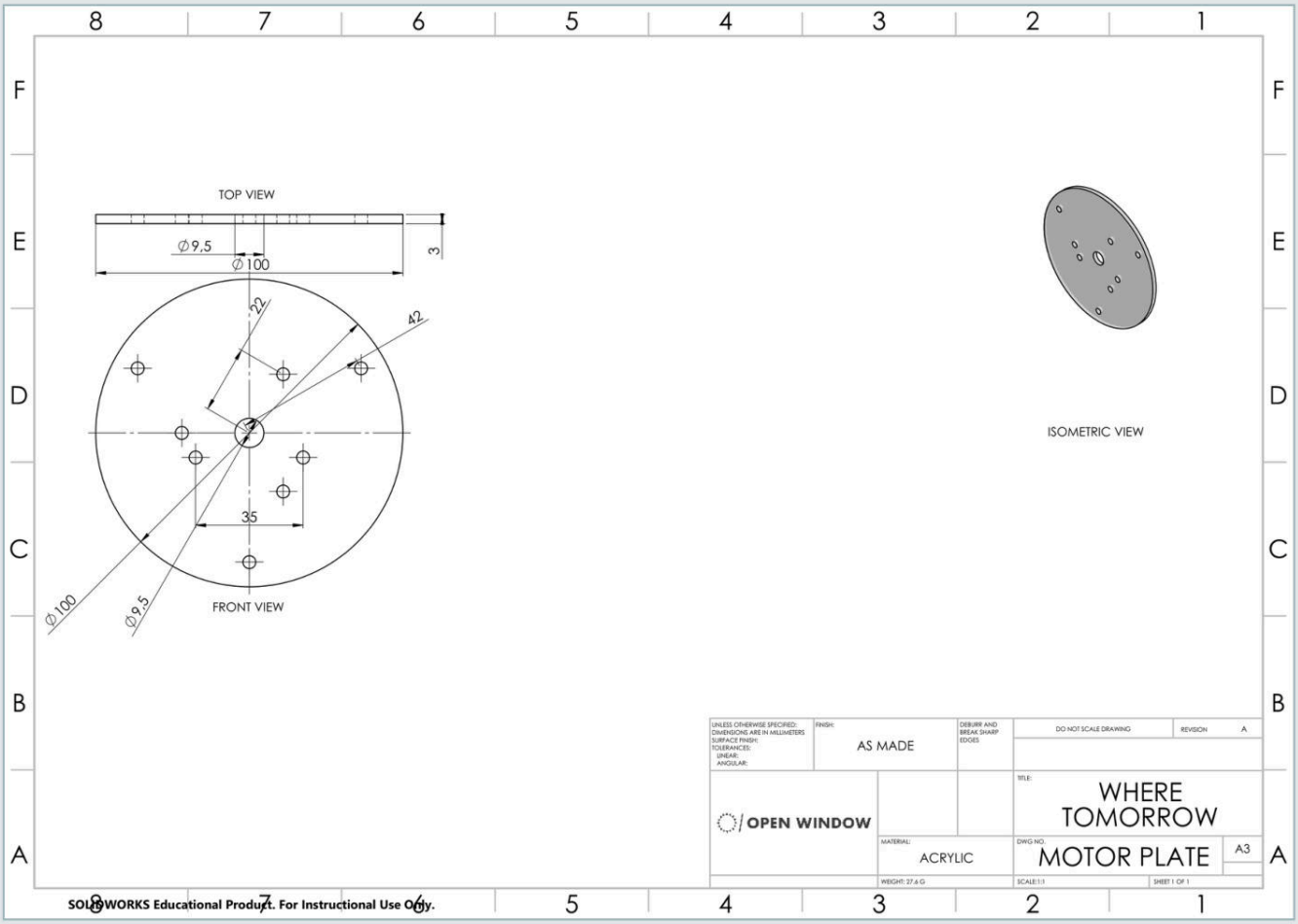

Figure 74: *Liam Cloete, Motor plate, engineering drawing, 2026.*

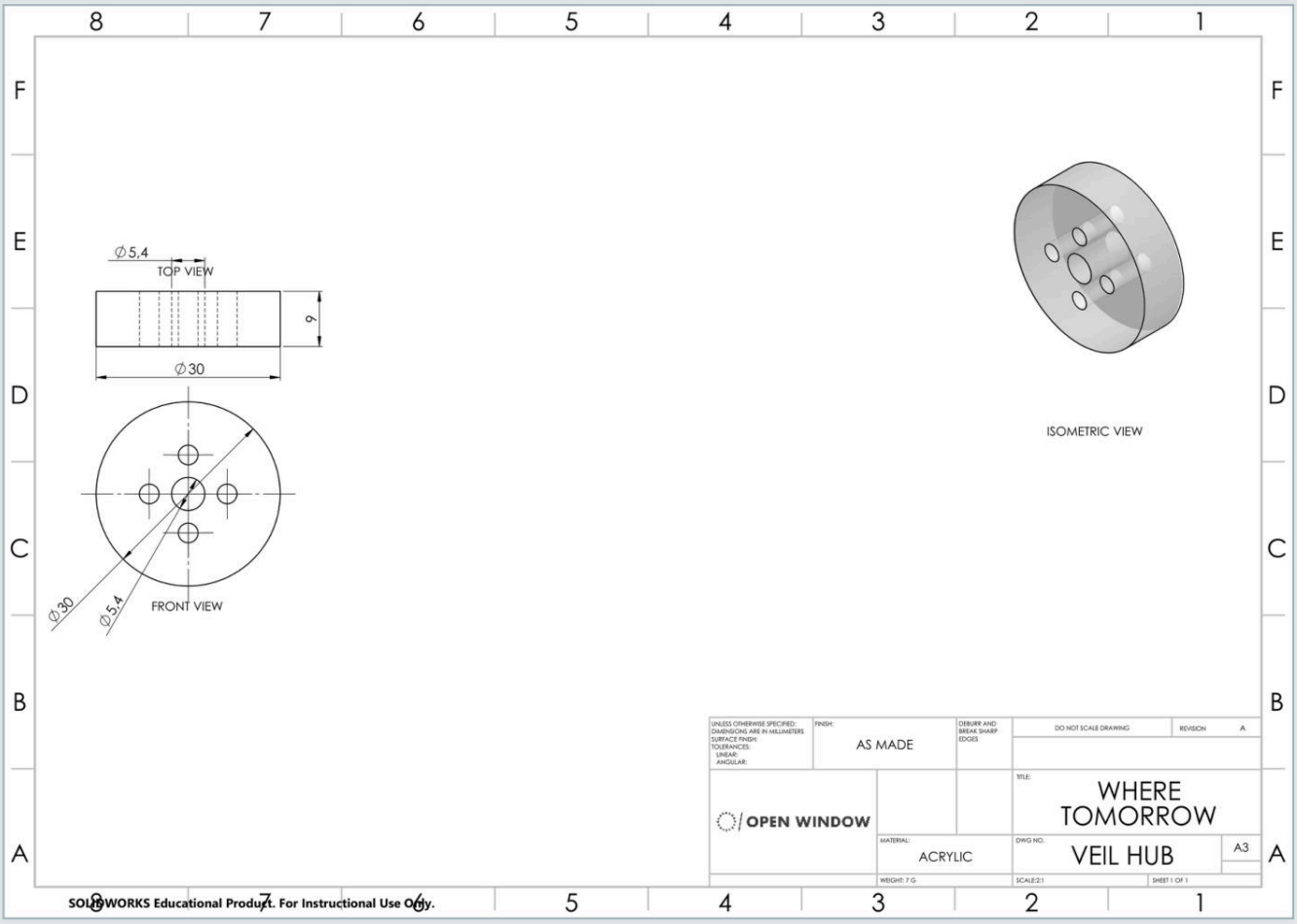

Figure 75: *Liam Cloete, Veil hub, engineering drawing, 2026.*

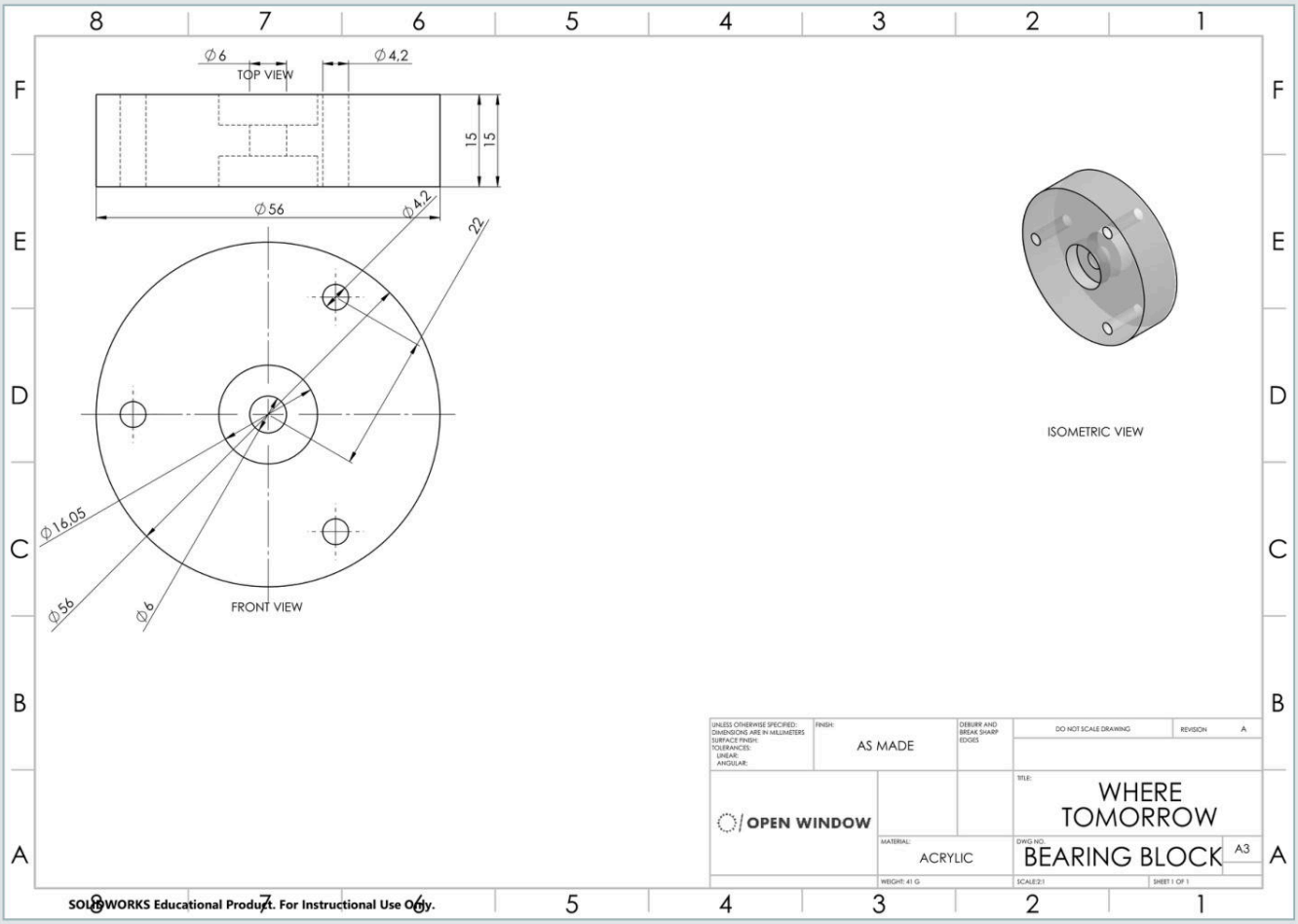

Figure 76: *Liam Cloete, Bearing block, engineering drawing, 2026.*

A clock suits that question better than any other piece of furniture, because its whole job is to show time passing.

Where Tomorrow

Liam Cloete
Industrial Design 300, Open Window 2026

