



ANDY NGUYEN
N11276151

**Project - Heat Stress On Outdoor
And Fabrication Trade Workers**

Authenticity Statement

This is to certify that to the best of my knowledge, the content of this presentation is my own work. This presentation has not been submitted for any subject or for other purposes. I certify that the intellectual content of this presentation and design is the product of my own work and that all the assistance received in preparing this report and sources have been acknowledged.

Your name: Andy Nguyen

Student number: N11276151

Date: 31/10/2025

AI Use Statement

I have utilised AI in this presentation (indicate what AI was used - e.g. GPT, Claude, Dall-E, etc to assist in various ways. The way I have used AI includes clarifying and simplifying texts and ideas from badly written sentences.

Your name: Andy Nguyen

Student number: N11276151

Date: 31/10/2025

Week 1 - Tuesday

AI USE STATEMENT on Report:

Research Report and final design; Submit with an AI statement, with sign off that you have done bulk of the work.

consistency is key; do moderate weekly work to build up the bulk. Specifically after FIRST SUBMISSION,

Concept & Ideation - middle of semester - variety of ideation

end of year exhibition industry



Self Directed Project Interests:

- drones - data collection / mapping OR payload movement.

hiking/ rock climbing? - on-body drone deployment for surveillance

Police / dangerous situations / rescue? - airborne to ground to underwater? Bush fires?

FPV Drone Storage - quick ergonomic safe -

- cooking - no Visual / physical interaction / contact blind instructions?
- outdoor / in field cooking - convenience (build/ takedown, User/s interaction), reliability,
- long-term isolation - FIFO workers / work at home / shut ins- meditation / wellness device?

- hearing impairment device for strangers

e.g deaf person needs to ask something to a stranger - how can the deaf person understand a stranger?

diff languages? - portable scribe / translator?

- Workplace PPE requirement / notification / instructions -

Portable-SOP-reader/display-for-user: - Heavy machinery is required by law to have an SOP next to controls

How to stop complacency with heavy machinery?

Heat Relief for outdoor work - How can you stop environmental conditions affecting the worker e.g heat, working at heights, chemicals etc.

- urban sense of direction - how to guide a user through unfamiliar locations / areas? languages? Signage?
- Capturing non visual components of events for memory.

Week 1 - Friday

- **Multisensory Cooking Tool for Non visual recipe following**
- ~~Multisensory Cooking Tool for Vision Impaired Users~~

Goal

Create a tool that allows users to cook and prep food using touch, sound, heat, and scent completely without sight.

themes: Inclusive sensory, accessibility, independence, domestic safety

Potential Angle:

Not just for blind users but also relevant for neurodivergent users, outdoors/off-grid use, and emergency situations where visibility is compromised.

- **FPV Drone Storage + Field Maintenance System (Anton - this problem is too niche and minor (french accent.) Delve deeper to find more of a key problem -> what could stop a user from flying in the first place? / after takeoff? / in flight? / Post?**

Design Goal

Design a compact, modular system for carrying, organising, charging, and repairing micro FPV drones (e.g., Tinywhoops) in the field.

themes: Niche hobbyist gear, tool storage, modularity, rugged transport

Potential Angle:

injection mouldable but able to tie in to maker culture (3d printing), personalisation, sustainable hobbying (longer drone life), or even classroom/educational FPV systems.

- **Wearable Heat Relief System for Outdoor / Labour Intensive Workers**

Design Goal

Create a passive or low-power wearable system to help tradies, farm workers, and couriers manage heat stress under extreme temperatures.

themes: Thermal regulation, wearable systems, worker safety ppe, climate resilience

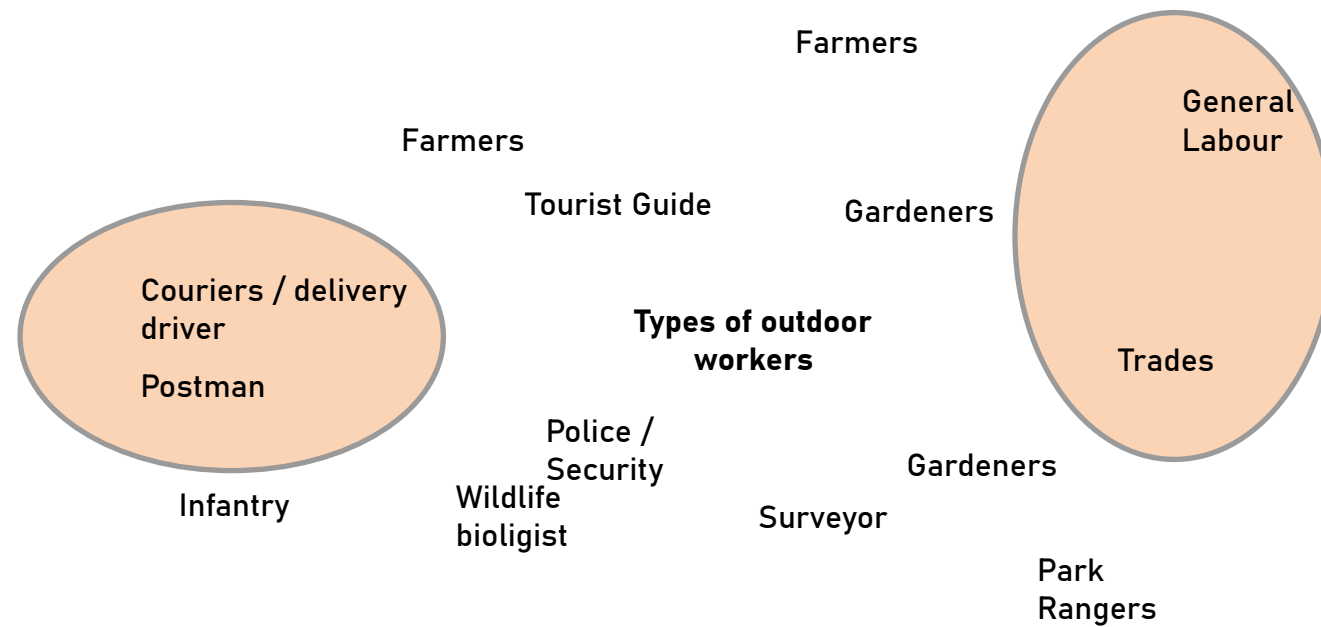
Potential Angle:

Climate change adaptation + Increased WHS. Could focus on rural areas, mining, or even school uniforms in heat-prone regions.

Feedback on ideas

From Anton

"The ideas are cool, but they tackle more of a minor inconvenience rather than a social or dramatic problem, maybe if you could look deeper and find bigger issues with say your drone idea. Then it could work. But I do find the heat-relief idea could be interesting."



Context + Stakeholders + Activities

This report will focus on carpenters, specifically framing

Trades such as carpenters are required to drive to their respective jobsite, which could potentially be if not hours away from their home.

On average, carpenters will start legally as early as possible (around 6am), and usually finish later in the afternoon (4-5pm). ____ records an average of ____ hours of work per week

P - Carpenters

A - Normally long work day (8 hors) consisting of heavy labour, and work with power tools.

C -

T -

The stakholders that would be involved with carpenters are their respective empoloyers themselves and the client.

Indirect stakeholders include but are not limited to,

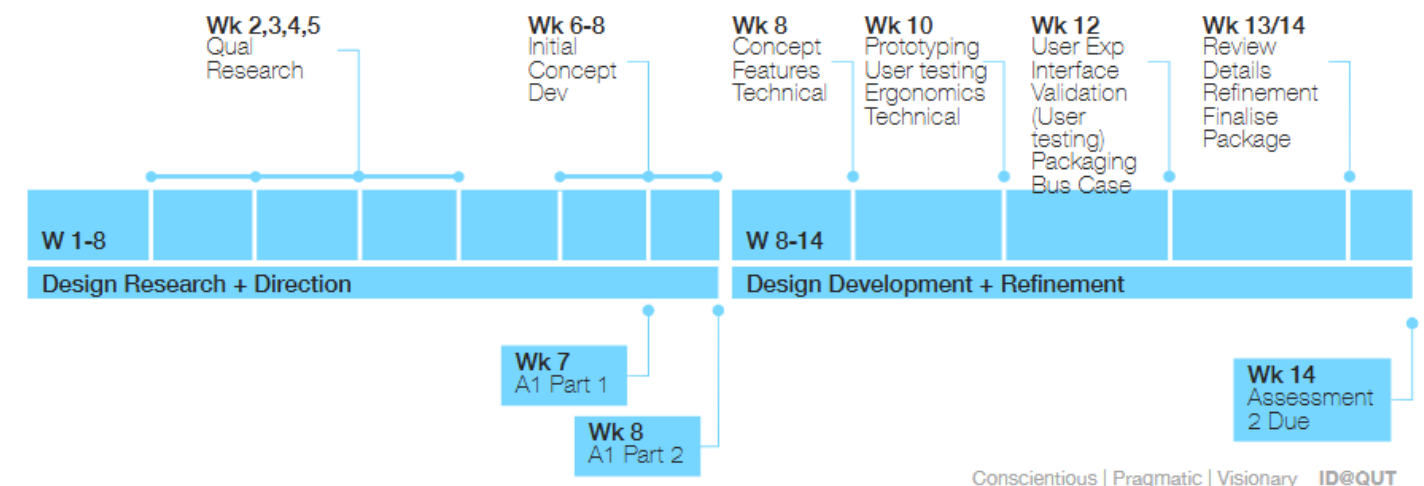
Government, Tool rentals,

Risks involved from heat-creep and heatstroke

Fatigue
Stress
Overwork
swaeting
dizziness
muscle cramps
light headedness
nausea vomitting

Risks involved from heat-creep and heatstroke

Fatigue
Stress
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swaeting
dizziness
muscle cramps
light headedness
nausea vomitting



The Problem.



General Labour

Trades such as framing and scaffolding undergo intense labour to carry large panels, steel tubing. Depending the size and time sensitivity of the job, workers may be persuaded to push themselves to complete the job on time.



Outdoor Work & At Heights

Trades such as framing and scaffolding undergo intense labour exposed in the sun, requiring to possibly carry heavy objects and tools on their body.



Welding

Welding is typically conducted within fabrication workshops (in a shed) but can also be done outdoors via SMAW also known as stick welding.

Arc produced heats metal into liquid, causing the extreme heat to radiate to the surrounding area.



Foundry

Although some sectors now are remotely operated e.g hot rolled steel mills. Some foundries producing mining equipment or one-off parts required personal to skim, pour, and possibly carry the crucible over to moulds.

Weaker metals such as aluminium are casted ~600C but stronger materials such as steel require higher temperatures of 1,600C.

Foundries such as the Bundaberg foundry have a crucible volume of 40 Tons, and have previously experienced incidents.



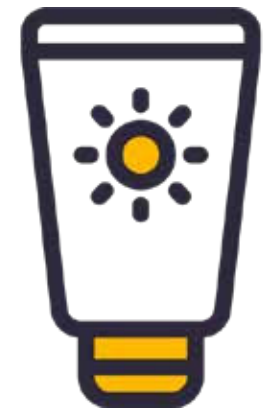
Glass Blowing

as glass blowing involves process requiring molten glass ~1600C requires the maker to directly shape the glass using their breath and hand tools. This makes Glass Blowers susceptible to heat related incidents due to the nature of the craft.

Existing Solutions



Hard Hat Brim + Neck Shade



Sun Screen



Portable Umbrella



Jobsite Tent



Portable & Rentable Water Station

Social Stigma

Cultural

Masculinity



4. Heat-related illnesses

Tradies working outdoors or in enclosed environments are at a high risk of developing heat-related illnesses, e.g. severe dehydration, heat exhaustion and heat stroke. If mismanaged, these conditions can lead to severe harm and, in extreme cases, death.

Preventative measures

Preventative measures for heat-related illnesses are simple in nature but should be implemented consistently.

- **Encourage regular hydration breaks** – research suggests that individuals working in intense weather conditions should be drinking a small cup (~200 mL) of water every 30 minutes, even if they are not feeling thirsty.
- **Promote use of lightweight and breathable clothing** – if your workplace does not require a uniform, prompt workers to wear long sleeve lightweight shirts in light colours to minimise heat absorption. If feasible, consider providing workers with light jackets or vests with pocket space for reusable ice packs.
- **Educate employees’ on the signs and symptoms of heat illnesses** – check out our [heat safety guide](#) for a list of symptoms.
- **Increase employees awareness** on maintaining hydration levels through educational [wellness seminars](#) or customised [workplace promotional material](#).
- **Review your company’s heat stress policy** – does it include the [9 key elements](#) that underlie effective heat stress policies?
- **Consider workplace environmental consulting** – Our [Occupational Physician Consulting Services](#) connects our highly qualified physicians with your workplace for site assessments and management plan consulting.

<https://www.sonichealthplus.com.au/health-hub/tradies-health/top-workplace-risks-for-tradies-and-how-to-manage-them>

The three best places for an ice-pack would be the sides of your neck, under your arms, and in your groin area. This allows you to cool your carotid, brachial, and femoral arteries respectively. The idea is that you cool the largest possible volume of blood and that cooler blood dissipates into the tissues and absorbs energy (heat) resulting in a net cooling effect.

At this point I'm just guessing, but if I had a single ice pack I'd probably put it between my legs. This way I'd get multiple major blood vessels delivering blood to both sides of the body.

Pflügers Archiv - European Journal of Physiology (2023) 475:1089–1095
<https://doi.org/10.1007/s00424-023-02835-7>

ORGAN PHYSIOLOGY

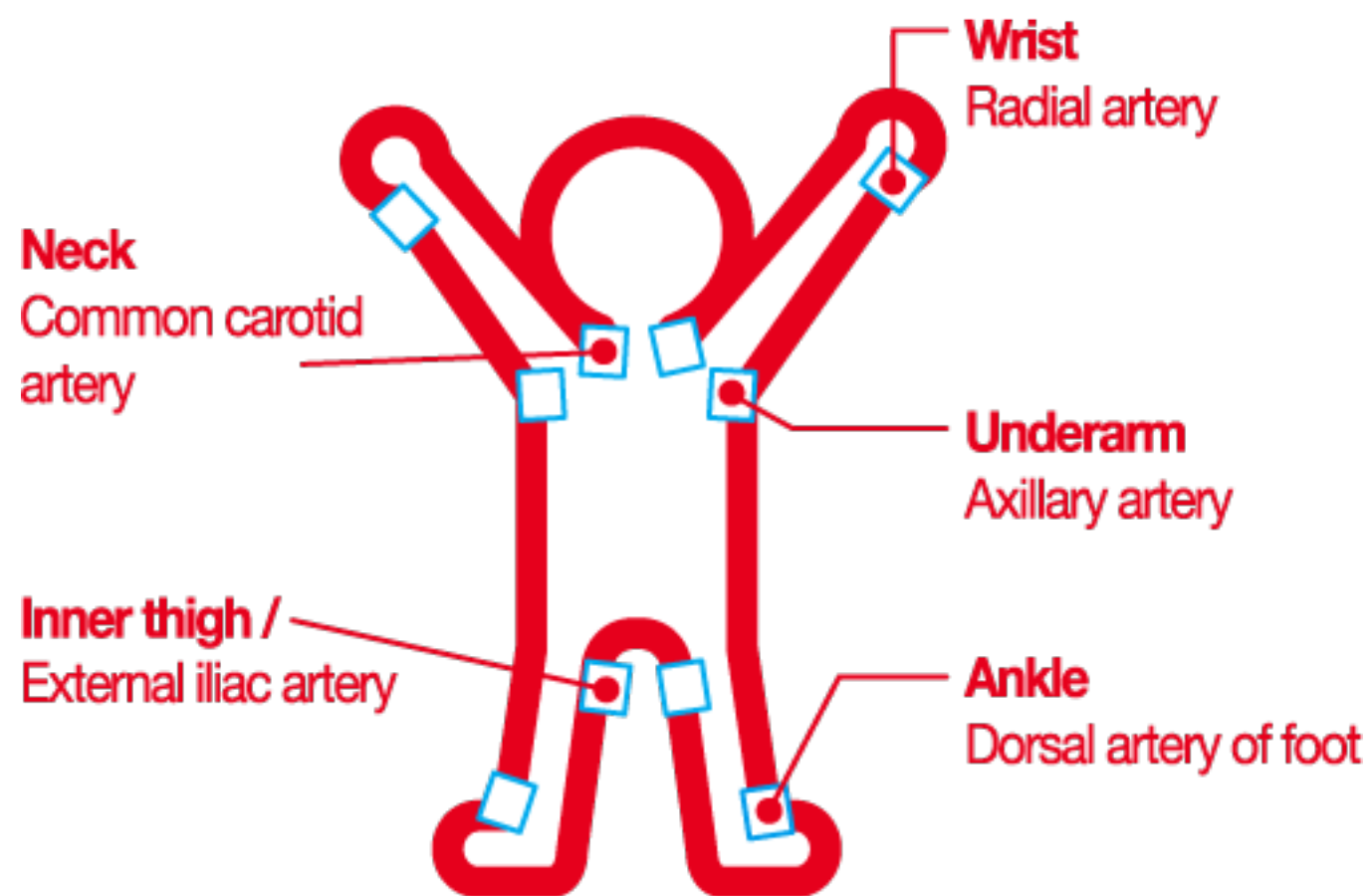


The effect of temperature on vascular smooth muscle: cooling-induced vasodilation in deep arteries and veins

Seham Mustafa¹

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The torso is the region of the body that generates the most heat, so local cooling is often applied to this region to improve thermal comfort of the human body. In this study, the local cooling at different torso parts including chest, abdomen, upper back, and lower back was applied to 20 subjects (10 males and 10 females) with low metabolic rate at 28°C, 30°C and 32°C (while relative humidity maintained at 50% RH). The results show that the local cooling of the torso can significantly improve the overall thermal sensation and thermal comfort of the subjects in a hot environment. Among these four parts of the torso, cooling the upper back has the best effect, followed by lower back cooling and abdominal cooling. The effect of chest cooling is the worst, which is mainly reflected by the experimental results at 32°C. The results of this study can not only be used to evaluate the potential of local cooling systems on torso parts but also to provide a design direction for cooling distribution in parts of the torso for wearable cooling garments.



Best Cooling Spots

Upper Back
 Lower Back
 Abdominal
 Chest Cooling

Although the cooling potential per unit area of the torso parts may not be as good as that of the head [13], [14], [15], [16], [17], [18], [19] which has the densest distribution of skin temperature receptors [20], [21], [22], [23], the torso region has a greater total cooling potential due to a four-time larger skin surface area than the head region [24], [25], [26].

https://www.mykoolfever.com/products_body.html

Fabrication Trades

- Engineer
- Machinist
- Boilmaker
- Welder
- Foundry

Outdoor Trades

- Carpenter
- Framing
- Erecting
- Concreter
- Sparky
- Traffic Worker
- Asphalt Laying

100% cotton drill industry-standard clothing

Long Sleeves to stop sparks and molten metal from penetrating skin

Trades that involve spinning machinery require these trades to roll their sleeves or wear short sleeve shirts.

Depending on the trade (machinist) gloves are prohibited due to spinning machinery

hi-reflective strip to help identify personal in low light conditions.

Trades that work within construction (framing, tilt panel, road works) require a hard helmet (hard hat) certified against AS1801.



Different colours represent different occupations e.g engineer, architect, client, foreman

- Mandatory Ultraviolet Protection Factor (UPF) 50+ rating
- Safe Work Australia suggests using long sleeves and pants but is not mandated.
- Clothing certified as either Class D (daytime use) or Class D/N (day and night use) (reflective material).

Drill industry steel-toe boots. Must also provide coverage to limit maximum ankle movement to prevent damage

Week 1 - Friday

Initial Background Research

QLD GOV

<https://www.worksafe.qld.gov.au/safety-and-prevention/hazards/hazardous-exposures/heatstress>

NSW GOV:

<https://www.safework.nsw.gov.au/hazards-a-z/working-in-extreme-heat/content-page-blocks/extreme-heat-the-basics>

Report On Rising temperatures

<http://www.bom.gov.au/state-of-the-climate/>

WHS on the jobsite

<https://www.safeworkaustralia.gov.au/duties-tool/construction/hazards-information/working-outdoors>

<https://www.worksafe.qld.gov.au/safety-and-prevention/hazards/workplace-hazards/construction>

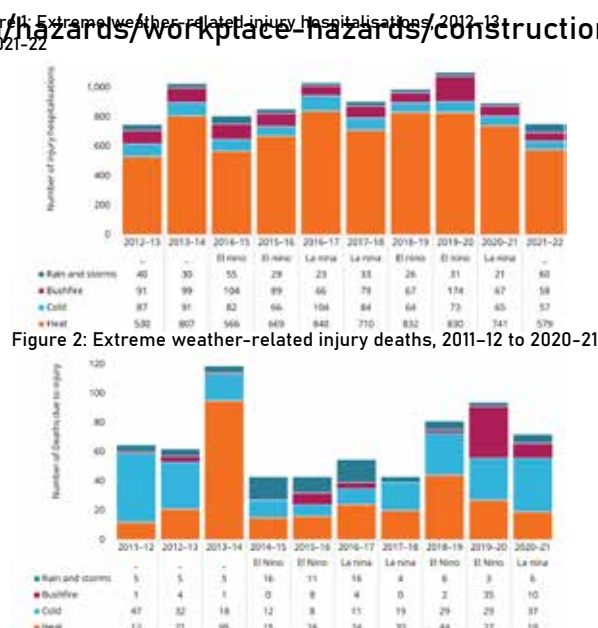
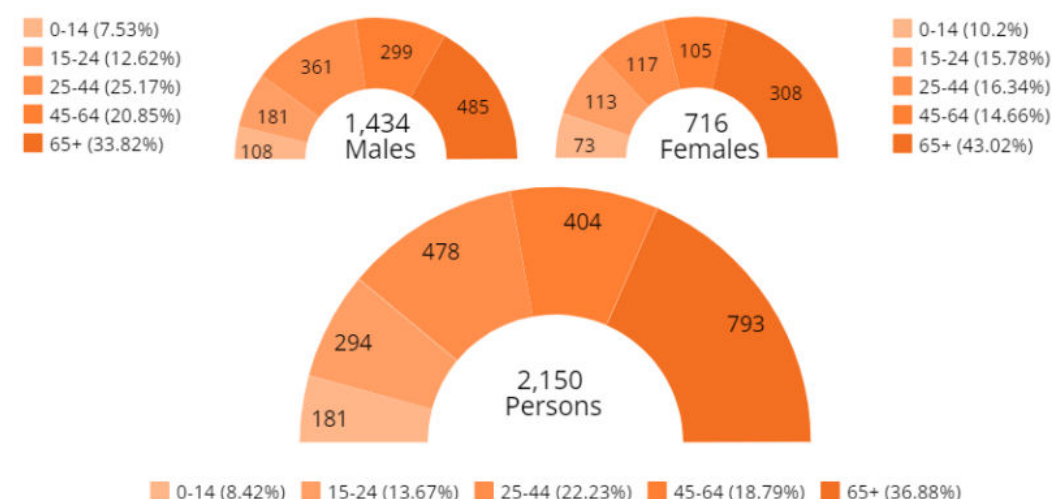


Figure 2: Extreme weather-related injury deaths, 2011-12 to 2020-21

Figure 8: Number of injury hospitalisations due to extreme heat by age and sex, Australia 2019-20 to 2021-22



Source: National Hospital Morbidity database (NHMD)

Week 1 - Friday

mental health & stress

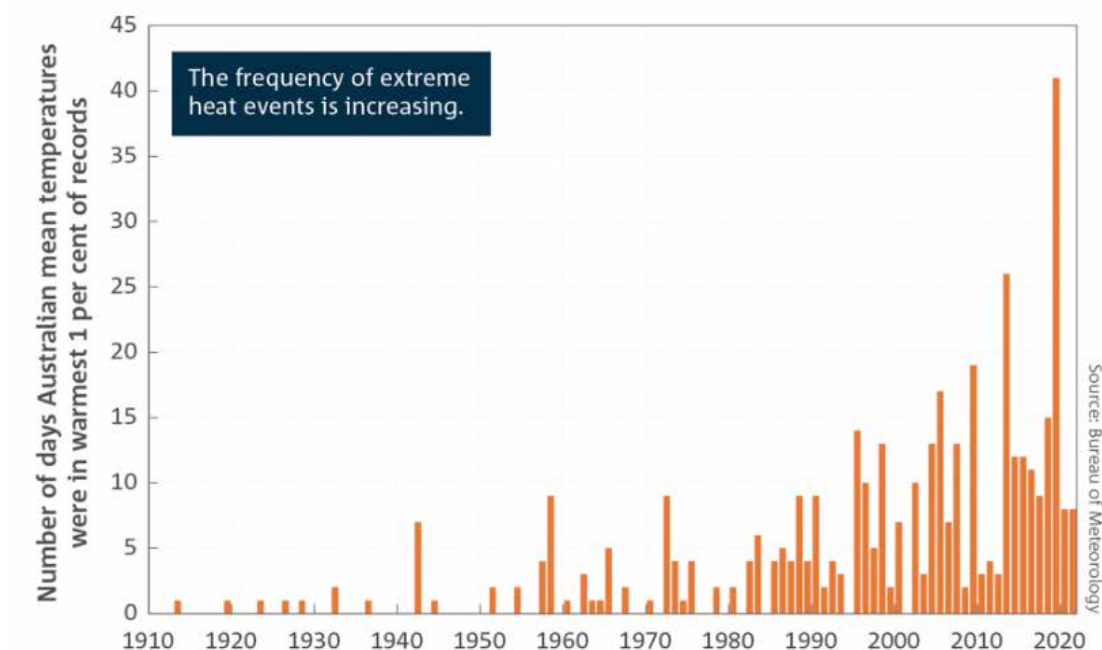
Mention here the sigma of being considered weak, if you stop work to rest from the heat.

ageing workforce

inadequate safety culture

independant contractors

Figure 9: The number of days with extreme heat are increasing across Australia over time

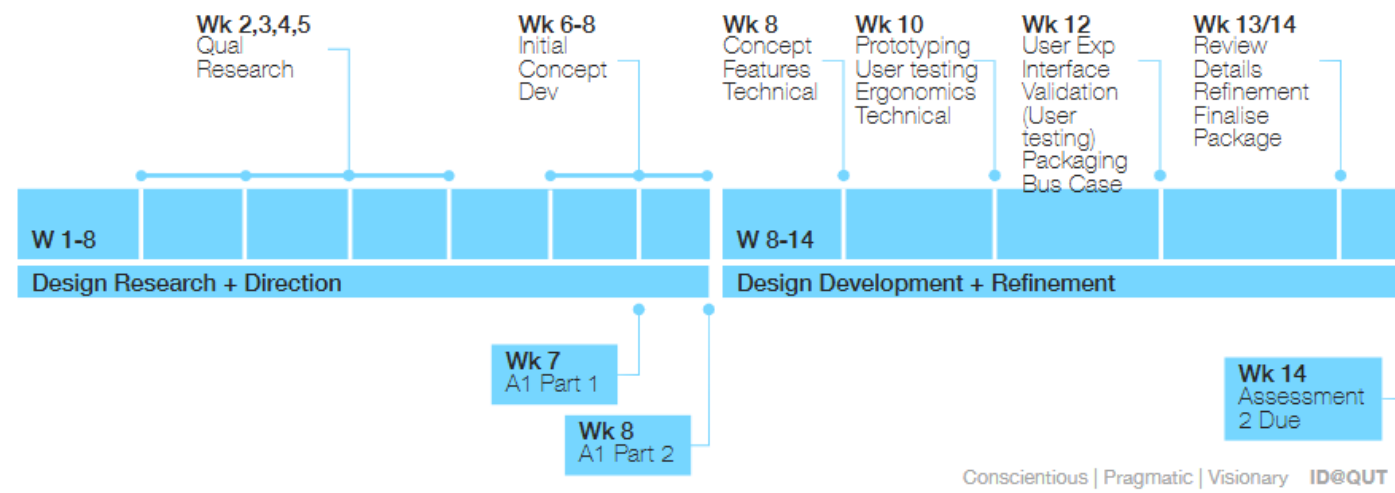


Source: BOM, State of the Climate 2022

Key Takeaways

Initial background research indicates, that heat-related incidents within job activities are steadily increasing.

Laws exist for the employer to ensure workers maintain safe environments within heat. However social stigmas among outdoor works, specifically within the trades have coworkers pressure others to 'push through' the pain promoting unsafe practices.



Project will aim to design around goals 3, 8 and 13 to develop a design intervention that will aid workers in improving their work experience and quality of life. Preventing long-term effects of harsh work such as silicosis, sun cancer (and others), physical strain.

Week 2 - Friday Ethics Lecture

Academic Honesty

Plagiarism is presenting someone else's work as if you created and wrote it yourself

Plagiarism is cheating and is regarded as grounds for failure, suspension and expulsion.

Using someone else's idea is nto academic dishonesty, provided you:

1. Acknowledge the source of that idea, as in in-text reference in the body of your assignment, and:
2. List the full reference ina reference list at the end of your assignment.

Good research is **ethical**

- Honesty - In development, undertaking and reporting of research
- Rigour - in the development, undertaking and reporting of research
- Transparency - in devlaring intresets and reporting research methodology, data and findings
- Fairness - in the treatment and recognition of others
- Respect - respect for research participants, the wider community, animals and the environment.
- Recognition - Aboriginal and Torres Strait Islander peoples to be engaged in research that affects or is particular significance to them.
- Accountability- for development, undertaking and reporting of research
- Promotion - of responsible research practices.

INFOMATION + CONSENT

Need to acquire consent from your participants in the forms of clear agreement and keep forms

ALL to coomplete:

General Consent Form (Signed as consent to participate)

Recruitment Flyer Document (information form to be read / understoof by all participants)

Relevant Method Form (Explaining surveys, focus group, etc)

To complete only if necessary:

Recruitment Email Information (if contact participants via email or if recruiting via social media)

Image Release Form (if taking photos / video of participants)

What Wee need to do

You are required to provide the following information to participants

Need to provide accurate and consistent infromation about your project/experiment and what participants will be required to do

inform them that information is to be used for the pripose of research in this subject only and for design ideation

Their responses / involvement will not impact their relationship with QUT in any way
Their involvment is voluntary, and they are free to withdraw from study at any time without question

Asl if they understand the above information and have the agree in written form (sign and date, email, something in writing)

FOR THIS WEEK + NEXT Week 3

1. RESEARCH YOUR TOPIC (ARTICLES, RESOURCES, INFORMATION, ETC)
2. COMPLETE PROJECT SYNOPSES THIS WEEK
3. BENCHMARK EXISTING PRODUCTS / CONCEPTS
4. READ CAREFULLY ON HOW TO CONDUCT METHODS (SURVEYS, INTERVIEWS, OBSERVATIONS, ETC)
5. DECIDE HOW YOU WILL CONDUCT YOUR RESEARCH (WHAT TWO METHODS WILL YOU CHOOSE)
6. PLAN HOW YOU WILL DEPLOY YOUR RESEARCH (WHO, WHAT, WHEN, WHERE, HOW)

Not now, but soon:

Reach out to participants (consent)

Conduct research (keep a good log of data)

Week 2 - Friday Ethics Lecture

Product Research

Initial research shows limited products in relation to combating the problem of heat creep among workers. Although there are products which indirectly support the issue, such as long term cold water bottles such as Yeti and Thermos bottles alongside the brands respective coolers.

How to tackle or counteract the problem of heat?

Remove the heat
slow the heat creep
redirect the heat

Design Statement / Question

How might we manage heat creep among outdoor carpetners so that they have lowers risks of heat-related incidents.

The aim of this report is to identify issues with outdoor trade workers and the impact heat has on them over the course of their workday.

Research Question

Make sure your research question states:

- What: what is it that you are doing (exploring, understanding, clarifying, comparing, etc)
- Who: be specific about who you are researching (people with disabilities, manufacturing workers, healthcare workers, etc)
- Where: specify the context, scenario, location (in Australia, manufacturing industry, care homes, hospitals, etc)

Researching

For each methods (minimum)

Interviews/Focus Group: 2-3 participants (depending on length)

Survey: from 5-10+ (short answer survey)

Observations: 1-3 (depending on length)

Observations + Concurrent Protocols: 1-2 (Depending on length)

Qualitive vs Quantitive

Preparing for your research / data gathering

Planned methods

- Google survey
- Multiple In-person Interviews will be conducted to gather first and second hand opinions working in outdoor and heavy labour conditions. It will be conducted with workers in different stages within their career

- Apprentice
- Fully Qualified
- Retired

Q: What occuptation do you / did you work as and how long have you worked in this industry?

Q: How long would you work on average and did this change at all throughout the year?

Q: Would you say that weather on the jobsite has impacted your performance, whether negatively or positively?

Q: Would you say you have been affected by heat at all throughout the day? or was it more of a single moment

Q: Did this occur a heathstroke? or cause you to stop working momentarily or for the day?

Q:

Project Topic	Heat Stress Relief For Trade Workers in Outdoor and Fabrication Environments		Headshot	
Self-Initiated	☒	Keywords		Trades, Heat Stress, Labour, Cooling
Scientific-Discovery	☐	Project Contact + Email		
Industry-Linked	☐			
Project outline (short summary of project)	Trade workers in the fabrication and outdoor sectors often face physically demanding tasks in high heat environments, including activities such as welding, casting, and prolonged outdoor manual labour. These conditions are further intensified by long working hours, placing workers at elevated risk of heat stress, fatigue, and associated health concerns. This project will investigate the intersection of environmental climate data, occupational health factors, and real-world user experience to understand the root causes of heat-related discomfort in these contexts. Through product benchmarking and ergonomic research, the project aims to identify needs and opportunities for a design intervention. The outcome will be the development of an innovative, user-centric product solution that actively mitigates the effects of heat exposure to improve worker comfort, performance, and wellbeing without compromising on durability or functionality in tough trade environments.			
Tentative Research Question	The aim of this project is to determine the extent and impact of heat stress on trade workers and the preventative measures that these workers take to avoid heat stress to identify potential solutions or new preventative measures.			
Participant Contacts	Vincent Nguyen nguyenthien99188@gmail.com Craig Scott craig.scott@tafeqld.edu.au Thao Nguyen contact.thao.now@gmail.com			

Little Advice from Anton
- maybe go down to a specific trade rather than both outdoor and fabrication

10. Were you told to ‘suck it up’ and keep working when affected by heat stress?
Short Answer

SECTION 3: Cooling Preferences

9. If you could cool one part of your body during work, which would it be? (Short answer)

10. How likely would you be to use an on body cooling device that
(Very Unlikely, Unlikely, Neutral, Likely, Very Likely)

Statement
Worn on the body (belt, harness, etc)
Requires battery recharging
Slightly noisy like a fan
Visible to others (not hidden)
Adds weight (~500g)

- Too expensive
- Uncomfortable
- Looks silly
- Gets in the way
- Other: _____

SECTION 5: Optional Demographics

15. Age range (Multiple choice)

- Under 20
- 21–30
- 31–40
- 41–50
- 51–60
- 60+

16. Location or general climate region
(Short answer)

17. How many years have you worked in your current trade?

Online Survey Questions

SECTION 1: About Your Work

1. What type of trade or industry do you work in?
(Short answer)

2. Where does most of your work take place?
(Multiple choice)

- Mostly outdoors
- Mostly indoors (e.g. workshops, sheds)
- A mix of both

3. In what climate do you primarily work?
(Multiple choice)

- Hot and dry
- Hot and humid
- Cool or temperate
- Varies seasonally

4. What kind of PPE or uniform do you usually wear during hot weather? (Short answer)

SECTION 2: Heat Stress & Experience

5. On a scale of 1–10, how often do you experience heat-related discomfort at work?
(Linear scale: 1 = Never, 10 = Constantly)

6. What symptoms of heat stress have you experienced while working? (Checkboxes)

- Excessive sweating
- Fatigue
- Headache

- Dizziness
- Reduced focus
- Irritability
- Nausea
- None

7. When do you feel hottest or most uncomfortable during a typical workday?(Multiple choice)

- Morning
- Midday
- Afternoon
- After breaks
- Constantly

8. Which body areas feel hottest or most uncomfortable? (Pick up to 3)
(Checkboxes with limit set to 3)

- Neck
- Upper back
- Chest
- Armpits
- Lower back
- Face/head
- Hands
- Feet

9. If you have been affected, did this cause you to stop work temporarily?
Yes Or No

SECTION 4: Design Input

11. Which of these would make you more likely to use a cooling device? (Checkboxes)

- Rechargeable/swappable battery
- Can clip onto toolbelt
- Hands-free
- Easy to clean
- Doesn't touch skin
- Can be turned on/off easily
- Quiet operation
- Durable/rugged build
- Affordable price

12. Do you currently use anything to stay cool while working?
(Checkboxes)

- No
- Shirt flaps/openings
- Ice packs/wet towels
- Fan/airflow device
- Other: _____

13. If a cooling tool worked well but was a bit bulky or ugly, would you still use it? (Multiple choice)

- Yes
- Maybe
- No

14. What would make you not use a body-mounted cooling device, even if it worked well?

- Too noisy

Week 3 - Benchmarking

Research Benchmarking

THIS WEEK

1. research your topic (articles, resources, information, etc)
2. Complete projects synopses this week.
- 3.
- 4.
- 5.

Why Research?

Justify Postion
Focus an approach or methods
reveal in-depth data
identify value/meaning
understanding user needs/hidden needs
uncovering something novel

Objectives:

Benchmarking

Benchmarking is not just about reviewing other products, and it is not just getting 'inspiration' from competitor products, it is a more rigerous...

1. Identify strengths / wekanesses of ideas
2. Set aims / objectives/ goals and track progress
3. Identify innovation against industry standard
4. Learn from the best in the industry.
5. Avoid recreating existing designs
- 6 Stay competitive

Benchamarking table No 1-10

Quality
Pricing
Style
Technology
Positioning
Reputation
Service
Features
etc.

Key Takeawys

Benchmarking is not about just the performance of the product itself, its about how it performs under use, marketing, manufacturing wise.

You can use it to determine why someone would prefer to purchase a product of this brand vs a cheaper / more expensive one.

Finding the weaknesses / strengths of each product, there might not be clear winner, but a trend where one excels in a certain range of catergories and vice versa.

	Competitor 1	Competitor 2	Competitor 3	Competitor 4	Competitor 5
Quality	3	8	5	8	3
Pricing	4	3	2	3	2
Style	7	4	8	9	8
Technology	7	9	4	9	4
Positioning	9	7	10	2	3
Reputation	10	4	8	4	8
Service	3	7	2	7	2
Features	7	8	6	8	6

BENCHMARKING: HOW?

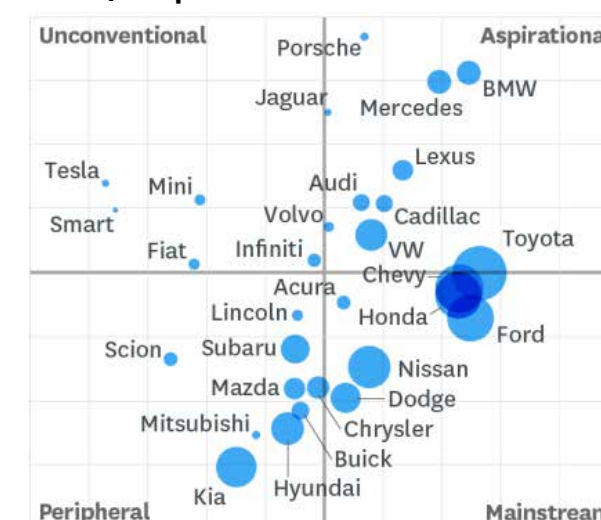
- Determine what product category / technology you are designing for
- Determine what products are already in the context you are exploring
- Collect relevant images of products / services
- Collect information about the products / services
- Identify main functions, features, aesthetics, form, style, price, etc
- Identify major similarities or differences
- Identify any gaps in the market
- Generate a visual representation of the comparison that provides some insights

spider graph



Can directly overlay these graphs to determine clear trends + possible weakness in categories.

Matrix/Graph



- Can Use different colours to relate to parent brands e.g red for lexus + Toyota, Yellow for Acura + Honda.
- Also use Visuals e.g Brand Logos to help.

Week 3 - Benchmarking

RESEARCH METHODS

You have been asked to deploy a triangulation technique for your methodology. This involves using 2+ research methods. The research methods include:

Surveys
Interviews (Focus Groups)
Observations
+Think/Talk Aloud Protocols

Survey

Some tips and hints:

- Define a clear purpose/goal for your survey
- For some your questions will be very specific, for others more broad
- Ask basic demographic questions (age bracket, experience, etc)
- Try and use a mix of quantitative and qualitative questions
- Quantitative: Likert scales, answer check-box, allow "other" if necessary
- Qualitative: Allow for short answers for open-ended questions
- Don't make your survey too long (between 5-10mins to complete)
- Don't ask leading questions (make them unbiased)
- Avoid using absolutes (always, never, all, etc)
- Don't ask two questions in one
- Test your survey first!

Interview

In research, an interview is a structured conversation where one participant asks questions, and the other provides answers. It is usually conducted as a one-on-one between interviewer and interviewee, but you can have group interviews (become focus groups).

Structured
Semi-structured
Open-ended

Ethical conduct of research: Always need to inform people about the interview, what the data is used for, and make sure they provide confirmation they understand this and provide consent.

Survey Vs Interview

A survey has planned questions, although similar to an interview asfadsgbsbwr

WHAT YOU NEED TO DO

Select methods / recruit participants / deploy research

- Select which two methods you will utilise (minimum)
- Design and develop those methods
- Generate consent forms (include required information)
- Recruit participants
- Deploy study methodically + rigorously
- Collect data methodically + rigorously

Ahead if you have research methods ready to go. But not behind if implementing start of next week.

		Quality	Pricing	Style	Technology	Positioning	Reputation	Service	Features
	700	6	10	1	5	8	3	4	1
	Silent Cicada	7	3	10	8	4	5	3	5
https://youtu.be/HMW-EuoMMY4									
	600 Comodo gear i2	10	10	10	10	10	10	10	10
	500-700 RANVOO 2025	10	10	10	10	10	10	10	10
	75 Nevenka Foldable Bladeless Neck Fan	10	10	10	10	10	10	10	10
	DIY solution	1	10	1	1	4	1	1	3
	THERMAL STAR® BODY COOLING SYSTEM	10	10	10	10	10	10	10	10
		Quality	Pricing	Style	Technology	Positioning	Reputation	Service	Features
	12 Ergodyne CHILL-ITS® 6700 Lime Cooling Bandana	5	10	6	7	6	5	4	2
	BCS4 Body Cooling System 3,000 - 6,500+	10	1	1	10	10	10	1	10
		6	8	8	9	10	5	1	8

Benchmarking

Converting the Individual products into groups and finding the common trends / themes so that it looks nicer for a radar cgart

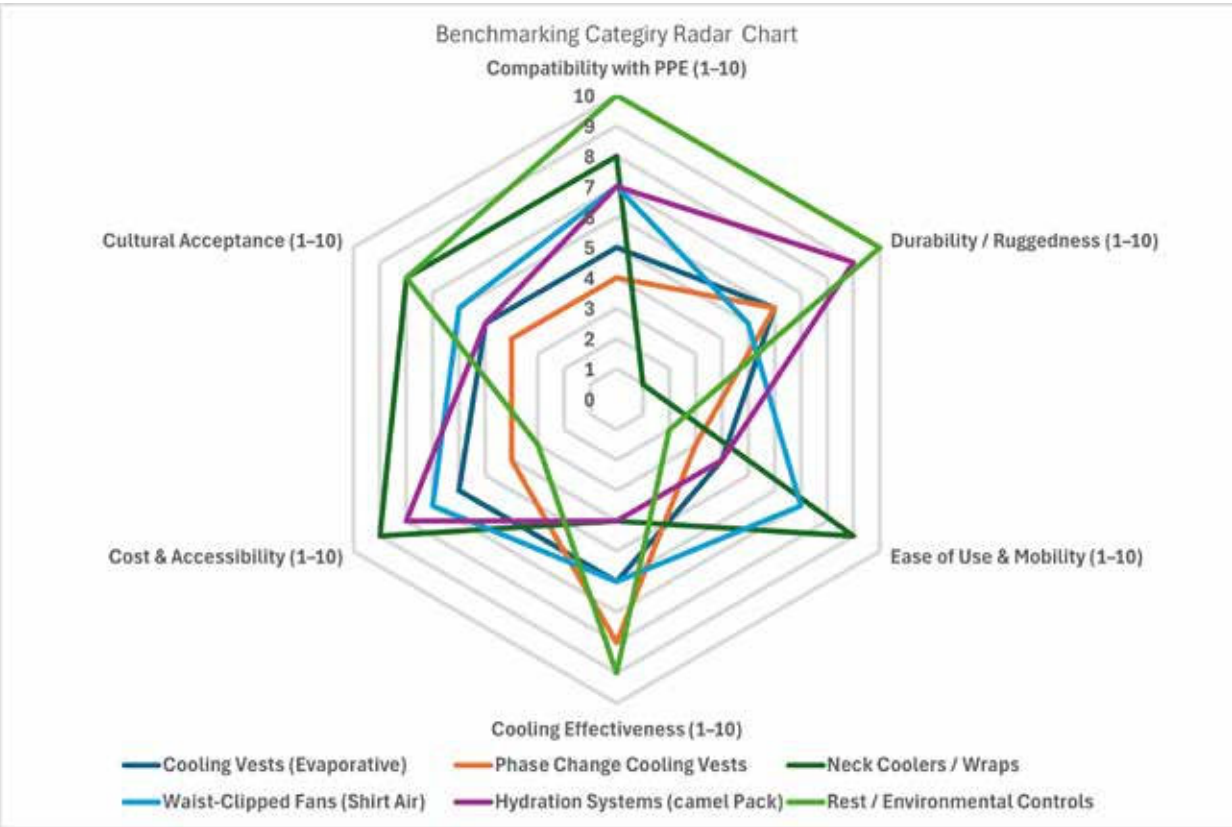
For Radar Chart purposes (for cost its reversed, so 1 is exp, 5 is cheap)

- 1 - Low
- 2 - Low Med
- 3 - Medium
- 4 - Med High
- 5 - High

Product Category	Example Product	Compatibility with PPE	Durability / Ruggedness	Ease of Use & Mobility	Cooling Effectiveness	Cost & Accessibility	Cultural Acceptance
Cooling Vests (Evaporative)	Cooling andanaTechkewl Hybrid Cooling Vest	Medium – Worn over PPE; may hinder layering 3	3 Moderate – soft fabrics, soakable	3 Medium – Hihg can restrict movement	4 Med-High – activated by water	3 Moderate (~\$80–\$150); online availability	Medium – seen as extra layer; some accept, some avoid
Phase Change Cooling Vests	Exact Tooling Phase Change Vest	3 Medium – bulk vs PPE compliance	3 Moderate – inserts can be fragile	2 Low – med – weight/ rigidity may slow movement	5 High – short-duration intensive cooling	1 High (\$350); niche suppliers	Low – bulky, not widely used on trades
Neck Coolers / Wraps	Tie Chilly Ice Neck Cooler Bandana	5 High – non-intrusive, fits under collars	2 Low -med – delicate materials	5 High – very mobile and flexible	2 Low-Med– needs reactivation	5 Low (~\$20–\$30); widely available	Medium – unobtrusive, culturally acceptable
Hydration Systems	Camelback / water bottles	5 High – external, no PPE interference	5 High – rugged gear	5 High – hands-free and mobile	2 Indirect – supports cooling via hydration	4 Low–Moderate (~\$20–\$100)	High – widely accepted, expected on site
Rest / Environmental Controls	Shade shelters, refuge chambers, water stations	5 High – no PPE conflict	5 High – site infrastructure	3 Variable – may require pausing work	5 High – very effective when used	1 High – site-dependent; infrastructure cost	High – culturally normal, expected safety measure
Hydration Systems	Camelback / water bottles	5 High – external, no PPE interference	High – rugged gear	High – hands-free and mobile	Indirect – supports cooling via hydration	5 Low–Med (~\$20–\$100)	High – widely accepted, expected on site
Waist / Shirt Airflow Fans	Air Cooler Vest / Pocket Fans (example)	3 Medium-High – fits under PPE shirt, low profile	4 med high – lightweight plastic, battery-powered	5 High – small unit, mobile, hands-free	3 med – moves air under clothing	3 med (~\$50–\$100); online	Medium – looks unusual, some scepticism

Bencharking reveals several strong products in the market, the Sony Reon Pocket, BCS4 Cooling Suit

However it was identified that only a few were marketed and designed for trade environments. Majority of the products were observed to seem gimicky and tacky. Such as the lowering costing products Often being a piece of clothing with a fan attached on afterwards.



EMPATHY MAPPING

Thinks

- “I know this is unsafe, but I can’t afford to fall behind.”
- “I wish there was a way to cool down without stopping work.”
- “Why isn’t there better equipment for this?”
- “If I say I feel unwell, they’ll think I’m weak.”
- “This job shouldn’t feel like a heat endurance test.”
- “It’s embarrassing when sweat gets in my eyes or fogs my glasses.”

Feels

- Drained, dizzy, and frustrated.
- Irritable or mentally foggy.
- Pressure to keep working despite discomfort.
- Concerned about long-term health but unsure how to manage it.
- A sense of pride in toughness mixed with quiet worry.

Pain Points

- PPE and uniforms trap heat.
- Cooling solutions are temporary or cumbersome.
- Breaks reduce output and are discouraged.
- Early signs of heat stress go unnoticed.
- Lack of real time awareness of body condition.

Needs / Opportunities

- Cooling that integrates seamlessly with PPE or workflow.
- Smart indicators for heat stress or overexertion.
- Systems that encourage rather than interrupt work.
- Culture shift: cooling = productivity, not weakness.
- Affordable and durable solutions suited to jobsite conditions.

Trade workers often wear tightly sealed helmets, hoods, or visors that trap hot air and sweat against the scalp and forehead — causing discomfort, fatigue, and increased risk of heat stress.

Most available cooling solutions:

Require power (e.g. fans) and fail in dirty, spark-heavy environments

Focus on clothing or vests, which aren’t compatible with headgear

Are one-size-fits-all, not adaptable to different users or helmets

If you're serious about this capstone making an impact, don't start with “how do I cool someone down?” — start with “how is heat ignored, misunderstood, or poorly managed?”

Innovation lies in:

Making heat stress visible

Improving the system of response

Designing for invisible integration (non-obstructive, non-invasive)

Thinking modular, scalable, and compliant

Dynamic Heat Flag System

Core Innovation: Make invisible heat stress into a visible safety signal.

Product Direction:

Peel-and-stick indicator badges for hardhats, tools, or PPE surfaces.

Use thermochromic or hydrochromic materials that change colour with temperature or sweat.

Could be snap-on panels that shift hue at critical thresholds (e.g., 37C skin temp or X mins of direct sun).

Imagine a universal symbol (like a red ring or expanding visual cue) that immediately flags concern.

Could be magnetic, adhesive, or velcro-based. No clothing integration required.

Work-Rest Feedback Companion

What if workers had a clip-on smart tag that passively logs exposure time, temp, and movement?

Could link to existing shift schedules

Offers insights, not just relief

Bonus: supports regulation compliance and safety audits

Could be low-fidelity (like NFC tags + printed QR guides) or higher tech with sensors. Great for future scalability.

Product Direction:

Low-tech: NFC badge or QR tag workers tap at the start of a shift to log their heat exposure time.

Mid-tech: Wearable tag (clips onto belt, helmet, vest) with:

Internal temp sensor (e.g., ambient + time logging)

Basic UI (LEDs, haptic alerts when it's time to rest or rehydrate)

Bonus: tie into regulatory guidelines — e.g., auto-alert at 40 minutes under 35°C for mandatory cool-off.

PPE Attachment Ecosystem

Rather than a single product, what if you developed a range of plug-and-play heat relief modules that attach to existing PPE?

Magnetic or clip-on cooling cells

Neck or shoulder attachments

Clip fans that don't break compliance

Think IKEA or MIL-SPEC modularity for heat relief

“Quick-clip Thermal Relief Modules”

Small, discreet, non-tech or low-tech modules that attach to PPE via a universal clip — like:

PCM gel pads (low profile, single-shift use)

Mist diffusers or hydration pads (no fan)

Shade fins or neck deflectors (no fabric, rigid EVA or silicone)

Colour-changing visual status markers

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Review Article

Health Impacts of Workplace Heat Exposure: An Epidemiological Review

Jianjun XIANG¹, Peng BI^{1,*}, Dino PISANELLO¹ and Alana HANSEN¹

¹ Discipline of Public Health, School of Population Health, The University of Adelaide, Australia

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Abstract: With predicted increasing frequency and intensity of extremely hot weather due to changing climate, workplace heat exposure is presenting an increasing challenge to occupational health and safety. This article aims to review the characteristics of workplace heat exposure in selected relatively high risk occupations, to summarize findings from published studies, and ultimately to provide suggestions for workplace heat exposure reduction, adaptations, and further research directions. All published epidemiological studies in the field of health impacts of workplace heat exposure for the period of January 1997 to April 2012 were reviewed. Finally, 55 original articles were identified. Manual workers who are exposed to extreme heat or work in hot environments may be at risk of heat stress, especially those in low-middle income countries in tropical regions. At risk workers include farmers, construction workers, fire-fighters, miners, soldiers, and manufacturing workers working around process-generated heat. The potential impacts of workplace heat exposure are to some extent underestimated due to the underreporting of heat illnesses. More studies are needed to quantify the extent to which high-risk manual workers are physiologically and psychologically affected by or behaviourally adapt to workplace heat exposure exacerbated by climate change.

Key words: Climate change, Heat stress, Workplace heat exposure, Health and safety, Work-related injury

Week 5 Lecture

AS1 report AS2 Final design + DDR (folio) 60%
2800 - 4000 words

size 10-12 arial aptos etc
Requirements before submission
word count (excluding tables, graphs, reference list, appendix) minimum of
authenticity statement
ai use statement
raw data in appendix (this will be deleted at the end of semester)

short brief introduction summary for each section

findings no interpretation - just data
discussion is for interpretation and relation to literature + benchmarking + your data

A1 aprts 2 initial concept due date is friday 12th sep 11:59pm
at least 5 concepts developed
drawings diagrams competitor existing products research, mood boards, brainstorming, etc in order to
demonstrate design process

in-class persentation - week 8 friday 12th sep
Digital powerpoint/pdf/etc scedule uploaded to canvas
5-7min max
brief summary of research (what do for primary

report due week 7th september friday (48hr avaiable)

Peer Presentation, assessed on ____ (48hr avalliable)

Studio

Interview 1 between T and I

A: So what's your trade and role? Roughly how many hours do you work in typical day?

T: My trade, I am an apprentice carpenter and I work roughly 38 hours a week.

A: How long have you been doing this type of work?

T:Three years.

A: Is most of your work outdoors on site or more in a workshop slash fabrication setting?

T: Most of my job sites are outside.

A: On a hot day, what's it usually like for you at work?

T: Personally, I wear long clothes, so long pants, long sleeves and a hat. So it's usually very hot, especially in summer. And the next thing that keeps me cooled down is just drinking a lot of water and sunscreen.

A: Do you wear any other sort of PPE? Like a face visor?

T: Yeah it depends on the work. If it's like grinding or if I'm cutting something specific and it's gonna fly around I have to wear like a visor.

A: So have you personally been affected by heat during work? Yes. You're feeling light-headed and dizzy or sick?

T: Yes, I have been light-headed before during summer, peak summer, when it's like 30 degrees and I'm working out in the sun, especially on the wagels when you're in the middle of nowhere. And it's to get to me and it's not very nice.

Did this cause you to slow down, make mistakes or take breaks that you normally wouldn't?

Yes, I would have to take breaks every now and then just because it's too hot to work and sometimes the tools or the material gets heated up and touching it with your bare hands, your hands get fried and it makes it even harder to work with.

Which part of the body would you say feels the heat the worst? And if you had to list them like in order, what would you say they were?

THIE: Pardon?

AND: Like if you had to list like the areas of your body if I'm like 1 to 5 Oh 1 to 5 like I'd start on each body part or like the rating I'd give Like it's like the most notable ones

T: Oh yeah definitely the back and then it goes to my face and then my hands. Is there like any particular spot in the back? Upper, lower? Probably in the upper back or it could be both depends because we always bent over or you're leaning forward you rarely lean backwards but yeah when you're leaning forward and your sun's just exposed you just get fried.

A: So when like you're usually affected how do you usually deal with it?

T: Depends. I'd run to the shade, just cool down for a bit, take five. Or grab a drink, just walk it out, or just keep working.

A: Do you or does the job site provide any steps to prevent this from happening?

They hand out sunscreen, but there's only so much you can do to stop the heat. If a job has a water fountain,

do you usually use it more often?

Yes, I do. If it's provided, I'd use it as much as I can.

So what does your team usually do when it gets dangerously hot? Do people speak up or do you guys just push through it?

It's never gone to a point where it was dangerously hot. It's like we all notice that it's hot, but we just

interview 1

push through it. Like if someone decides to like take a step back just to cool down,

what would you think would be the usual reaction?

Everyone’s got a breaking point so I wouldn’t blame them for taking a step back just to cool down because Because if I was in the same situation Well, I took a step back and I got judged for stepping back because it’s too hot. That wouldn’t be fair.

THIE: Have you ever tried a cooling product or method that didn’t work, and why not?

I haven’t. I haven’t tried any cooling products.

AND: Even like those crystal sweatbands, like Portable Water Station?

THIE: Portable Water Station? Nah.

AND: Like have you researched about these products before or have you not just like had any interest in using them at all?

I haven’t had any interest in cooling products. The only thing that I’d use is probably like the Smoko room that has aircon running there. They cool down then run out but then they only last so long because then it would just get really hot again.

If someone brought a gadget. To the job site to stay cool. How do you reckon other workers would react?

I mean it works it works. It’d be a little odd at first but like They cool and I blame

Is there anything about jobs like culture that would make it harder for you to admit that you’re overheating.

T Uh, not really. Everyone’s got, I don’t know, free will to talk. You just, if you need help with something, you just talk to them. Talk to someone. Uh

A: do you think it would be harder to like, talk about if you had like, more... like, toxic co- like, workers? Yeah, probably.

T: Depends on the people. (If) They’re not very nice there’s really no point talking to them. You’re better off just keeping it to yourself or telling the boss.

A: If there was something like tough enough for site use that actually kept you cooler, what would you want slash need for it to wear it? Can you repeat the question please? If there was like a gadget or device that was good enough for site use,. What would you want for it to have to make you wear it? Like a subtle battery? Strong enough? Doesn’t touch your skin?

T: As long as it lasts for a long time, I don’t have to constantly keep charging it or else it just becomes pointless. Like working with it for like five minutes and then it just dies and then you’re charging for I don’t know two hours just to get it working for another five minutes

A: What would make you not want to use a cooling device oh, yeah Like apart from a battery would

there be any other things that would make you lean away from like cooling gadgets.

T: If it’s too bulky, because on top of that I gotta wear a tool belt, and if it’s getting in the way, then it’s useless. Because then it’s stopping me from working.

A: If your coworkers were using a cooling gadget, would you be more inclined to use one as well?

T: Depends. Depends how good it is. And if it’s really expensive or if it’s expensive at all then yeah that’d probably stop me. I’d just dish it out and just tank the heat.

A: What would you say is like too expensive for you to invest in one?

T: Maybe like \$500? Yeah I reckon \$500 to one grand is a bit much.

A: That’s the end of you. Thank you.

END OF INTERVIEW

Coding

1. “I am an apprentice carpenter and I work roughly 38 hours a week.”
Codes: trade role, weekly workload
2. “Most of my job sites are outside.”
outdoor exposure, worksite environment
3. “I wear long pants, long sleeves and a hat... very hot in summer.”
PPE use, personal comfort strategy, sun protection
4. “Light-headed before during peak summer... 30 degrees... not very nice.”
heat symptom reported, physical impact of heat, heat threshold
5. “Take breaks... tools or material gets heated up... hands get fried.”
reduced productivity, tool usability affected by heat, need for breaks
6. “Definitely the back, then my face, then my hands.”
body heat zones, discomfort location ranking
7. “Run to the shade... take five... grab a drink... just walk it out.”
coping strategy, shade seeking, hydration behavior
8. “They hand out sunscreen... only so much you can do to stop the heat.”
limited employer intervention, basic site support
9. “We just push through it... it’s hot but we keep going.”
cultural norm endurance, toughness culture, no formal heat response
10. “Wouldn’t blame them for taking a step back... everyone's got a breaking point.”
empathy, worker acceptance, individual thresholds
11. “I haven't tried any cooling products... I'd use the Smoko room with aircon.”
no product adoption, reliance on indoor cooling, low awareness

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- toughness culture
- cultural norm endurance
- empathy and acceptance
- open communication
- peer perception
- toxic coworker avoidance

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Interview 2

So I'm just going to be in the interview now. Starting? Yeah. So what's your trade and role?

My trade is electrician. I'm currently a fourth year in mechanical electrical.

So what does that entail?

Just HVAC systems in industrial and commercial applications. So like stuff to do with airflow and aircons. Yeah. In a large scale.

Roughly how many hours do you work in a typical week?

On average about 40. 40, yeah. Yeah.

Is most of your work outdoors on site or more in a workshop or fabrication setting?

80% of my work is outside workshop. On the field. Would this be like exposed to the elements or more like inside a building? I reckon 30 to 40% I will be outside like on a roof or outside. But there will be weeks where I will be exposed to the elements more than other weeks.

So on a hot day, what's it typically like for you at work?

Well, if we're outdoors, it's wearing long sleeves and necessary sun safety equipment, making sure we've got a water bottle and taking frequent breaks when needed. Oh, yeah.

Would your uniform just be the 100% drill industry standard ones?

Yeah, just the standard industry ones, yeah. I'm pretty sure the uniform we have has got some type of UV protection as well. Not crazy, but there's some bit of it there in the uniform.

Do you have like an option to choose either between short or long sleeves or are you mandated?

Yeah, yeah. So there are some sites though that are mandated for long sleeves and pants. Yeah.

So have you personally been affected by heat during work?

Not anything bad. Just like probably a little bit of a heat stroke, something like a minor heat stroke. Once because I stayed up in a roof for too long.

If one was like no issue at all and 10 was unbearable, how bad would you consider last summer?

Last summer? Well, I found it with my field of work to be probably a six. It wasn't too bad because I wasn't exposed to that much sun. So I thought it was pretty bearable.

So when you're usually like affected by the heat or like working outdoors, do you notice to like slow down, make mistakes or take more breaks off than you normally would?

Yeah, I take frequent breaks for like water, like rehydrating and just getting out of the sun's rays every so often. In terms of mistakes, not really, but I do work a little slower.

So have you ever considered like using anything apart from water to cool down? Probably just going into a shaded area and water is what I've been doing in the outdoor area.

So do you have like any personal stories you could tell me about the last time you got affected by heat?

Yeah, it'd probably be, what I could mention is probably that one in the ceiling where it was during summer in Brisbane. And stayed up there for a little longer than I should have without taking a break since there is no constant ventilation or any areas to just take a break in there.

How long would you say you like stayed up there for until you had to take a break?

I think I was up there for just over an hour.

And I'm assuming you had to go back up just to finish the job?

Yeah.

So do you work more in like an individual setting or in like a team environment?

I work more in a team. Usually it's just two people, three max, sometimes four. But it's usually two, so I don't know if you'd consider that a massive team but... Yeah,

would this just be one apprentice and then (one qualified)

Yeah, yeah,

So what do you, like say if it's just you and another worker, what would you guys normally do when it gets like dangerously hot? Like do people speak up or do you just push through it?

I've never experienced personally anything where it's been dangerously hot but I'm pretty sure if like it was that bad, we would speak up about it. Or someone would, like the manager of the site, like the builders, I would tell everyone to just take a break when needed.

Would there be anything about like the job site culture that would make it hard to admit that you're overheating?

Like would it like depend on like who you're working with, maybe someone you're more comfortable with, you'll be more willing to admit you're overheating? I mean I've got no problem talking to people because communication is pretty important in the industry. But I don't think I'd have a problem, maybe for other people, I'm a little bit more less inclined to talk to someone, intimidating maybe. But yeah, I've personally never experienced that type of, yeah.

Do you think other workers handle the heat differently from you and have you noticed like them using, or the older tradies using different tricks than you or the younger ones?

There are other trades that are just used to the heat because they're more exposed to the elements and they're more used to it. In terms of tricks, I don't think, I think the older people are less worried about the effects of the sun than younger people are, to be honest. Yeah.

If someone like stops work suddenly just to take a step back and cool down, what would be the usual reaction? Do people more like respect it, ignore it, or do they just like take the piss at you?

Interview 2

Well, we might joke about it here and there, but like, we do respect it because it's pretty important for everyone to make sure they're healthy and well at work. Yep.

So have you ever tried like a cooling product or method that didn't work? Why not?

I'm trying to think...

Like a wet towel on your forehead or?

I don't think I have tried anything. The only thing I would have tried close to something aiding me in the heat would be like a brim extension on a hard hat.

Brim extension. Yeah, so it just sits on the hard hat and it's kind of like a, turns into a wide brim. I just don't protect from the sun.

Yeah, but I haven't tried anything else other than that. Like I haven't tried putting a towel or anything like that. Just because I think it, I've never thought of it and it'd probably hinder work as well.

So have you like ever like researched or like just found a cooling product that you think you might buy?

Oh yeah, there was this one product where it's magnetic and you can stick it onto like a metallic surface and stick an umbrella on it. It's got like a portable, portable shade.

If there was like something tough enough for you to use and actually kept you cool, what would it need to be like for you to wear it slash use it?

It needs to be compact. Yeah, because carrying a lot of stuff around, it's pretty annoying. But when something's compact then you can just have it there. Yeah.

Do you carry like a tool belt or do you carry like a pack on as well?

I carry like a, like a carry bag.

Would you be more likely to use something if like other workers had it as well?

Probably, actually, if a lot of other people are using it and they had something good to say about it.

Yeah. Yeah. If you could design like your own cooling setup or work, what do you think it would look like? My own cooling, like device? Yeah.

Probably just a floating, like portable shade that just follows you around. Yeah.

I forgot to ask a question about that. Which part of your body would you say like feels the worst? After sun exposure?

Yeah. Probably my head. Yeah, because I got a hard hat on all the time and sweat and heat just builds up in there.

Is there any like particular region that's like more predominantly heated up than the rest?

On the head? Yeah, would you say like the top of the head or like the back of the head? Yeah, probably the top. Probably the top. The top and the back. It's actually, probably the back actually. Like the back of the head.

Interview 2 - Coding

“I reckon 30 to 40% I will be outside like on a roof or outside. but mostly work on ceilings indoors”

Codes: partial outdoor exposure, worksite environment

2. “Wearing long sleeves and necessary sun safety equipment... water bottle... frequent breaks”

Codes: heat mitigation behavior, PPE use, hydration strategy

3. “Just like probably a little bit of a heat stroke...”

heat symptom reported, mild heatstroke experience

4. “I do work a little slower. (when affected by heat)”

reduced performance in heat

5. “only tried brim extension on a hard hat... like a wide brim”

current cooling aid, PPE modification, sun protection solution

6. “It needs to be compact... carrying a lot of stuff is annoying.”

design preference compact, mobility constraint, user need minimal intrusion

7. “If a lot of other people are using it and they had something good to say...”

peer adoption influence, social validation of products

8. “Portable shade that just follows you around.”

ideal fantasy product, autonomous cooling concept, desire for mobility with shade

x

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AXIAL CODING Themes:

Heat Exposure and Impact

- partial outdoor exposure
- mild heatstroke experience
- reduced performance in heat

Current Coping Strategies

- heat mitigation behavior
- hydration strategy
- frequent breaks
- PPE use
- shade seeking

Equipment and Uniform Limitations

- PPE modification
- standard uniform with UV
- current cooling aid
- sun protection solution

Site Culture and Communication

- team dynamics
- communication openness
- peer adoption influence
- social validation of products

Design Preferences and Needs

- design preference compact
- mobility constraint
- user need minimal intrusion
- ideal product fantasy
- autonomous cooling concept

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INSIGHTS FOR DESIGN

- frequently deal with heat but don't have dedicated or innovative cooling solutions.
- strong preference for compact and non-intrusive gear.
- Site culture supports speaking up about heat, but social proof affects adoption of new tools.
- Head (especially back or top) is the area most affected — potential for targeted cooling design.
- Current solutions are low-tech (e.g. water, shade, brim extensions), suggesting opportunities for subtle product integration.
- Ideal product would provide shade, be portable, hands-free, and easy to use.

Steve

Section 1 – General Background

Q: Yeah, so... just to start off, what's your trade and role? Like what kinda work do you do?

Yeah, so I'm a concreter. I work mostly on tilt panel stuff. So like pouring slabs, setting forms, lifting the big panels into place, all that kind of heavy commercial stuff.

Q: And how long have you been doing that for?

Ah, about 18 years now. Started as a young bloke and just stayed in it.

Q: Roughly, um, how many hours would you say you work in a normal week? Just like an average.

Most weeks would be around 50, sometimes more. Depends on what jobs we've got on and if we're doing any big lifts or early pours.

Q: Would you say most of your work's outside, like on site? Or more in a workshop setting?

Pretty much all outside. There's the odd bit of work under cover or in a shed, but even then it's still hot and open. Most of the time you're out on the slab.

Q: And when you're out on site, is that usually out in the open or do you get a bit of shade or cover here and there?

Nah, it's mostly just wide open. Like unless you're under the crane or working near some structure, you're just in the sun all day.

Q: On a hot day, like, what would you normally be wearing for work? Just regular PPE and stuff or... anything extra?

Just standard high-vis shirt, usually long sleeve, steel caps, hard hat. Gloves if you're handling steel or panels. Sunnies when you can. If we're pouring or patching, maybe extra like an apron or sleeves but that just makes it hotter honestly. We do also wear like rain boots if we're working with a wet slab.

Q: Do you usually work by yourself or is it more of a crew thing, like team environment?

Always a crew. You need a full team for tilt work. You got patchers, crane crew, finishers everyone's work comes together.

Q: So, like, when it gets really hot out there on site, how does it usually feel during the day? Like... what's it like working in that kind of heat?

Yeah it's rough. The slab just reflects the heat back up at you. Your boots feel like they're melting, tools are burning hot, and the sun's just smashing you. It's draining. We also have people on top of the tilt panels placing the anchor so they're literally not able to move at all otherwise they'll fall.

Section 2 – Personal Experience

Q: Have you ever felt like... properly affected by the heat while working? Like lightheaded or sick or anything like that?

Yeah, a few times actually. One time I probably nearly fainted. Just got real dizzy and had to sit down before I keeled over.

Q: Do you remember the last time the heat really got to you? Like could you run me through what happened, sorta step by step?

Yeah, I was on a job up north, think it was about 36 degrees. We were patching panels after a lift. I'd been working straight for about an hour and started feeling shaky, like I could barely concentrate and felt super light headed. Vision went a bit blurry too. Sat down on and one of the boys brought me water. Took about 15–20 minutes before I felt alright again.

Q: Would you say that, like, being in the heat makes you slow down a bit or maybe even make more mistakes than usual?

Yeah for sure. You don't think as clearly and your reactions are slower. Sometimes you forget stuff or just go through the motions without double checking.

Q: Have you ever seen anyone else get affected? Like, I dunno, people making mistakes or having near misses 'cause of the heat?

Yeah I've seen a couple of guys take a rest really quick but nothing too serious. Other times I've seen people drop tools or trip because they're just zoned out from the heat. I would say the older tradies, they're usually better at managing it; like they know their limits and won't push themselves too hard. But apprentices, yeah, they're more prone to it. They're usually trying to prove themselves or keep up, so they don't want to speak up or stop, even if they're struggling.

Q: Do you reckon there's a difference between what the company says you should do in the heat, and what actually happens on site?

Yeah, definitely. They say take breaks, drink water, look after yourself; but when there's a deadline or a pour happening, no one's really stopping. You just keep going till the job's done.

Q: If one is, like, no problem at all, and ten is completely cooked, how bad would you say last summer was for you?

Last summer? Probably an 8 or 9. It was brutal. Some weeks it felt like we were frying out there.

Q: When it gets hot, why do you usually reach for water instead of anything else? Do you feel like it actually helps or just sorta delays the heat getting to you?

Water's just the easiest. Doesn't really fix it, but it keeps you going a bit longer and it's better than nothing. Kinda just holds it off. Once you're already cooked though, water's not gonna save you.

Q: Is there a particular part of your body that you reckon cops the heat the worst? Like somewhere that feels it more than the rest?

Yeah, the back of the neck and lower back. You can feel the sun burning through your shirt. Also your hands — especially handling hot tools or mesh.

Q: When it gets dangerously hot, what does your crew usually do? Like, do people speak up or does everyone just try to push through?

Most of the time we just push through. Unless someone's really struggling, no one says much. You might have a quick break in the shade but that's about it.

Q: If someone did stop to cool down or take a break, what do you reckon the reaction would be? Like, do people respect it or take the piss?

Bit of both. Depends on the crew. Some would be like, fair enough, go cool down. Others might give you a bit of stick, but it's usually just joking around.

Q: Do you reckon job site culture makes it a bit harder to speak up when you're overheating? Like depending who you're working with?

Yeah sometimes. You don't want to look soft or like you're not pulling your weight. It depends on the supervisor too. Some are chill, others will just tell you to get on with it.

Q: Have you noticed other workers handle the heat differently to you? Like older blokes vs. younger ones, do they have their own tricks?

Yeah the older guys are better at pacing themselves. They don't rush. The younger blokes try to go hard and end up getting wrecked quicker.

Q: Do supervisors actually check in with you when it's hot or is it more like... up to each person to look after themselves?

Mostly up to you. Some supervisors might ask how you're going but most are just watching the schedule. If you're still working, they assume you're fine.

Q: Do you notice your apprentices dealing with the same stuff you went through? Like same heat problems?

Yeah for sure. They don't know the signs yet. I've had to tell a couple of young fellas to go take a break 'cause they looked pale or spaced out.

Q: Do you reckon newer apprentices are more at risk because they don't wanna say anything or look soft?

Yeah 100 percent. They wanna prove themselves so they won't say anything, even if they're feeling crook.

Section 3 – Preventative Measures / Site Culture

Q: Have you ever tried something to stay cool that just didn't work? Like a product or method that

wasn't really practical?

Yeah, tried one of those wet vests once. It felt heavy and just dried out in like 20 minutes. Didn't really help at all.

Q: Have you ever avoided using something 'cause you thought it might get in the way or maybe people would give you a hard time about it?

Yeah, definitely. Some stuff just looks silly or gets in the way when you're working. You don't want to be the only bloke on site with some weird fan hat.

Q: If there was a cooling product that actually worked and could survive site use, what would it need to be like for you to actually wear it or use it?

It'd have to be lightweight, not bulky, and not get in the way. Something that looks like normal PPE but helps cool you down.

Q: Would you be more likely to give something a go if, like, a few other people on site were already using it?

Yeah for sure. If everyone's using it, it's normal. No one's going to give you a hard time about it then.

Q: If you could make your own cooling setup for work — like anything you wanted — what would it look like? Doesn't have to be realistic either, just something that would actually help.

Probably like a high-vis shirt that actually stays cool, even in the sun. Or a hard hat with a fan built in that keeps your head from cooking. Maybe a belt with a little water sprayer too. Just something that doesn't get in the way.

	Interview 1	Interview 2	Interview 3
Common Themes	THEME: Heat Exposure and Physical Impact - outdoor exposure - heat symptom reported - physical impact of heat - body heat zones - reduced productivity - tool usability affected by heat	Heat Exposure and Impact - partial outdoor exposure - mild heatstroke experience - reduced performance in heat	Heat Exposure and Impact - partial outdoor exposure - mild heatstroke experience - reduced performance in heat
	THEME: Coping Strategies and Environment - PPE use - hydration behavior - shade seeking - coping strategy - reliance on indoor cooling - breaks as response mechanism	Current Coping Strategies - heat mitigation behavior - hydration strategy - frequent breaks - PPE use - shade seeking	Current Coping Strategies - heat mitigation behavior - hydration strategy - frequent breaks - PPE use - shade seeking
Differences	THEME: Workplace Culture and Social Norms - toughness culture - cultural norm endurance - empathy and acceptance - open communication - peer perception - toxic coworker avoidance	Equipment and Uniform Limitations - PPE modification - standard uniform with UV - current cooling aid - sun protection solution	Equipment and Uniform Limitations - PPE modification - standard uniform with UV - current cooling aid - sun protection solution
	THEME: Equipment and Design Requirements - product longevity requirement - form factor limitation - mobility constraint - need for non-intrusive design - need for heat-resistant tools	Site Culture and Communication - team dynamics - communication openness - peer adoption influence - social validation of products	Site Culture and Communication - team dynamics - communication openness - peer adoption influence - social validation of products
Insights	THEME: Product Adoption Barriers and Incentives - no product adoption - cost sensitivity - price ceiling - peer influence - value perception - social novelty	Design Preferences and Needs - design preference compact - mobility constraint - user need minimal intrusion - ideal product fantasy - autonomous cooling concept	Design Preferences and Needs - design preference compact - mobility constraint - user need minimal intrusion - ideal product fantasy - autonomous cooling concept

Design Direction
Influence

The main theme identified through the interviews was movement restriction, all interviewees clearly stated that they would desire that their movement not be hindered if a cooling product was used, e.g too heavy, too bulky.

Having a light-weight, yet rugged, low profile & slim design

THEME: Heat Exposure and Physical Impact

- outdoor exposure
- heat symptom reported
- physical impact of heat
- body heat zones
- reduced productivity
- tool usability affected by heat

THEME: Coping Strategies and Environment

- PPE use
- hydration behavior
- shade seeking
- coping strategy
- reliance on indoor cooling
- breaks as response mechanism

THEME: Workplace Culture and Social Norms

- toughness culture
- cultural norm endurance
- empathy and acceptance
- open communication
- peer perception
- toxic coworker avoidance

THEME: Equipment and Design Requirements

- product longevity requirement
- form factor limitation
- mobility constraint
- need for non-intrusive design
- need for heat-resistant tools

THEME: Product Adoption Barriers and Incentives

- no product adoption
- cost sensitivity
- price ceiling
- peer influence
- value perception
- social novelty

Heat Exposure and Impact

- partial outdoor exposure
- mild heatstroke experience
- reduced performance in heat

Current Coping Strategies

- heat mitigation behavior
- hydration strategy
- frequent breaks
- PPE use
- shade seeking

Equipment and Uniform Limitations

- PPE modification
- standard uniform with UV
- current cooling aid
- sun protection solution

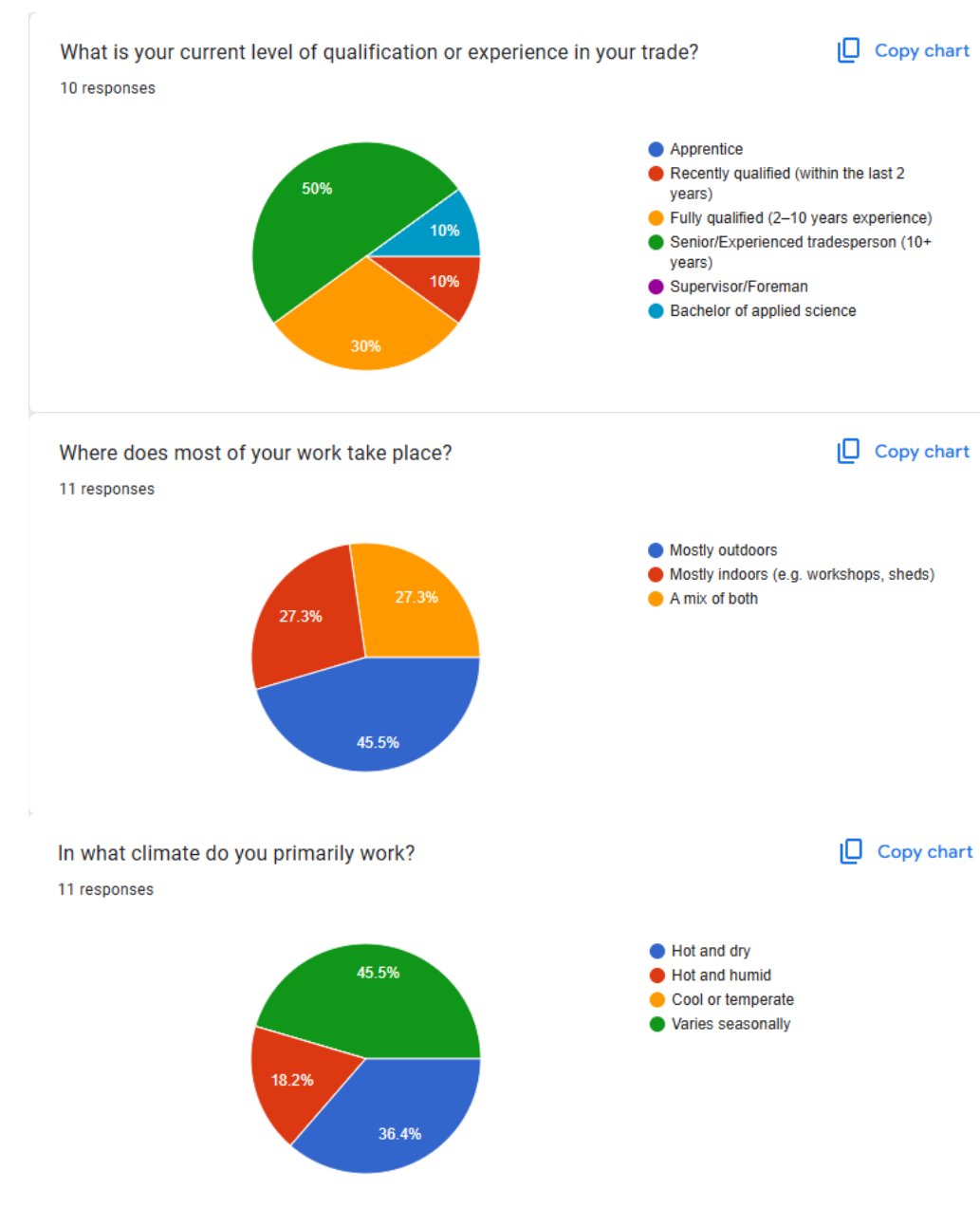
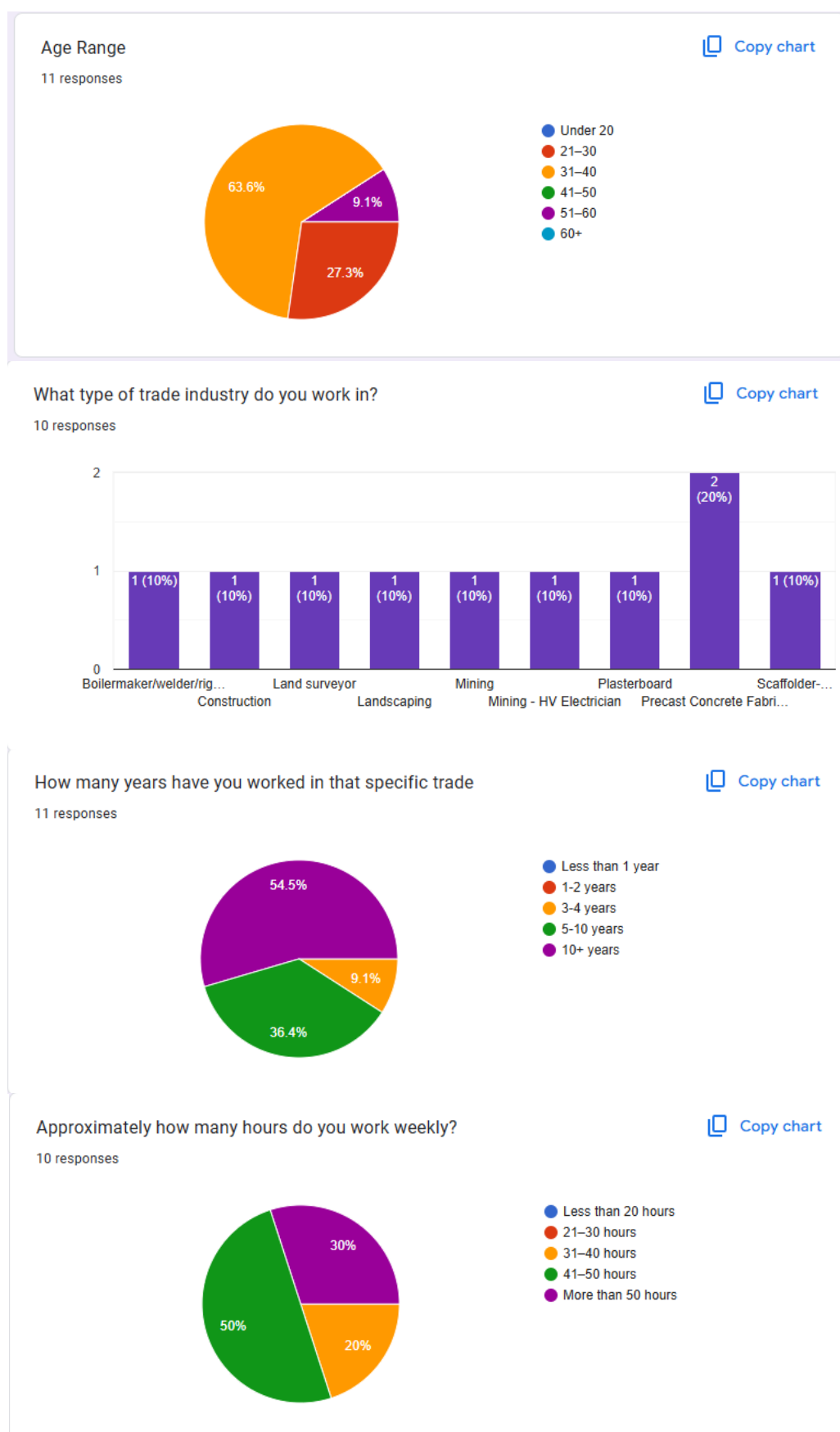
Site Culture and Communication

- team dynamics
- communication openness
- peer adoption influence
- social validation of products

Design Preferences and Needs

- design preference compact
- mobility constraint
- user need minimal intrusion
- ideal product fantasy
- autonomous cooling concept

Survey Results



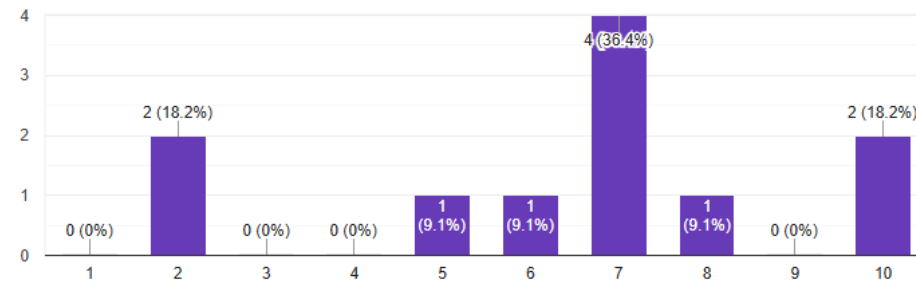
What kind of PPE or uniform do you usually wear during hot weather?

- Long Sleeve 100% cotton drill industry
- Long sleeve and pants hi vis
- Steel caps, long sleeve work pants and cotton drill shirt w bamboo or merino wool undergarments, broadbrim hat with neck flap, headband or cooling towel, neck buff, earmuffs, gloves, sunscreen, sunglasses
- None
- Lace up boots, long socks, full length pants, long sleeve shirt, leather gloves, eye protection, hearing protection and hard hat
- Hi vis long pants and long shirts
- Long sleeves long pants
- Shorts, gloves, hardhat, sometimes safety glasses
- Long pants and shirt. Hard hat. steel capped boots
- none
- Proper hat and spf50 multiple times a day

On a scale of 1–10, how often do you experience heat-related discomfort at work?

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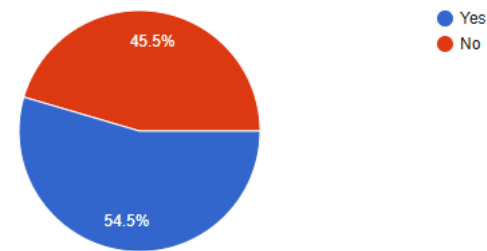
11 responses



If you have been affected, did this cause you to stop work temporarily?

[Copy chart](#)

11 responses



How did you recover?

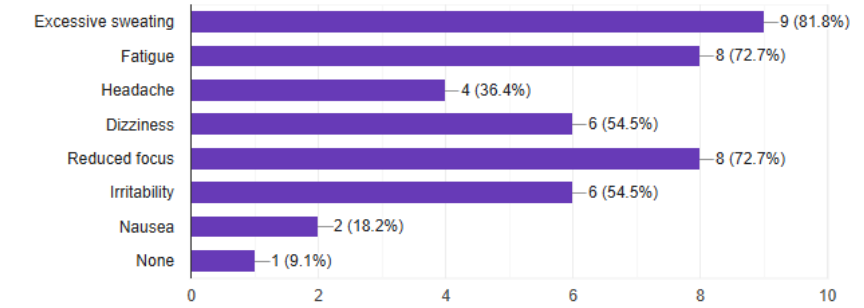
9 responses

- We stop working once it gets to 34c
- Shade breaks, rotated tasks, worked the shittiest task in the cooler hours; morning and evening for example.
- Water, breaks, hydrolite
- Naturally
- Plenty of water
- Break in the shade, hydrate.
- Drink water and time
- Rest, hydration, shade, consuming electrolytes and enough nutritious food
- Go inside or sit in car with air con. Sip water.

What symptoms of heat stress have you experienced while working?

[Copy chart](#)

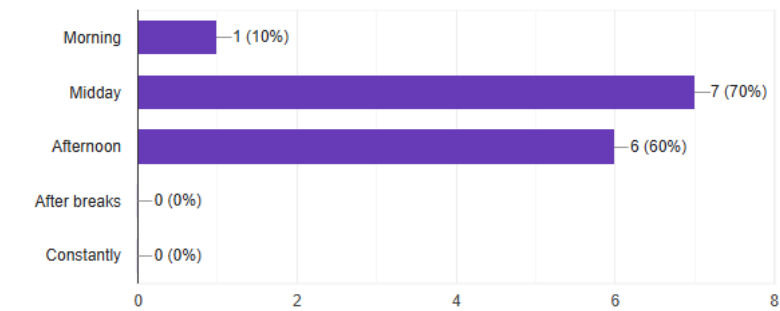
11 responses



When do you feel hottest or most uncomfortable during a typical workday?

[Copy chart](#)

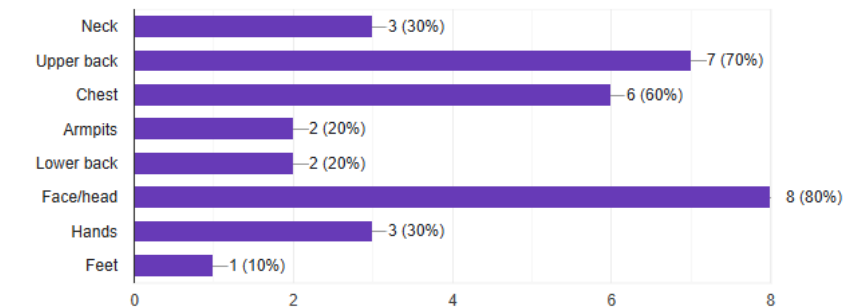
10 responses



Which body areas feel hottest or most uncomfortable? (Pick up to 5)

[Copy chart](#)

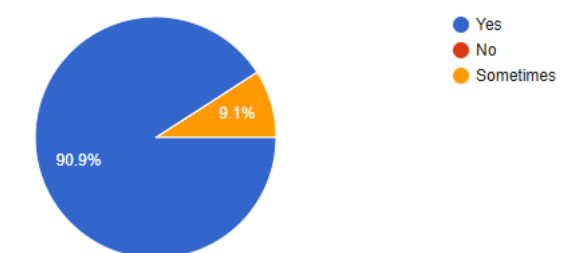
10 responses



Do you make a conscious effort to stay hydrated during work?

[Copy chart](#)

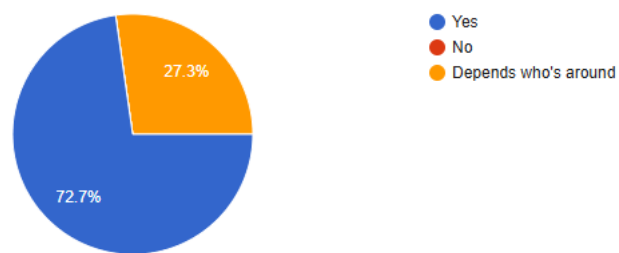
11 responses



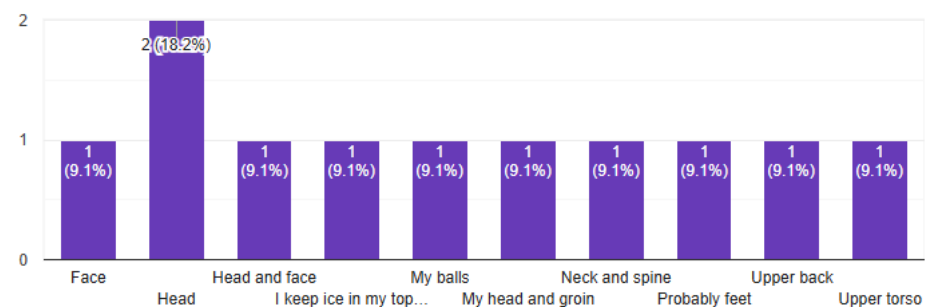
Does your workplace provide any support for managing heat (e.g. cooling breaks, hydration stations, shaded areas)

- Water Fountain on site
- Water Station, rest room fridge and freezer
- Depends on company and jobsite. Many disregard industry standards, some go above and beyond
- Yes, I stop work once it reaches 34C. Due to the products we use they don't react to heat well and it's not recommended to use while over 36c
- Plenty of water on hand
- Absolutely. All of the above
- Refuge chambers. Cars have air con. Hydralite temp monitoring
- Some jobs do some don't
- The lot
- Not needed
- No

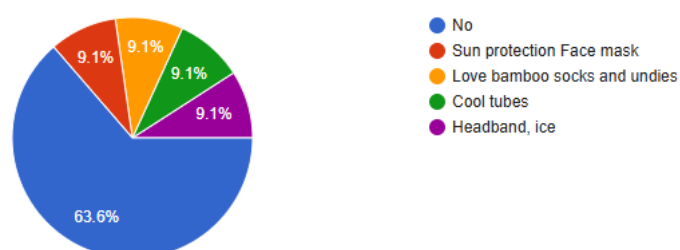
Do you feel comfortable speaking up when the heat becomes too much?
11 responses



If you could cool one part of your body during work, which would it be?
11 responses



Do you currently use anything to stay cool while working? (e.g a cooling headband, portable AC)
11 responses



Have you ever wanted to try a cooling tool but didn't? If so, what stopped you?

- Looks too gimmicky
- Not good enough too expensive
- Prefer not to rely on electronic tools
- No, I would get in the way
- They don't last long. I work in high hazard areas often. Clothing doesn't last long, burns, rips and tears. Also I carry enough gear on me through the day, I don't want another thing to carry
- No, would be one more thing I'd need to worry about keeping charged or strapped to me
- Yes. Not organized.
- NA
- no
- They all look like scams

If you do use a device, what do you not like about your current cooling device or ones on the market today?
5 responses

Nil

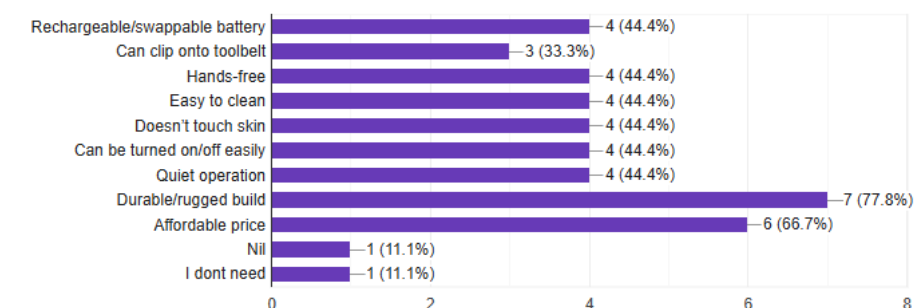
NA

No, they all shit and yours will be too.

Its loud

Looks too gimmicky

Which of these would make you more likely to use a cooling device?
9 responses



Total Responses: 11

Observations & Insights

Responders do experience the affects of heat, however the current market of products hinder and underperform to the needs. Noticeably mentioned, the cooling performance and cost.

Aesthetics were also mentioned,

Data provided the trend that majority if not all participants, do not currently use a cooling product

Participants do keep a conscious effort to stay hydrated even if the jobsite does not provide any ammeities.

One particular responder features a jobsite that stops work at 34C, and does not continue unless it begins to cool down.

Application

Participants Particularly want a product that

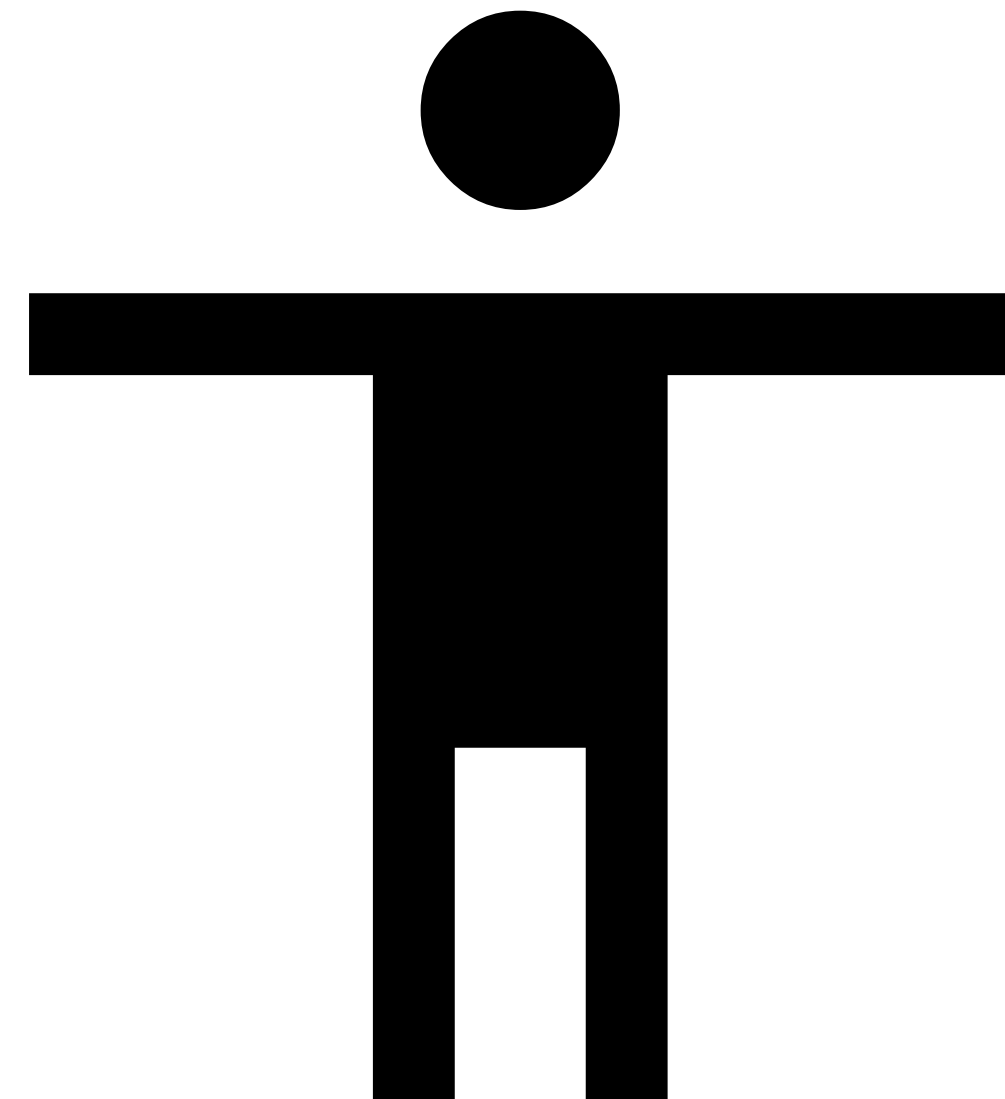
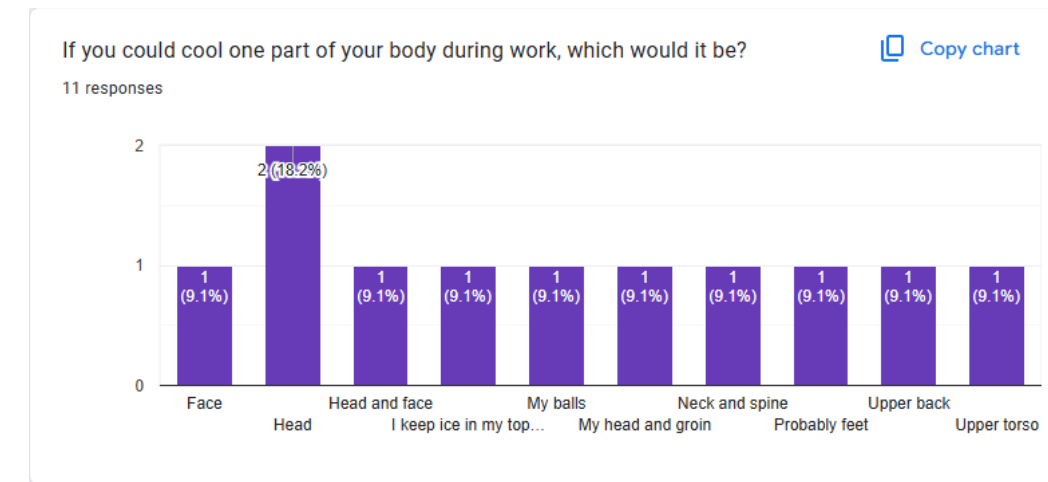
- Rugged and Durable
- Affordable (Answer from an interview suggested that \$500 to \$1000 would be too unappealing for an investment)

Secondary Needs

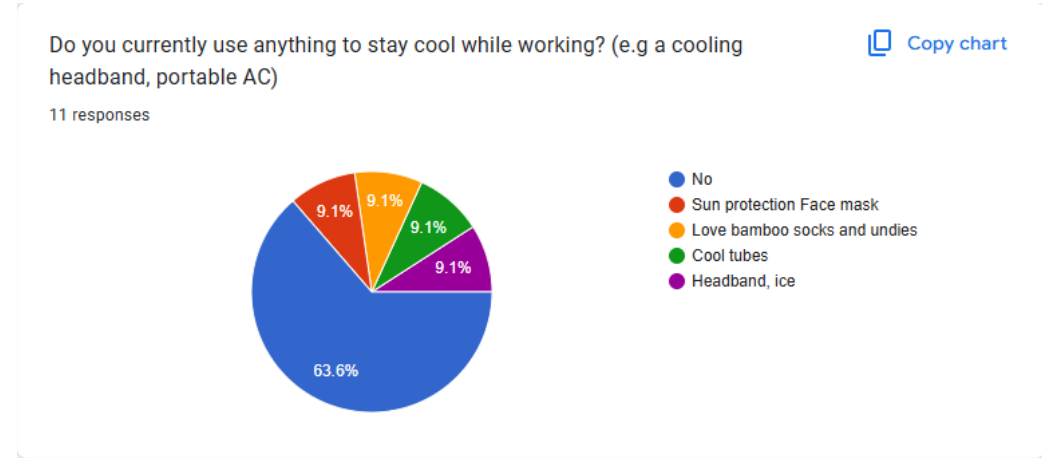
- Rechargeable / swappable battery
- hands-free
- easy to clean
- doesnt touch skin
- turn on/off easily
- quiet operation

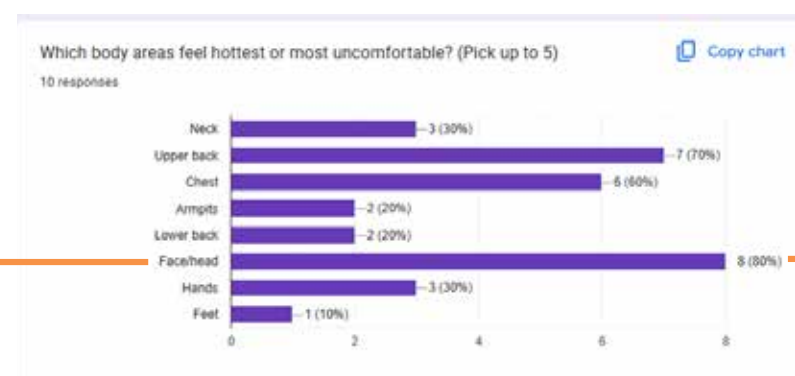
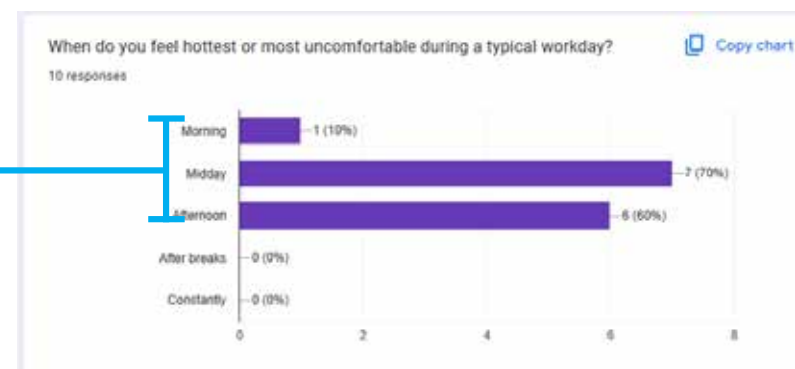
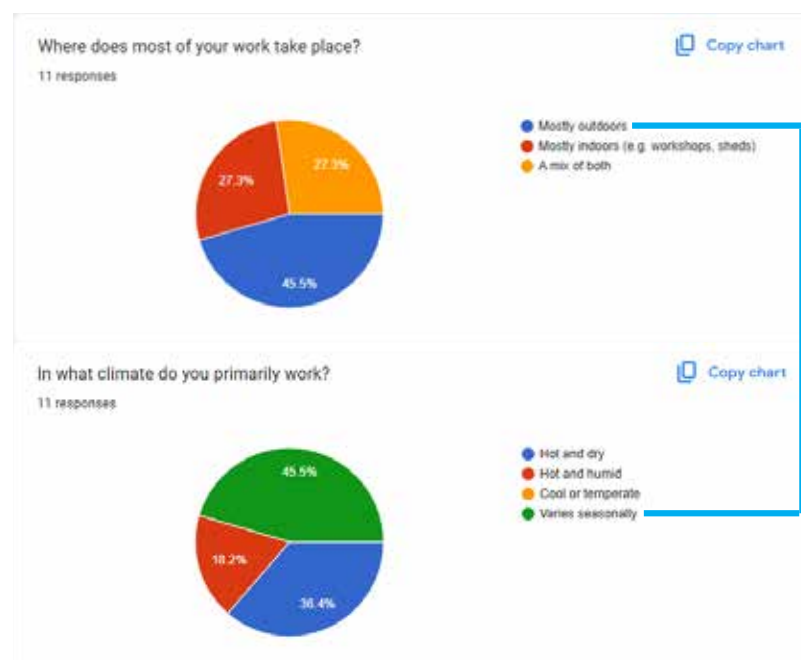
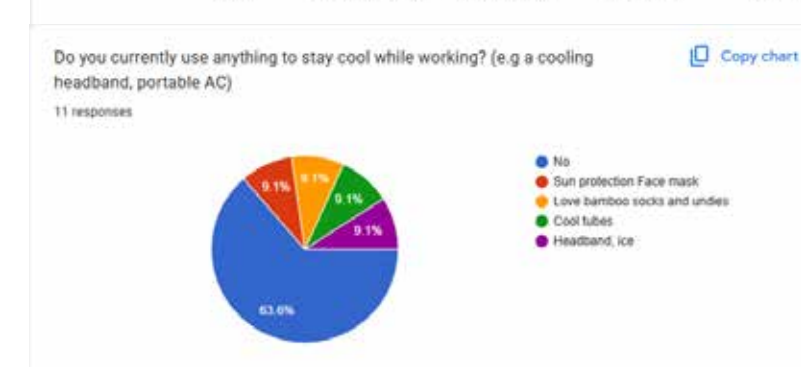
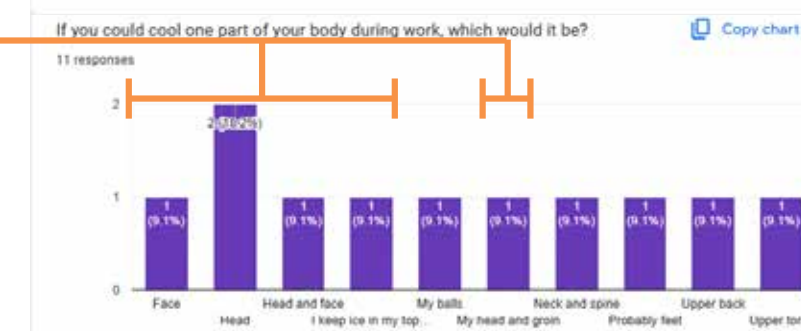
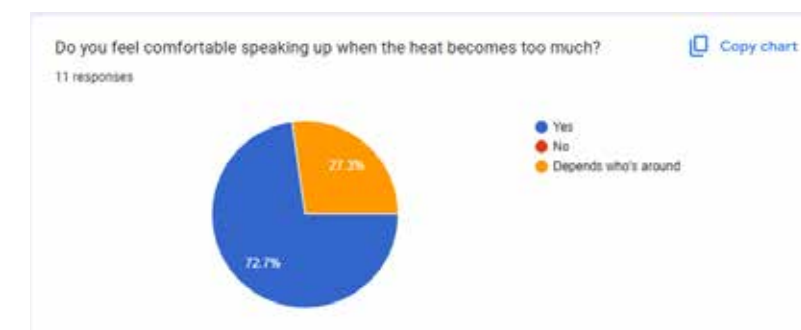
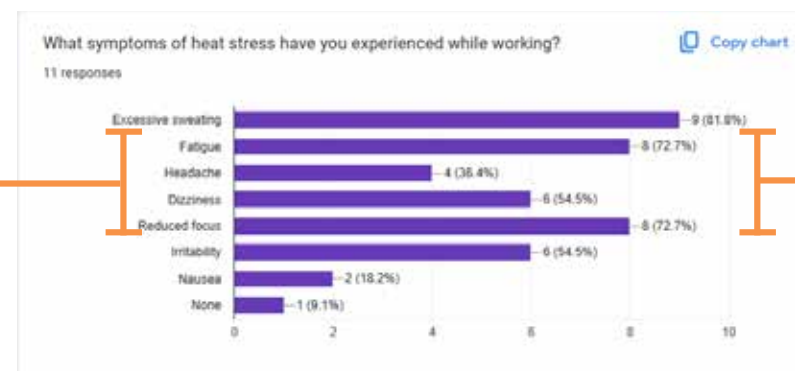
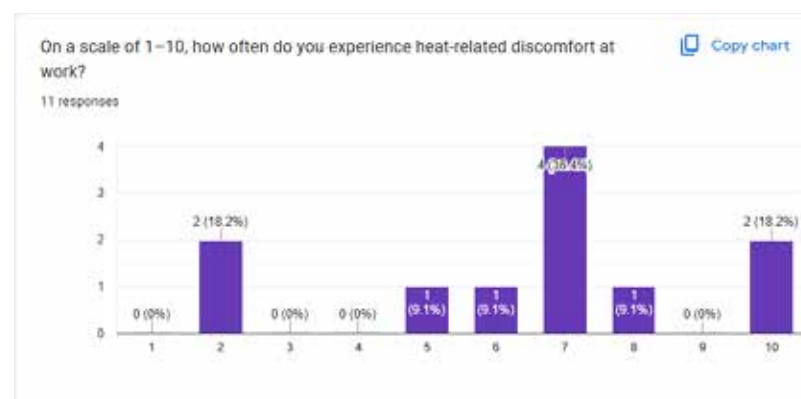
This pattern seems closely to how jobsite tools are designed e.g an impact drill

Trade workers may position a cooling device as a an investment rather than a....



https://www.jstage.jst.go.jp/article/indhealth/51/1/51_2012-0089/article/-char/ja/





A1 Part 2: Initial Concept due date is Friday 12th Sep 11:59pm
(effectively Sunday 14th Sep 11:59pm with 48-hour extension)

concept presentation is
Friday 12th Sep from 1pm-3pm / Room B101 + B101A
Formative Presentation
Group of 8-10 students
Digital presentation (PDF/PPT/etc) between 5-7min
Student-led presentations
All students to engage in presentation as well as feedback / discussion
Outcome is to choose direction based on feedback / discussion

GUIDELINE + STANDARDS

Australian Consumer Product Safety System
<https://www.pc.gov.au/inquiries/completed/consumer-product-safety/report>
Product Safety Australia: Mandatory Standards
<https://www.productsafety.gov.au/product-safety-laws/safety-standards-bans/mandatory-standards>
Product Safety
<https://www.accc.gov.au/business/treating-customers-fairly/product-safety>
Testing to Product Standards
<https://www.productsafety.gov.au/system/files/Testing%20to%20product%20standards%20-%20Principles%20for%20test%20organisations.PDF>
Standards Australia
<http://www.standards.org.au/Pages/default.aspx>
International Standards Organisation
<https://www.iso.org/home.html>

exporting adhering to TGA but also local standards eg FDA (US)

dexterity design

- Age
- sweat
- how do you design for the capabilities of someone whos not able to hold efficiently
-

Finger, Hand, Arm

e.g a jar, is it really hard to open

SIZING + SPACING OF INFO

How is it branded, what labels and packaging experience does the product have?

Visual Field + context

what environment of work / use - Day / Night, Rain, Dusty

What other clothing, PPE?

How does it change what you can do in terms of following mandatory standards

Hearing + Speech

Loud noise- stress levels, how does it affect communication - not effective or streamlined?

Mobility + movement

people with limited mobility? Disabilities?

intentional? e.g stopping ankle / wrist overextension?

Moving + Transportation

where does it store? why there?

Cognition

information overload

How much information is needed for the product to work.

instructions

Why does your product need instructions? have you design for it to work without user needing it?

Familiarity

Using familiar motions, actions, interfaces to the era. e.g floppy disk for save icon, levers on underside of chairs

User Centered Elements (UCD)

Make sure you consider the user-centred elements for your particular product / project. Think through the design, how would your target user group utilise the product and engage with it - as a result, what are the critical considerations in that context?

Research Question Update after draft

so at first my research question was

‘The aim of this report is to identify the key issues trade and construction workers face in managing heat stress, and to understand why effective cooling measures are not being used to protect against heat-related illness and performance decline.’

INTO

‘The aim of this report is to explore how trade and construction workers experience heat stress, why current on-body cooling solutions are underutilised, and what design opportunities exist to create interventions that are compatible with PPE, workflow, and workplace culture.’

Week 8

experience design

a design approach that aims to create appropriate positive experiences before, during and after user product interaction

experienced focused (user expectations)

Time longitudinal

context (relevance)

user familiarity (how do you make the design as familiar as possible so that users don't get confused / understand to learn the product better)

affordances, the relationship between the properties of a product and the capabilities of the agent using the product (who is your user? do they think that it's usable)

mappings the association / relationship between an action and an event.

feedback, the means of communicating the result of an action.

manufacturing

Bill of Materials

Standard parts

custom parts

drawings

quality assurance

The five ideas

1. Hardhat cooling attachment

2. PCM spine thing

3. Remote Worker Heat stress tag indicator

4. sleeve / waist fan?

5. On clothing clips for camel pack / water bottle / umbrella shade?

Week 8 - Aesthetics

Aesthetic Theory

Psychophysical - Properties

This is the most basic information about design and aesthetics.

- Colour: e.g Red connotes energy, orange connotes happiness, blue connotes stillness/stability
- Shape + Form: Square forms connote stability. round forms connote softness, wedges connote direction
- Materiality: Metals, wood, plastic all connote different things

Organisational - Properties

Our visual system is tuned to organise information, to bring structure or order in the wealth of information that reaches our brain. Simply put, we like to look at patterns that allow us to see relationships or create order.

1. Unifying properties

Balance – e.g symmetry. proportions

2. Complexity + Variety

- In some circumstances, we seem to search for complexity and variety, a type of behaviour coined diversive exploration
- Visual patterns are important; too little and they are boring, too much and they overwhelm – somewhere in the middle is good.

3. Unity in Variety

- In some circumstances, we seem to search for complexity and variety, a type of behaviour coined diversive exploration
- Visual patterns are important; too little and they are boring, too much and they overwhelm – somewhere in the middle is good.

Meaning Properties

Meaningful properties are by definition subjective and are rather not properties of things, but properties as we perceive them

A. Familiarity + Prototypicality

- Familiar things are more often liked than non-familiar things (to a point)
- Prototypical representations of things (recognisable classifications) are often more preferred than things we cannot recognise (context plays a role)

B. Originality, Novelty + Innovativeness

- Familiar things are more often liked than non-familiar things (to a point)
- Prototypical representations of things (recognisable classifications) are often more preferred than things we cannot recognise (context plays a role)

C. Most advanced yet acceptable

MAYA principle. Designers need to find a balance between innovation and novelty (advanced) and a certain amount of typicality (acceptable) - Can be a difficult thing to balance

D. Product expression and association

- We tend to attribute many more differentiated meanings to a product, that sometimes rely on deeper meanings
- We could for example associate something as strong or weak, traditional or modern, masculine or feminine...
- We don't have good data to identify if and how these associations contribute to aesthetic qualities.

7 Principles of Art + Design

Balance: the visual weight of the elements of the composition

Contrast: the difference between elements in a composition.

Emphasis: an area that is visually dominant and commands the viewer's attention

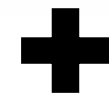
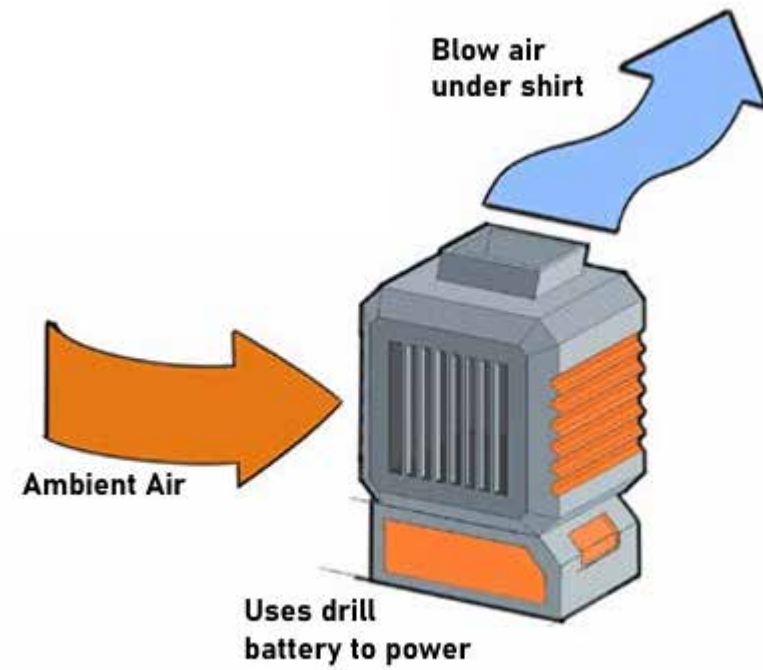
Movement: the result of using elements (lines, edges, etc) such that they move the viewer's eye around

Pattern: the uniform repetition of any of the elements or any combination thereof

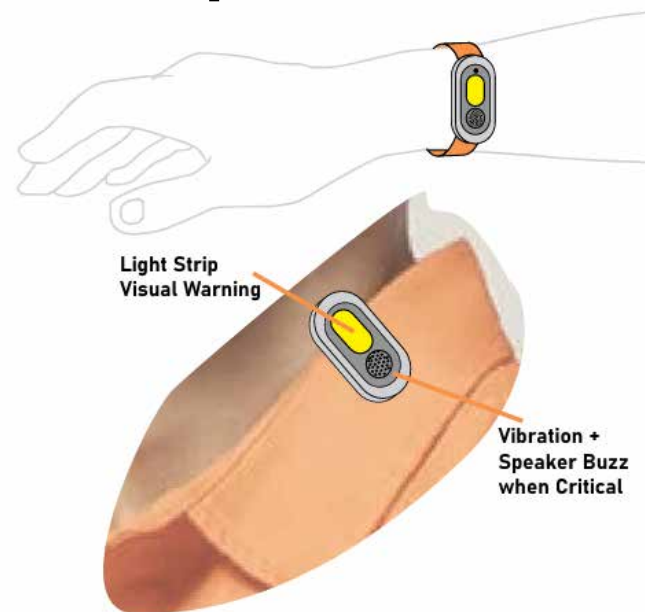
Rhythm: created by movement implied through the repetition of elements of art in a non-uniform but organized way

Unity/Variety: Too much unity creates monotony, too much variety creates chaos; you need both

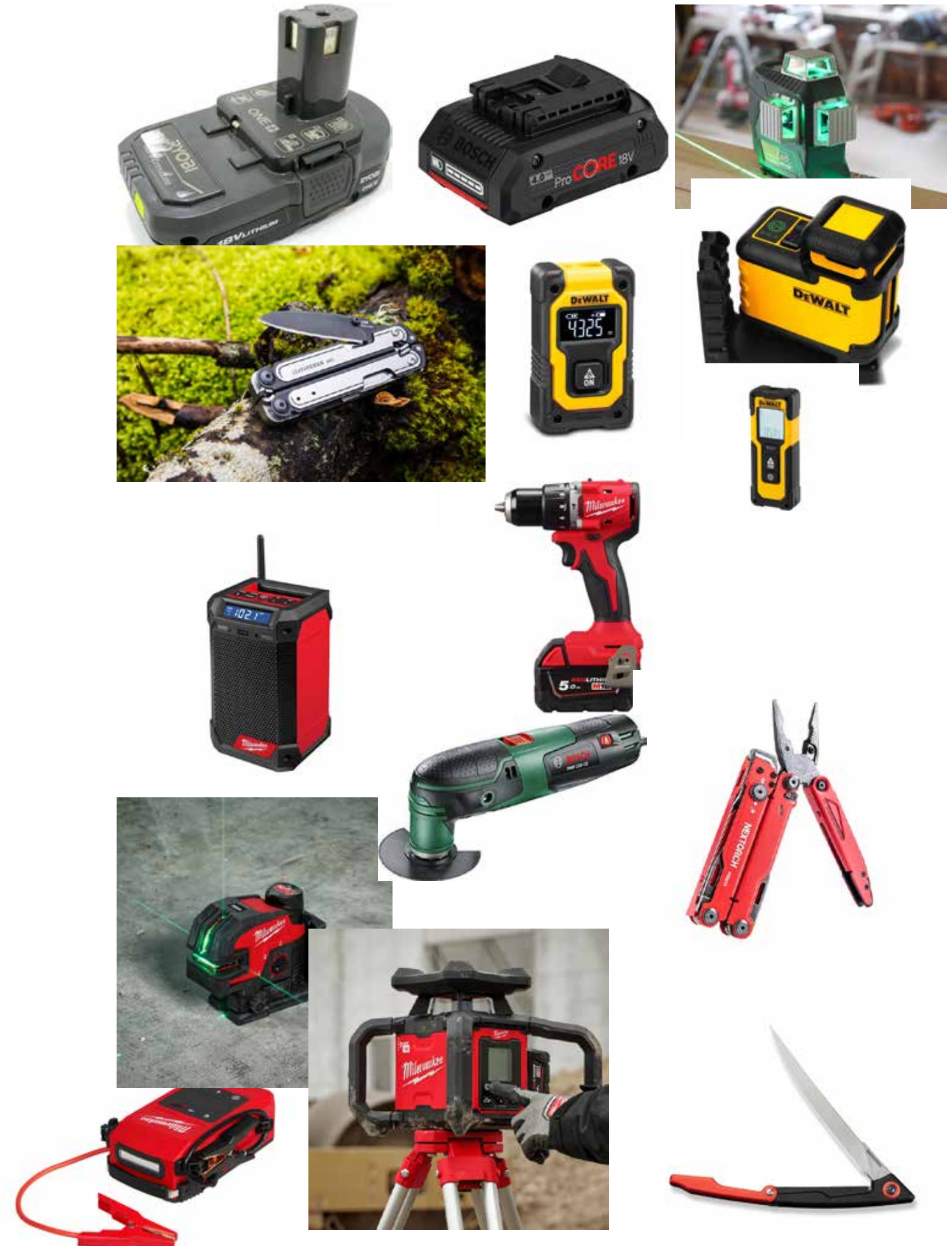
Chosen Concept / s



**Integrate
concept 4**



MoodBoard



Capstone Innovation Layer

Smart Control Module (Independent unit)

A small add-on circuit with:

Temp & humidity sensor (cheap, <\$10)
Accelerometer (movement)
Timer/pattern logic

tells the fan when to speed up / down automatically.

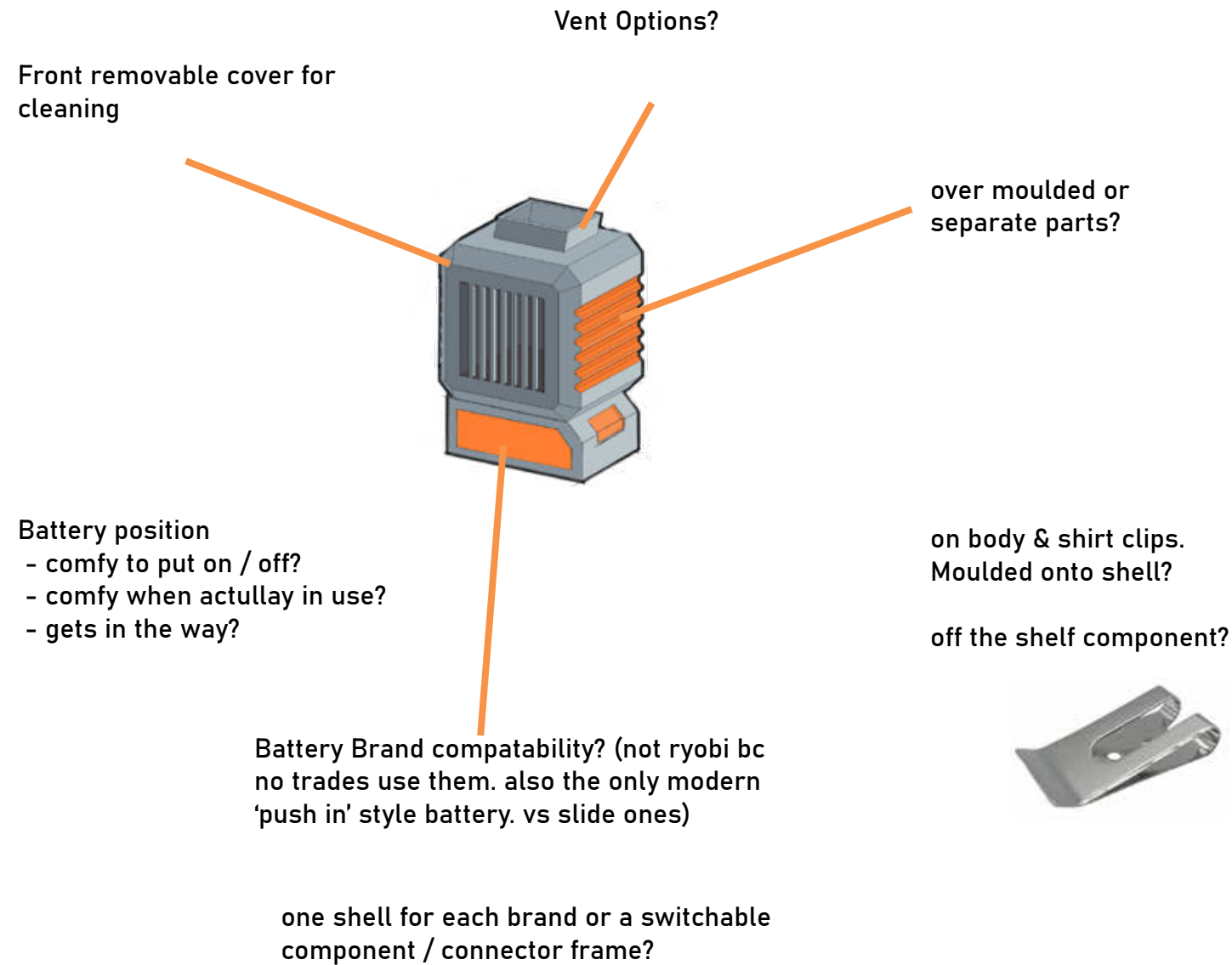
Adaptive Modes

- Idle Mode = low power airflow
- Active Mode (detected by movement OR high ambient heat) = medium
- Heat Spike Mode (sustained high heat + humidity, or time-of-day prediction) max power

User Override

Keep a manual button - can force High if they want.

- Independent & self-contained (no app, no external system needed)
- Heat-aware and context-responsive (not just "on/off")
- Battery-smart (extends runtime by only using max when necessary)
-



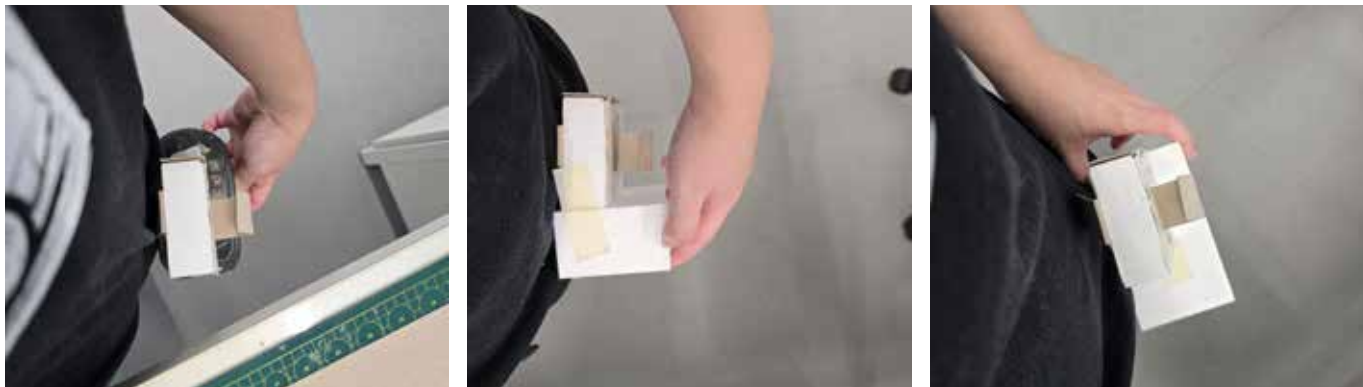
Foam Prototyping



Using a ryobi battery, I mocked up a design that would have similar dimensions to the width of the battery. I tested two orientation of the battery, sitting beside the fan and under.

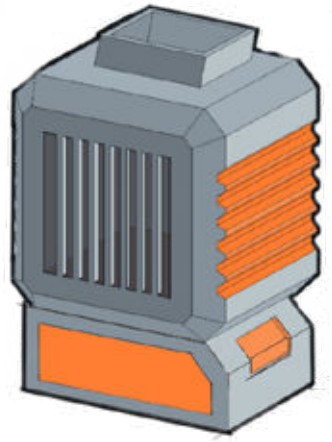


Wearing the fan felt a little awkward but because of the foam, I wasnt able to fully understand how weight would have played in the prototype.



Playing with orientations of the battery.

3d printin and testing this

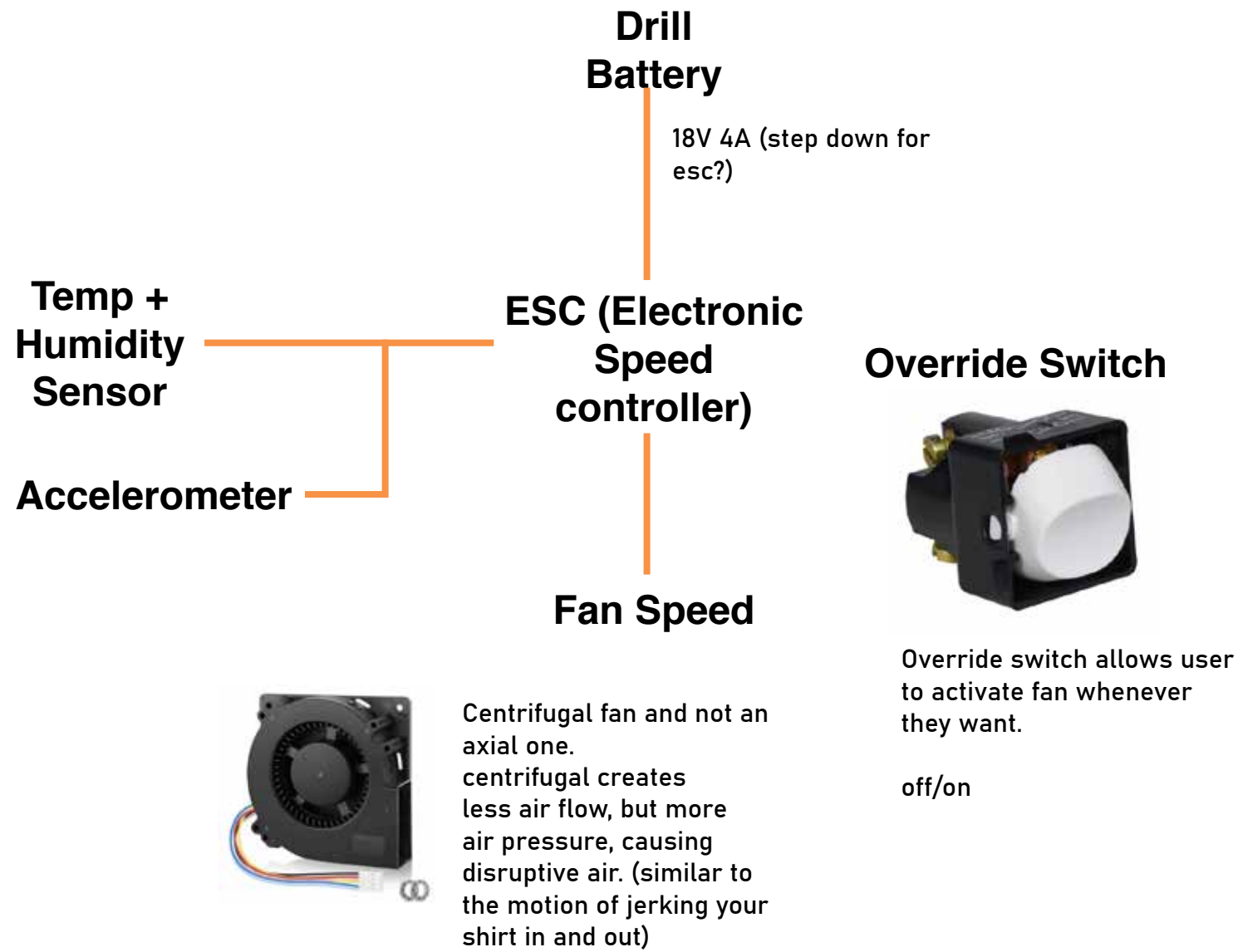


Initially I 3d printed a design using the same measurements as the foam model, but now that it has a clear form, and actually put it on my waist, this thing sucked. I wanted to keep this thickenss so that the form would not arch out because of the battery however the probably would have been better to thin the top and loft to the thickness of the battery.

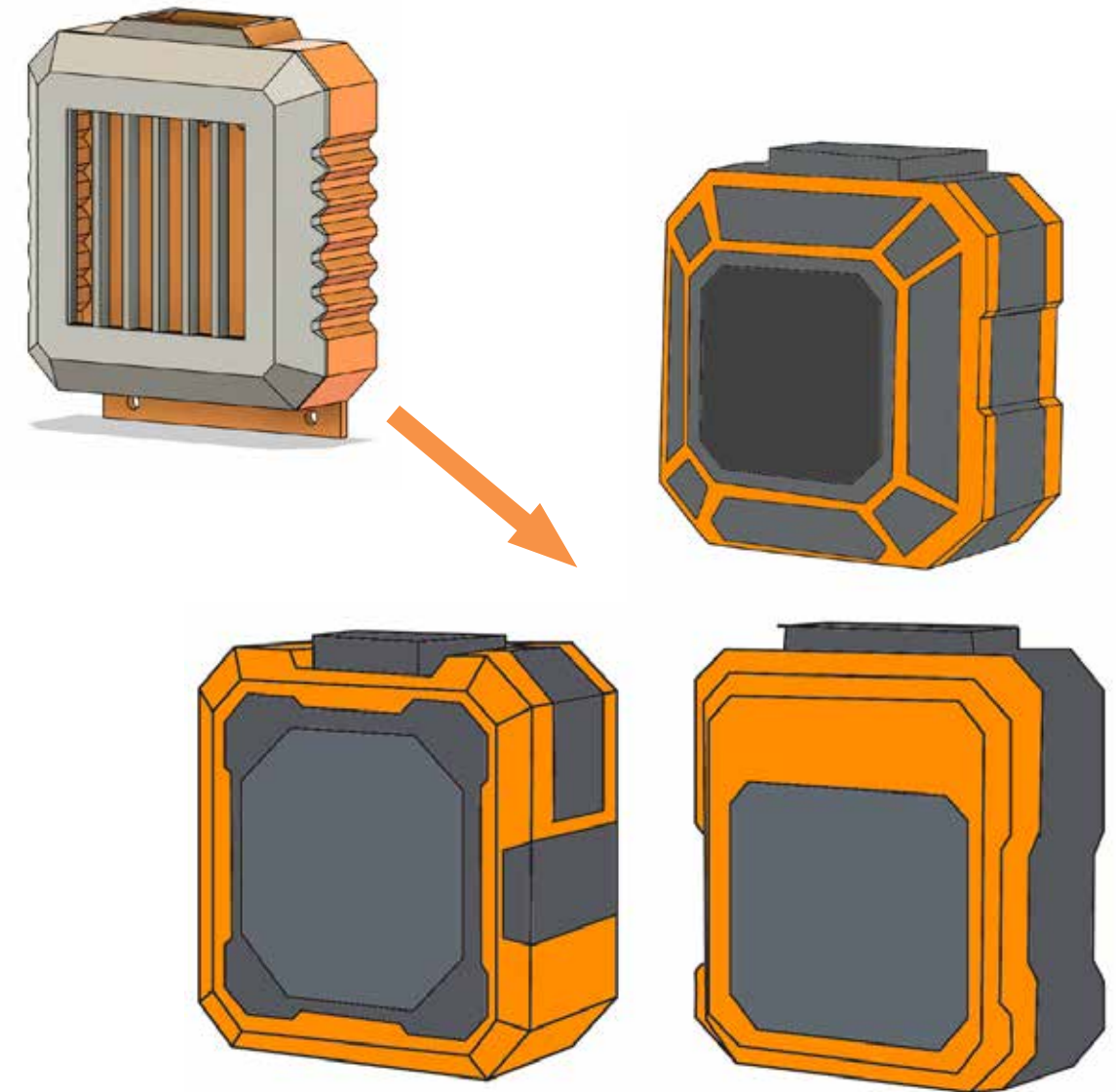
tldr: this was ass, too thick, bulky, looks bad, felt bad,

The only thing I took from this was the battery adapter.

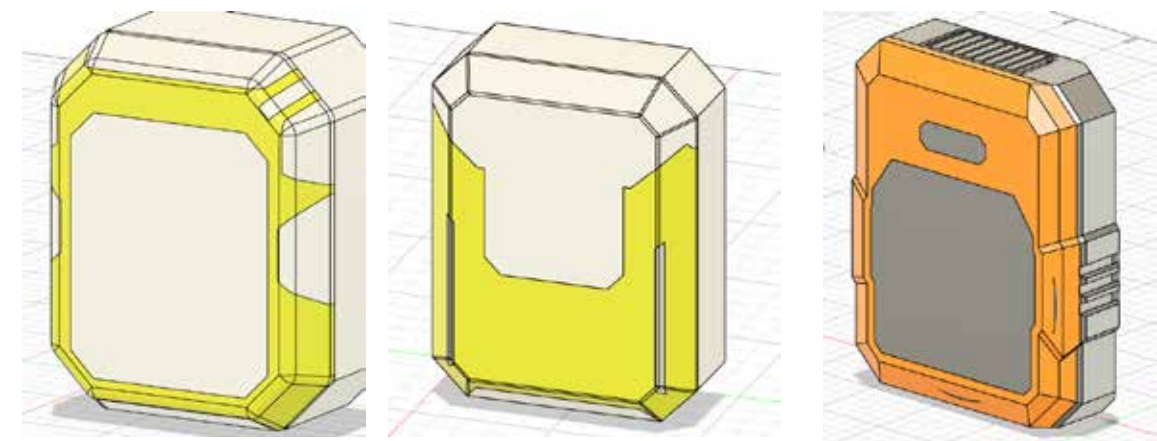
Electronics / Function



Aesthetic Development

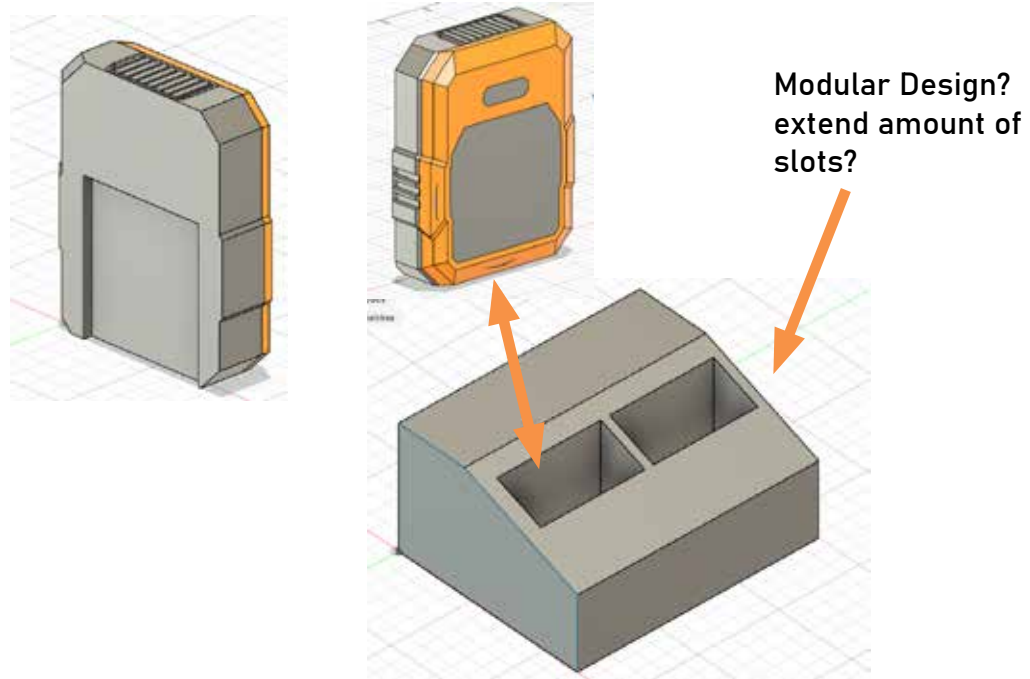


screwed up the measurements (fan unit should be more rectangular bc fan used is 110mm)



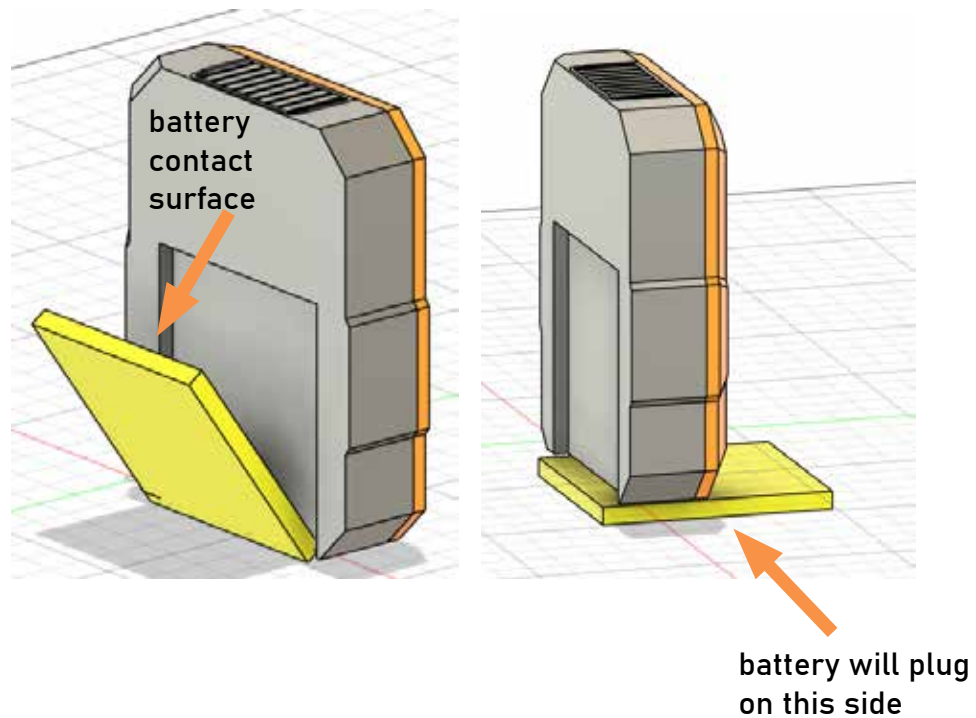
Charging Station

Comes with multiple units and one docking station, users place it in to charge (off a drill battery). By approaching this way users can either use more than one, or switch when out of charge. Possibly having a modular design to the dock could allow for users to charge more than 2 at a time.

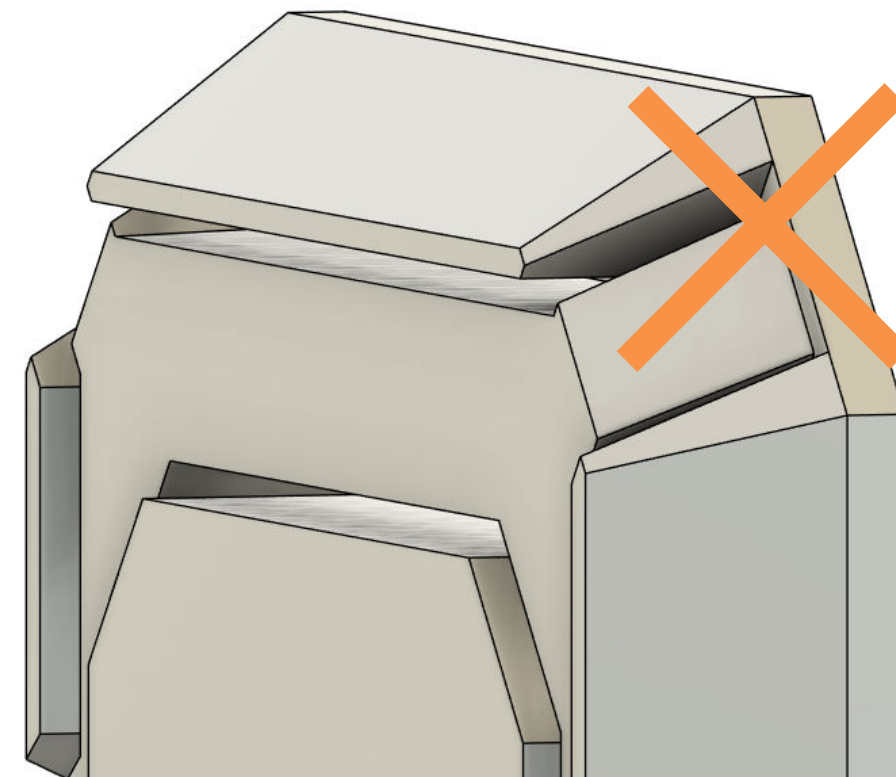
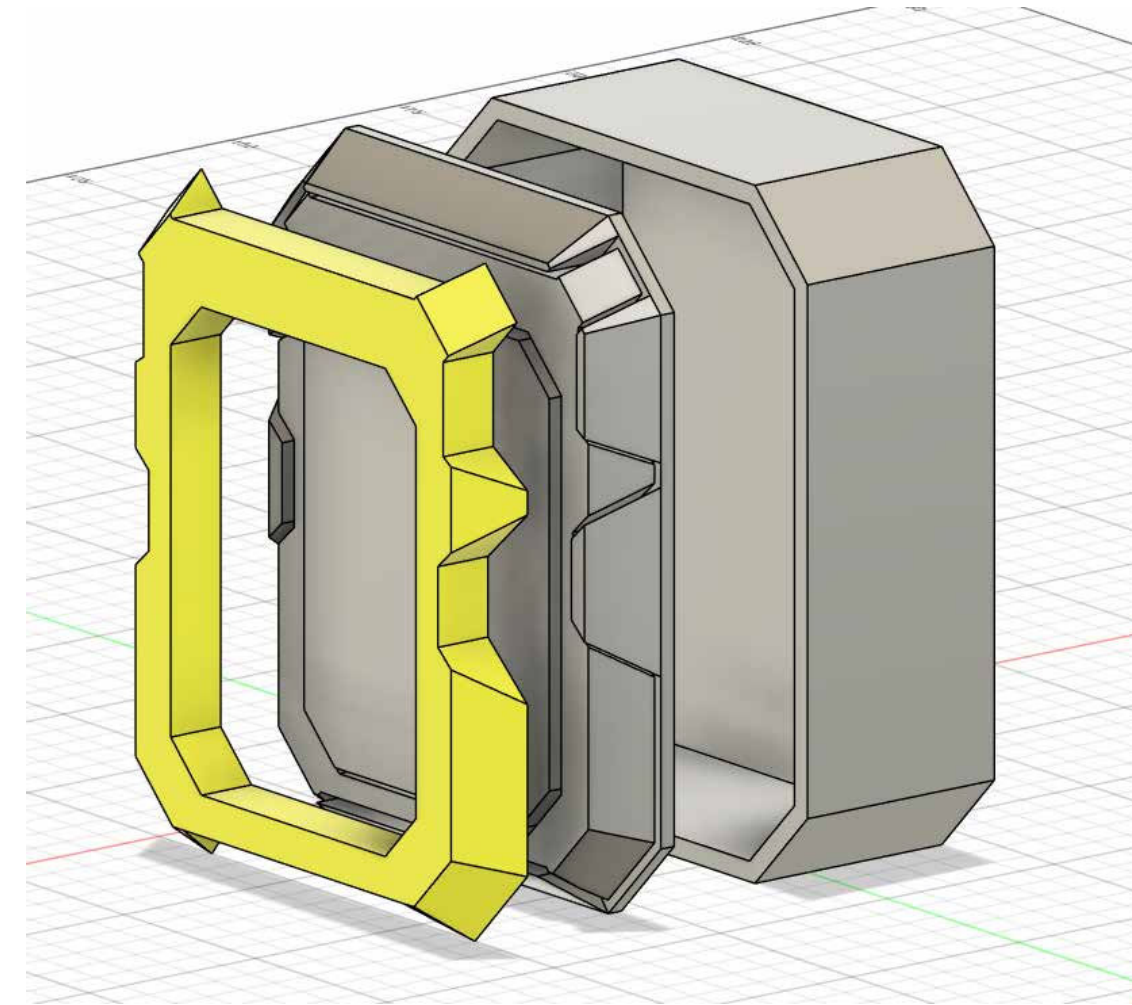


Foldable Port Clip

hidden pannel that can clip out so that you can use drill battery over the internal battery



First Attempt at trying to do overmould, I extruded the gaps before shell the second copy of the body results in deep channels.



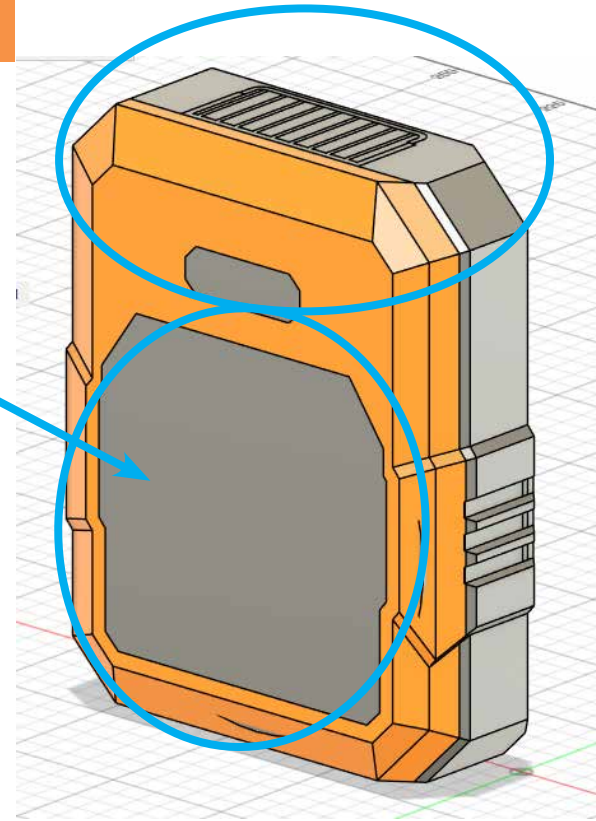
Filtration & Meshes

Feedback provided said that a method of cleaning or filtration so that dust doesn't blow under the shirt would be good

maybe having a mesh, that can be slide off whenever the user wants.

In practice would only really need one for the intake, as it would filter air before it goes into the blades. A second filter may be redundant and reduce performance and increase part count and cost.

removable mesh here for intake



Clipping Onto The Belt / Shirt

various of clips were explored to see which could securely clip on the users clothing without requiring

- hardware,
- allow quick removal,
- non-bulky,
- strong enough for trade work (rough physical movement, drops, water & dust proof),
- not introduce any unnecessary components

User Interaction +

allowing

independent variable speed changes without user input will help



Before the final prints I ran into some issues with the internal layout the ports on the pcb were causing slight collisions with the outer shell, which prevented the two halves from closing properly.

I had to adjust the internal standoffs and port cutouts to create better clearance for the components.

During this stage, I also tested the overmould thickness, targeting a 1 mm layer to balance flexibility and durability.

(According to Protolabs' design guidelines for overmoulding, a 1 mm thickness is suitable for achieving consistent adhesion while maintaining the tactile feel of a soft grip without adding excess bulk.)



Tested the fitment of the overmould:

Originally I planned to use a 3D printed TPU overmould to simulate the soft grip texture, but I wasn't able to get any reliable prints in time. Instead, I focused on assembling and testing the main housing.

I added heat-set inserts for the belt clip to make sure the fastening was secure and wouldn't risk stripping threads if it were just plastic. The overall test fit of the prototype went smoothly, with only some minor alignment and tolerance issues around the fan housing that I'll adjust in the next revision.

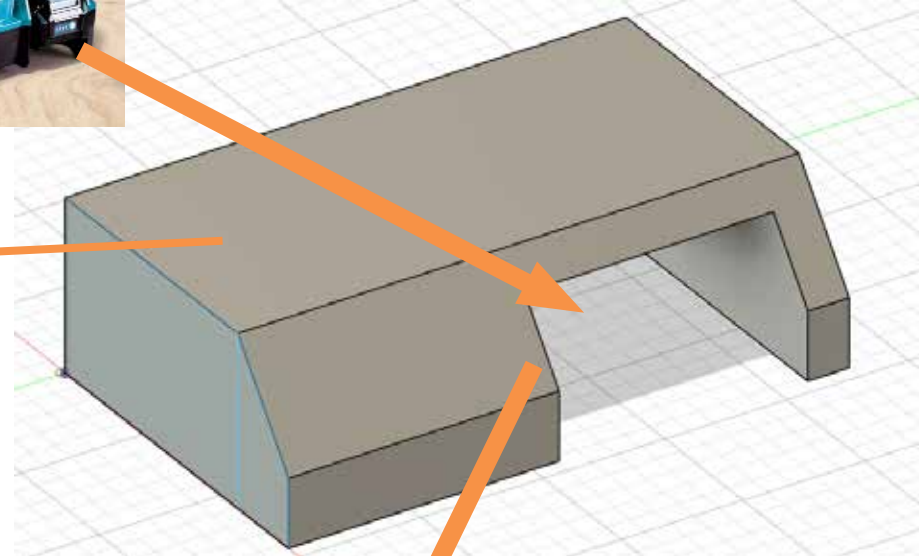


Docking Base For Fan Units



The first version i wanted the battery to sit upright, and this would allow for consistency and flow of the overall shape of the dock.

However, I think this shape has more potential to be fitting for a larger amount of fans whereas the 2nd ver is better f

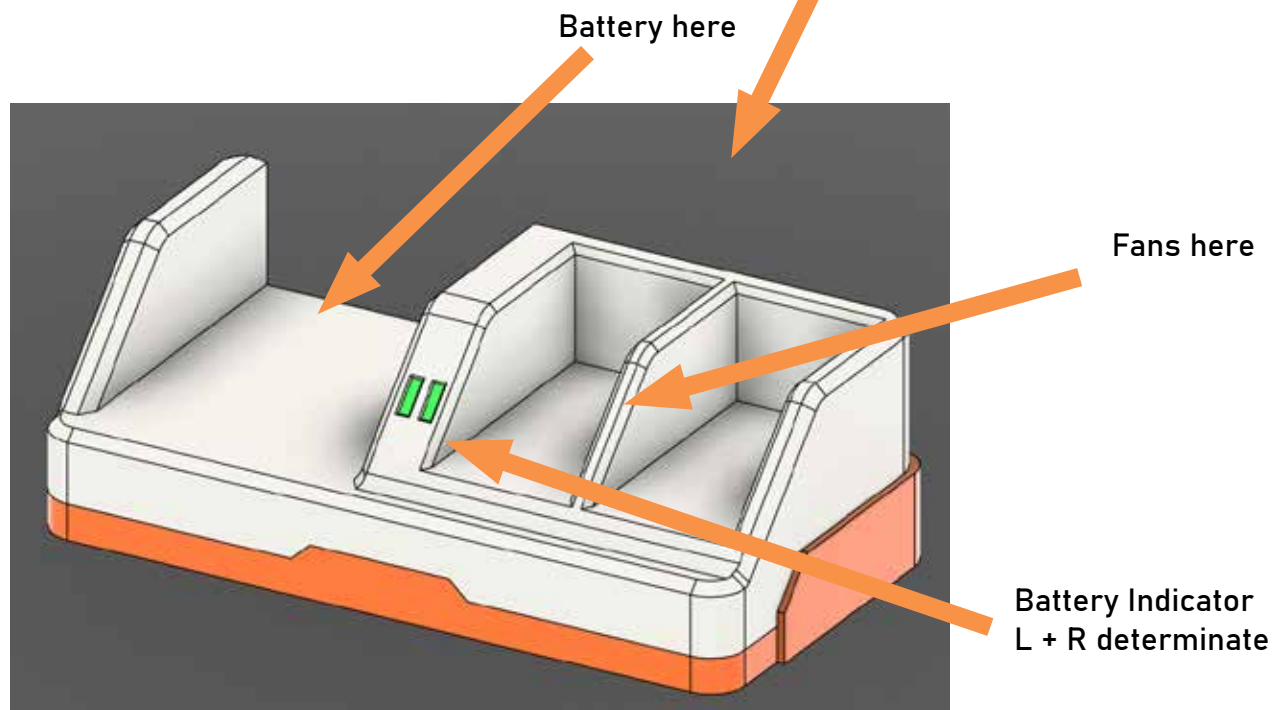


fans would sit on this top surface but it kinda looks awk

I think this would be the better approach, but with research backing up that workers dont want to carry more things, 2 is most likely enough

2nd version was to have all interactive elements inline with each other.

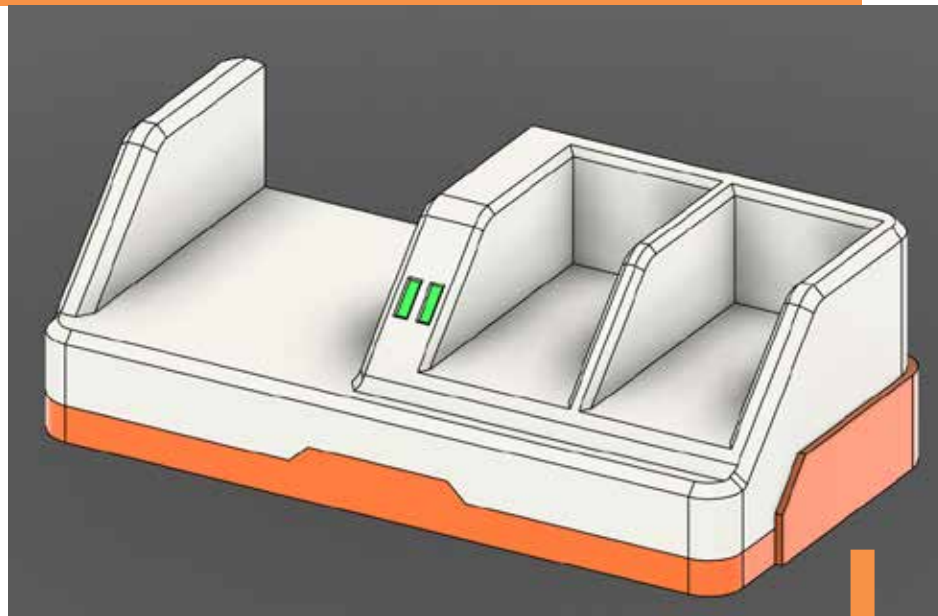
By inverting the battery connection top surfaces of fans and battery housing align along each other, creating a more **cleaner, more integrated silhouette**. This approach **eliminated the visual step or height discrepancy** that is present with an upright battery cavity (above), allowing the dock to read as one continuous, compact unit rather than three separate volumes.



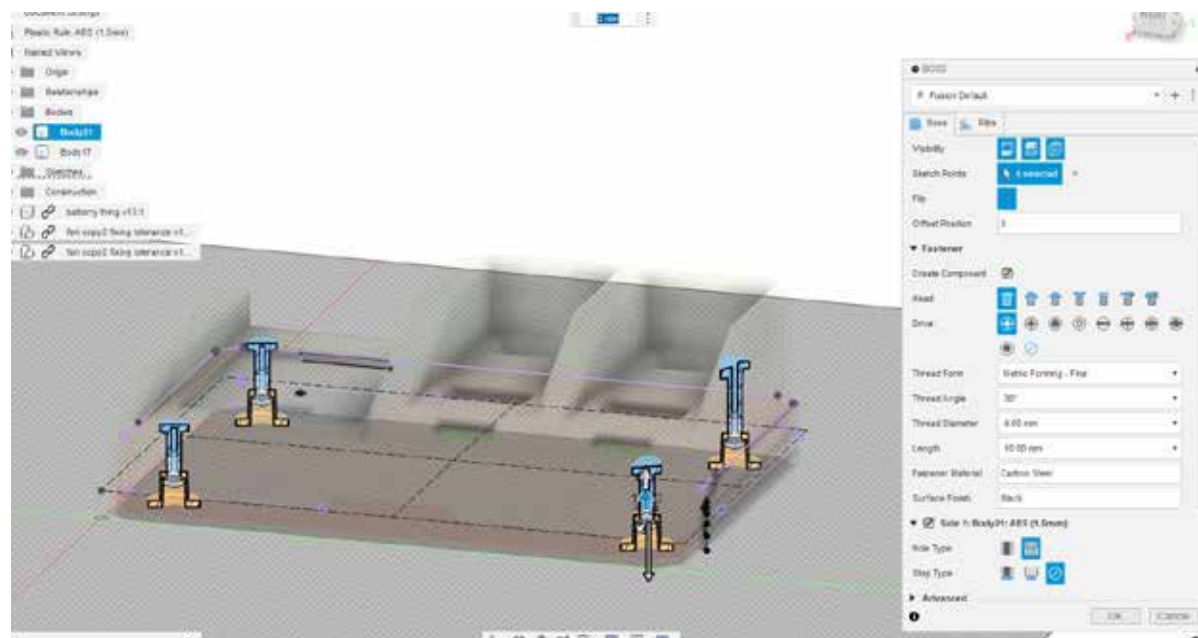
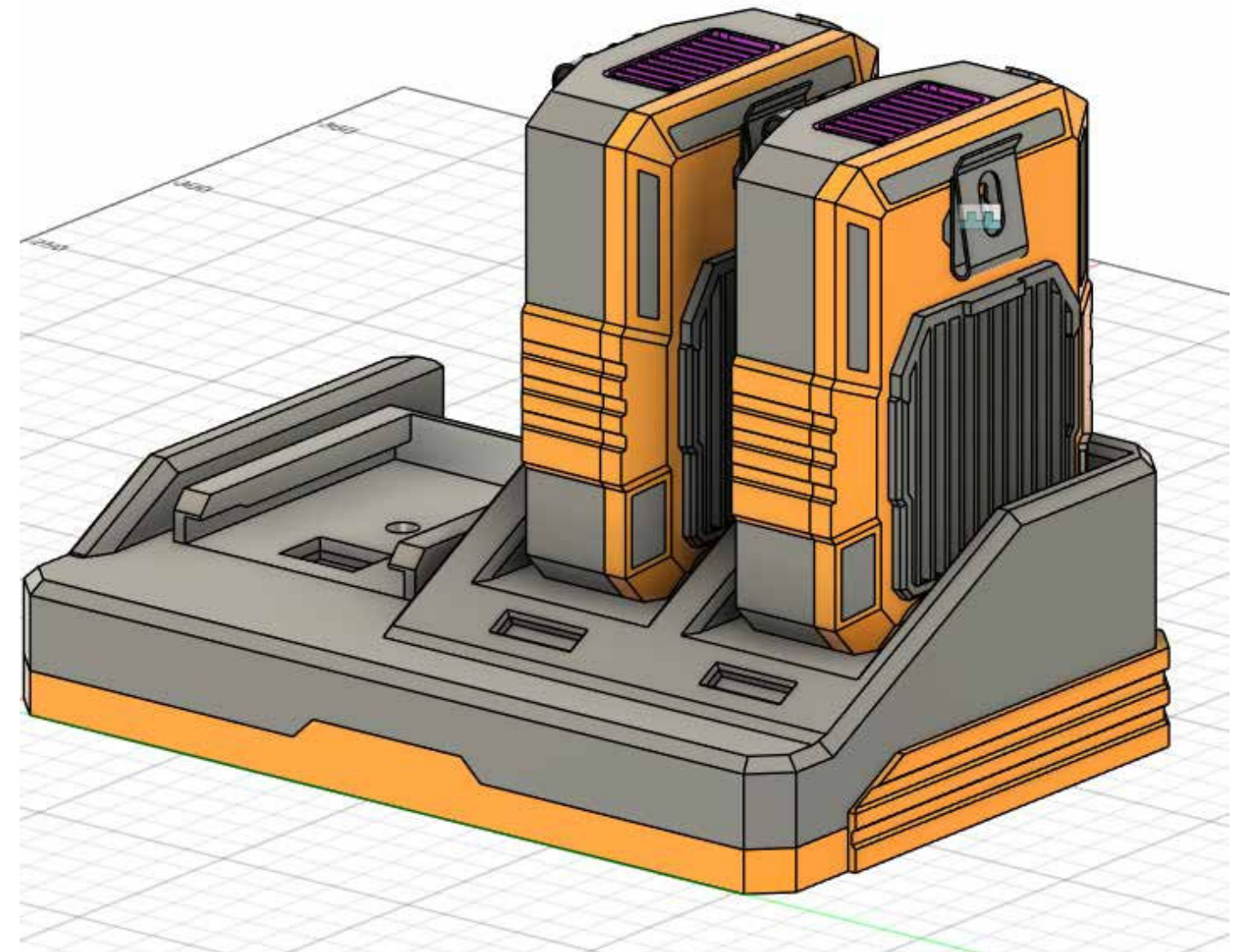
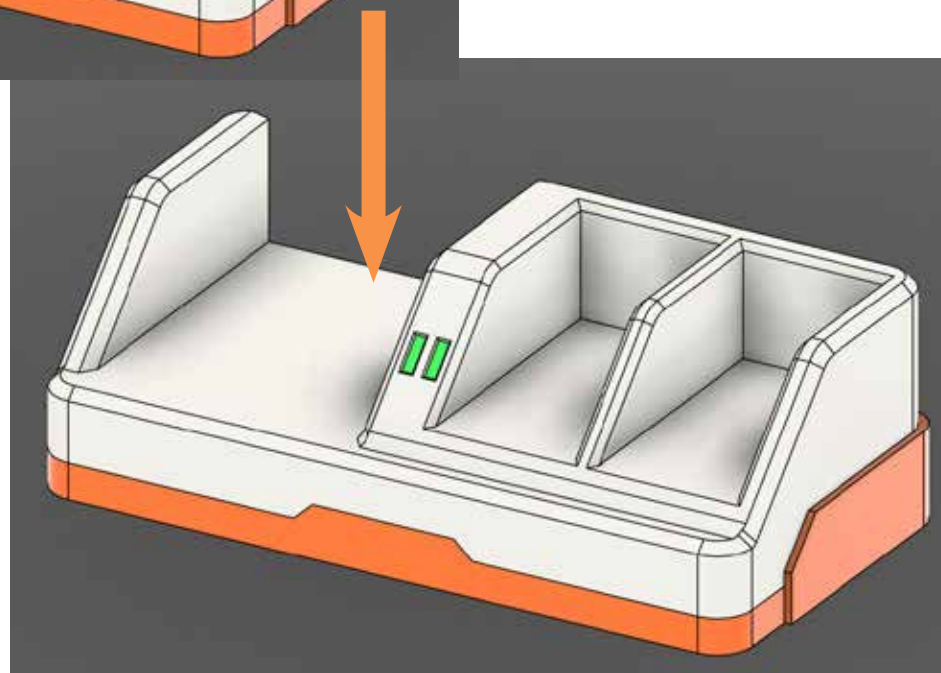
user experience with pulling the battery out would also be awkward, as the bosch, dewalt brand requires you to push in a button to retract the lock, then pull it out of the dock.



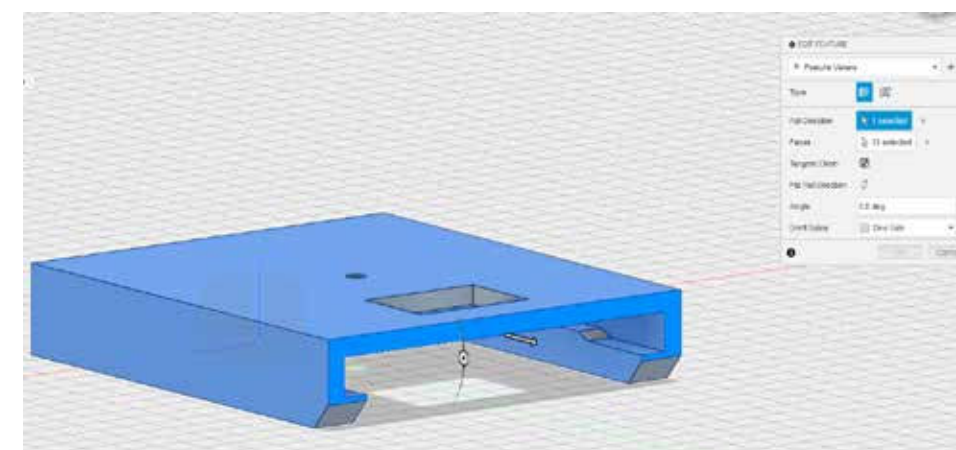
user experience on this would be easier, as person knows where battery is supposed to go, culd potentially design for swappable directions.



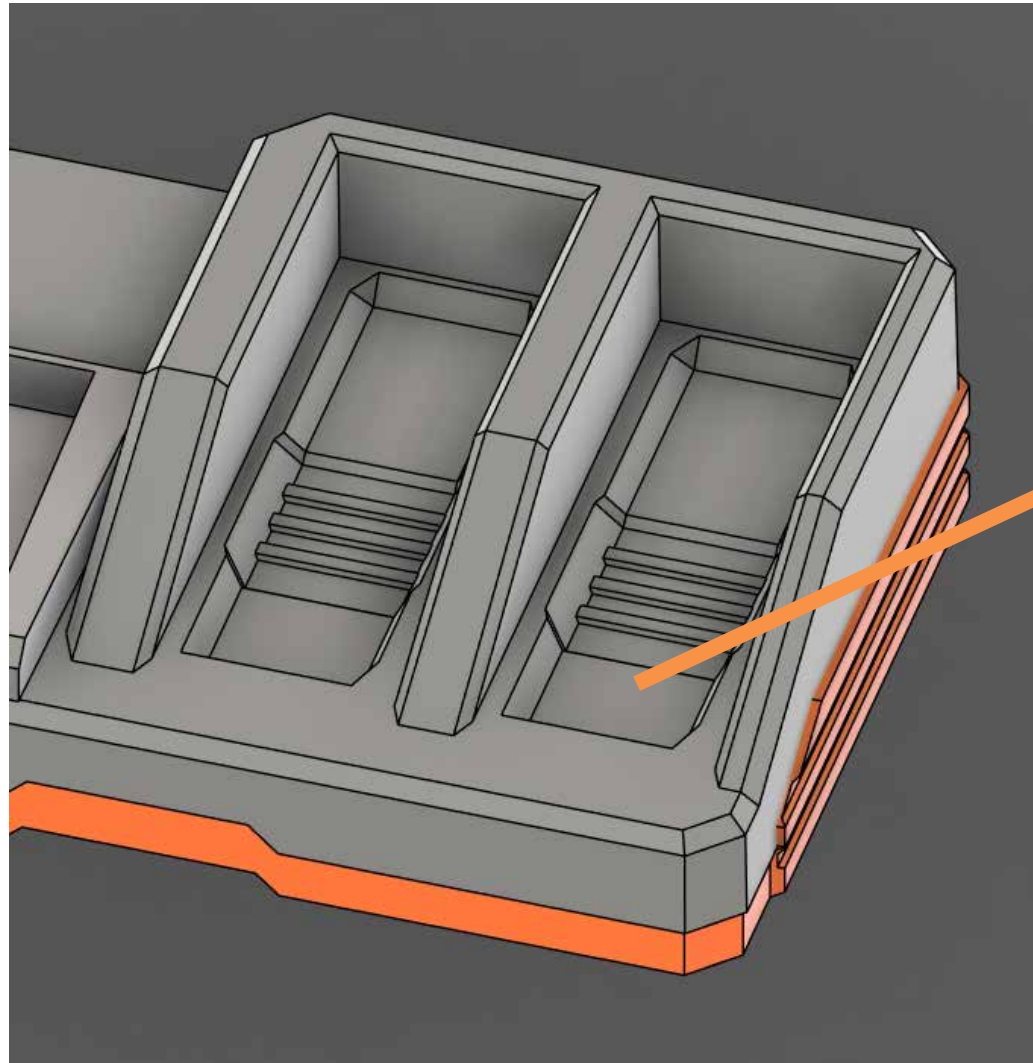
Changed from Filets to chamfers to more closely match the fans themselves



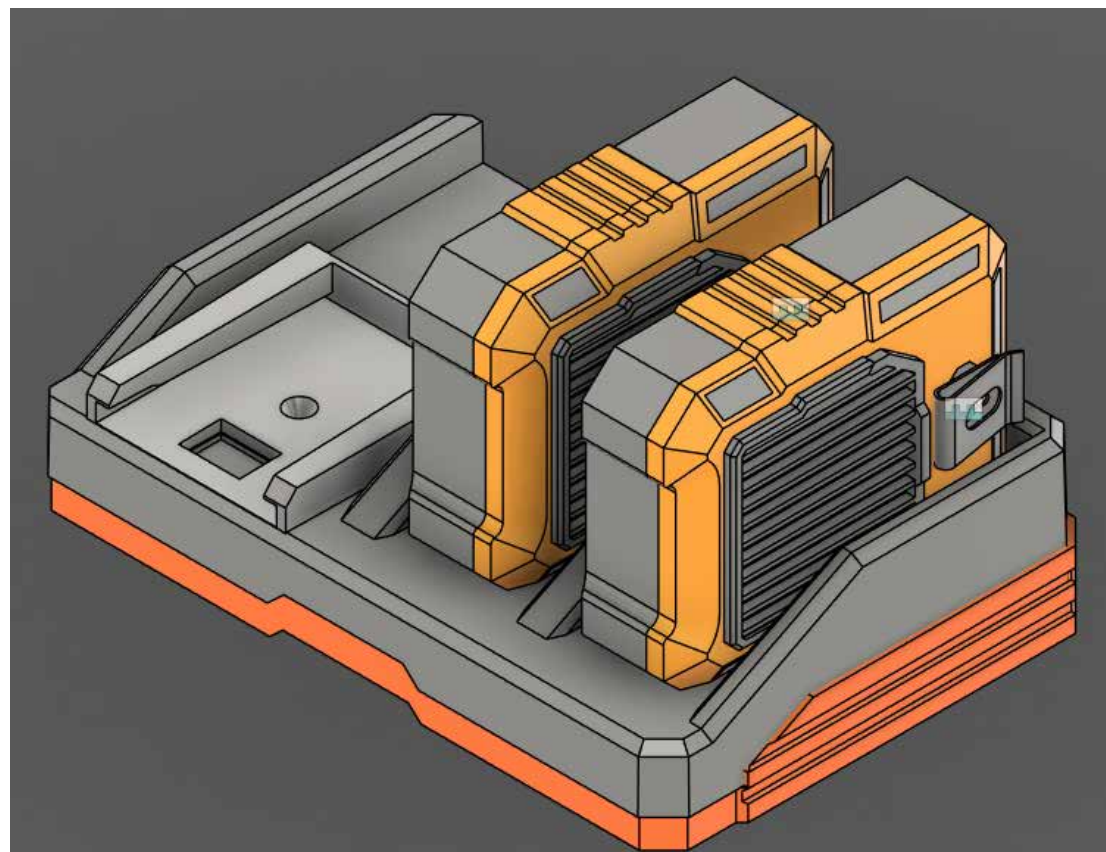
Boss features in Fusion, NOTE, do not use a circle sketch to tell where to put the boss, because it stops the boss that gets screwed into from changing size when inserted.



nce Assembly was sne i drafted all components with a 2 degree draft angle, and 3 degrees for the dock as they are bigger parts.



Indents for dock to sit lower / more securely



Painting

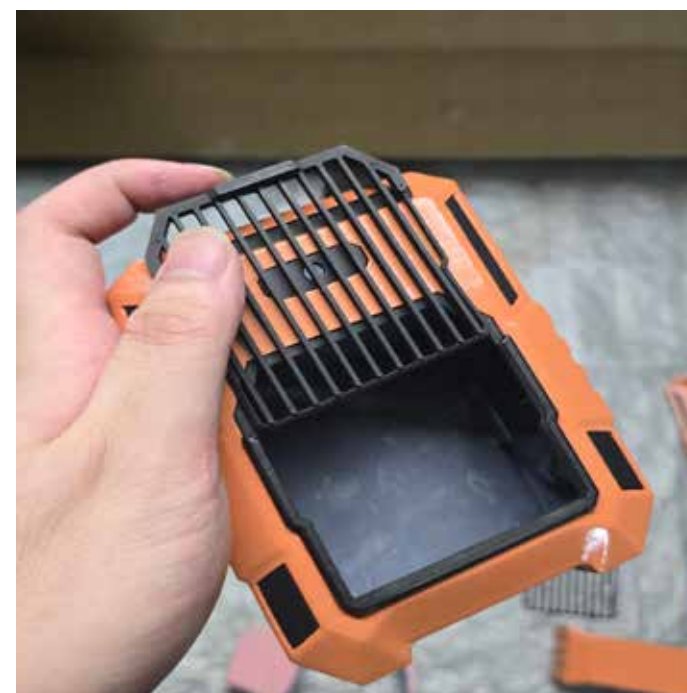


For the casing that goes below the over mould, i only had to sand the surfaces that would be exposed.



Filled large gaps with blade putty, primed then sanded down

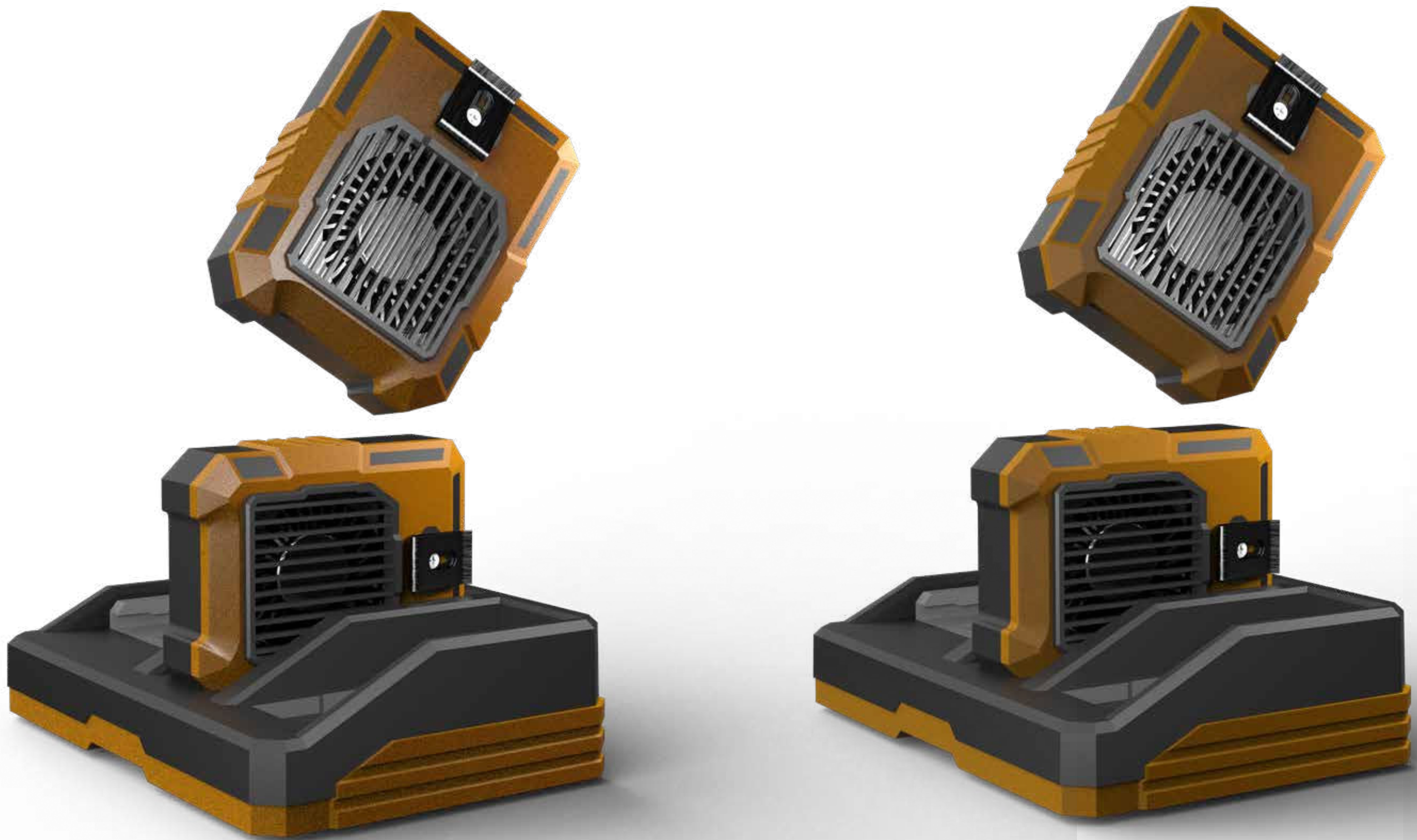




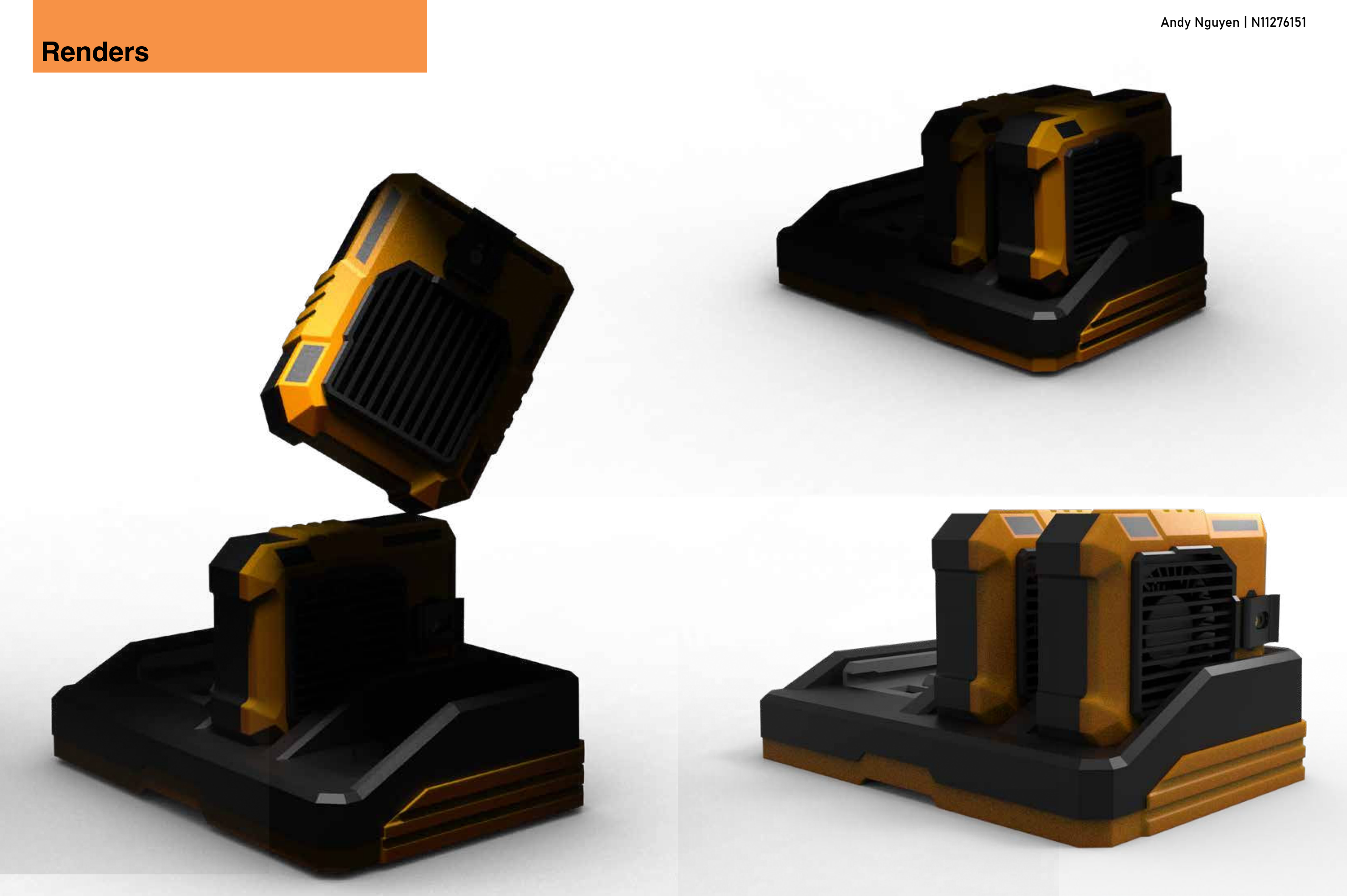
Used a matte black, and a semi-gloss finish on the orange. This orange stayed this colour and darkened over the few days sadly.

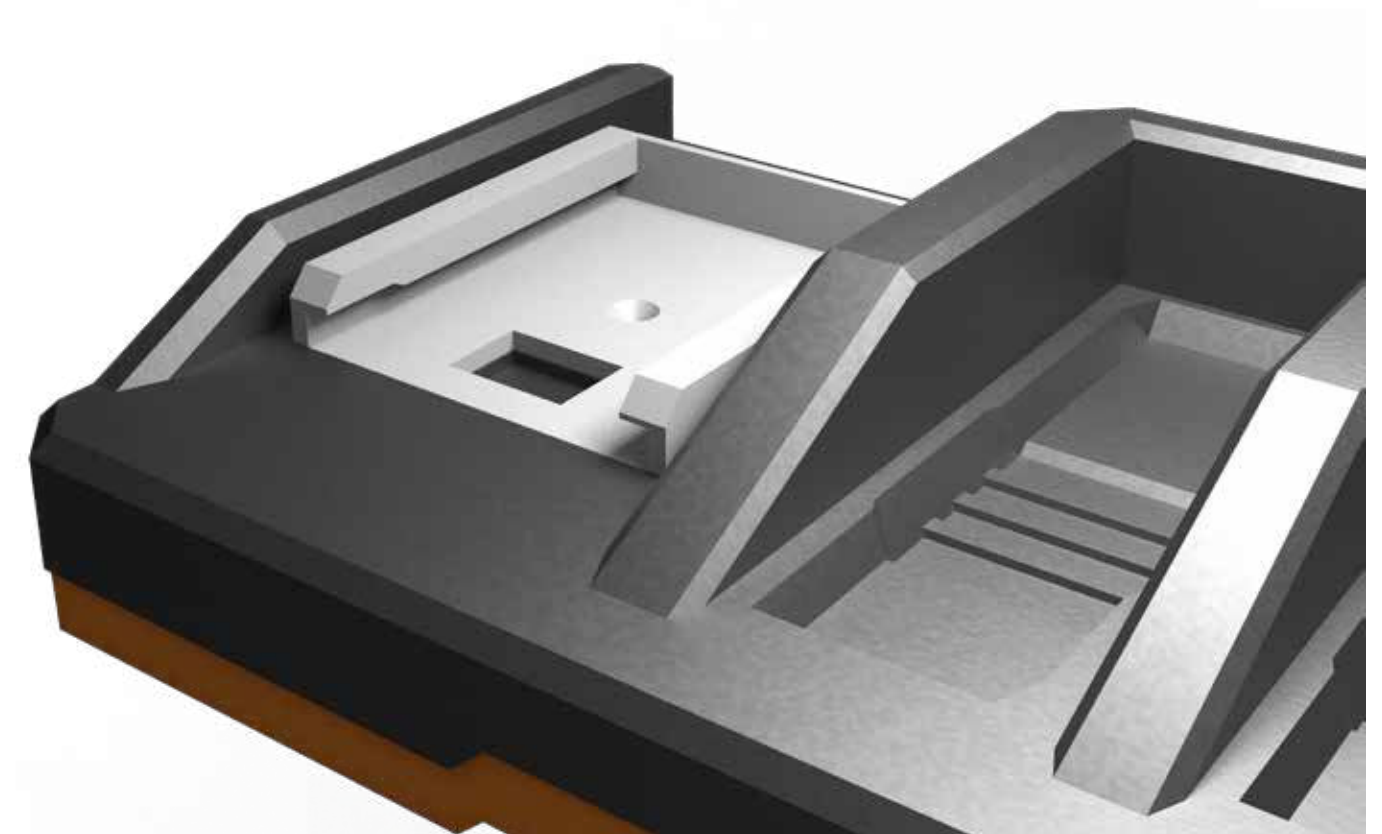


Putting Heat Inserts in



Renders







Renders



Renders



Prototype Photos

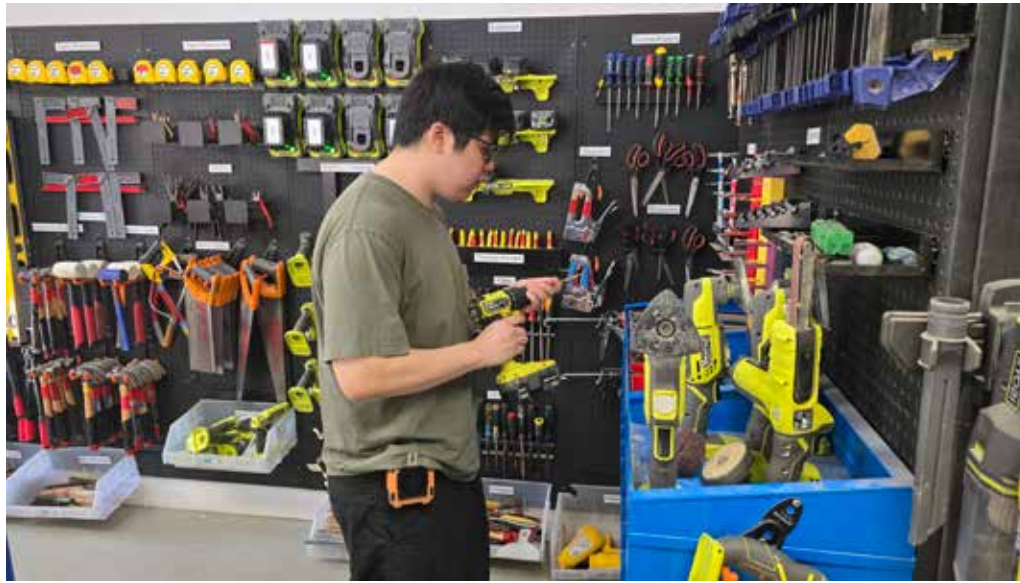


Prototype Photos



In Context Photos

On Waist



On Neck

